DEPARTMENT OF MINES

SOUTH AUSTRALIA

GEOLOGICAL SURVEY OF SOUTH AUSTRALIA

OIL EXPLORATION REPORT - FUEL SECTION

REPORT ON A RECONNAISSANCE GEOLOGICAL SURVEY OF THE PROTEROZOIC-CAMBRIAN SUCCESSION OF YORKE PENINSULA WITH REFERENCE TO OIL EXPLORATION IN THE CAMBRIAN SYSTEM

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LIST OF PLANS AND ILLUSTRATIONS

I. INTRODUCTION

The investigation embraced by this report was initiated as a special project under the direction of the Chief Geologist, with the object of assessing the oil prospects of the Cambrian rocks of Yorke Peninsula. Following a preliminary reconnaissance in March, 1956, it was appreciated that insufficient outcrop and borehole data was available in two critical areas for sound geological interpretation, and sites for two stratigraphic boreholes were decided upon.

Geological mapping and a thorough search of previous literature and records was continued as boring progressed, and the composite results are contained herein.

In the latter stages of the investigation, R.S. O'Driscoll (Senior Geologist) was appointed to supervise the conduct of the survey. The Regional Mapping Section was freely consulted on stratigraphic problems, particularly Dr. B. Campana (Senior Geologist) and R. Horwitz (Assistant Geologist); assistance in field mapping was provided by R. Horwitz and C. Bleys.

Acknowledgment is also due to Yorke Peninsula residents who kindly supplied much valuable, unrecorded information on boring in the region, namely A. Hickman, retired boring contractor of Port Vincent, F. Swincer and A. McKenzie.

II. THE PROTEROZOIC - CAMBRIAN SUCCESSION

1. General Statement

The foundation of Yorke Peninsula consists of igneous and metamorphic rocks of the Archaean shield which is so extensively developed to the westward on Eyre Peninsula and beyond. Similar metamorphic rocks of the basement are exposed as folded inliers within the core of the Mount Lofty Range, near Adelaide.

In places, and particularly along the eastern shoreline, the basement rocks are overlapped by unmetamorphosed and gently folded sediments of intermittent marine and continental facies, representing attenuated marginal deposits of an Upper Proterozoic-Cambrian geosyncline.

In the southern part of the Peninsula, the Precambrian and Early Palaeozoic formations are almost wholly covered by unconsolidated boulder clay and siliceous sand which are attributed to a continental glaciation of the Permian Period. These are overlain in turn by Tertiary marine sediments which are mainly developed in low-lying areas marginal to the present coastline.

Outcrops are locally found in certain coastal sections, but inland the rocks are almost wholly concealed by a mantle of Pleistocene and Recent deposits, and soils. Notable among these are the sheet limestone which is extensively developed in the soil horizon, irrespective of underlying rock types, and several classes of aeolian deposits.

Despite the limited exposures, sufficient additional data has been obtained from scattered bores and excavations to permit the preparation of a generalised sub-surface geological map on which all the major subdivisions outlined above are represented (Fig. 1). Detailed field investigations have been limited, however, to the areas underlain by Proterozoic-Cambrian sediments, and only these are dealt with specifically in the following text.

2. Previous Investigations and Conclusions

No systematic regional mapping has been previously undertaken on Yorke Peninsula, but numerous unrelated reports dealing with the geology, hydrology and mineral resources of localised areas - which together embrace the greater part of the Peninsula - may be found in technical publications and Departmental files. This information has been broadly co-ordinated on the geological map of South Australia published by the Mines Department (1953) at a scale of 32 miles to an inch.*

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*This map also includes unpublished observations by R.C. Sprigg, who supervised its preparation.

Fossiliferous Cambrian rocks were first discovered on Yorke Peninsula (and in South Australia) as pebbles on the beach at Ardrossan (Tepper, 1879), and fossils contained therein were identified as trilobite remains and Archaeocyathinae (Etheridge, 1882). A few years later, similar Cambrian limestones carrying Tribolites and Pteropods were located at Curramulka (Fletcher, 1890), and this and other nearby occurrences were described more fully by other investigators (Pritchard, 1892; Tate, 1892; Howchin, 1892).

A comprehensive geological report dealing mainly with the Precambrian and Cambrian succession at Ardrossan and Minulta was contributed by Howchin in 1918. The observations contained in this paper form a sound basis for all subsequent work, although his correlations suffer to some extent by incorrect dating of the Adelaide System. In another useful contribution with similar conclusions, Jack (1917) makes special reference to the geology of northern Yorke Peninsula in relation to mineralization of the Moonta and Wallaroo mining districts.

In the most recent published account, Howchin (1925) summarizes information on the fossiliferous Cambrian rocks of Yorke Peninsula, in which the occurrences at Curramulka, Ardrossan, Dowlingville, and Kulpara are accurately described. However, it will be shown herein that incorrect conclusions were drawn regarding the age of limestones and dolomites at Clinton. In this case, Howchin apparently accepted an earlier (and incorrect) generalisation by Jack (1919) in a report on the Clinton phosphate deposits.

It has previously been assumed in most scientific papers and survey maps that no Upper Proterozoic (Adelaide System) sediments occur on Yorke Peninsula. However, as a result of a deep borehole sunk in the hundred of Ramsay, in 1931, Ward (1944) makes the following comment on purple shales and crystalline limestones intersected at depth:-

"The latter probably belong to the Upper or Middle Precambrian, but their exact position in the column cannot be indicated. They do not outcrop at any known point, and their existence on Yorke Peninsula was not known prior to the boring of this hole."

The current investigation* has revealed that a reasonably thick and complete succession of Adelaide System sediments do in fact outcrop below the fossiliferous Cambrian System at Kulpara, on Yorke Peninsula, and has provided additional data confirming the conclusions drawn by Ward in respect to similar occurrences in the central portion of the Peninsula.

3. Stratigraphy

A. South Hummocks Range (Kulpara - Clinton Area).

The Kulpara - Clinton area has been mapped on a regional scale in the course of the present survey. At an early stage of this investigation it became apparent that the Cambrian limestones of Kulpara (Howchin, 1925; Barnes and Kleeman, 1934) pass along strike beneath the Tertiary coal basin at Clinton, where progressively older sediments are exposed along the South Hummocks escarpment; this is contrary to information shown on the current geological map of the State (1953).

The conclusions of the present survey are presented on an accompanying geological map at a scale of two inches to one mile (Fig. 1). The map is based upon a reconnaissance survey by the writer in which the broader stratigraphic units were recognised, and a later, more comprehensive survey by R. Horwitz (Assistant Geologist). Mr. Horwitz is also to be credited with many of the stratigraphic observations included in this section of the text.

(a) Type Sections

The stratigraphy is outlined by the following detailed cross-sections at regular intervals along the South Hummocks Range (refer to Figs. 2 and 3).

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*An independent study of Cambrian rocks on Yorke Peninsula has been recently undertaken by F. Daily, of the Geology Department, Adelaide University, but his results have

Clinton Section A-A'

Dips variable from 25 to 45 degrees easterly

	Members	Approx. Thickness (feet)
1.	Gritty quartzite with odd quartz pebbles. Locally poor outcrop.	
2.	Blue-grey, pink and cream dolomitic limestones and magnesites, dominantly massive, but nodular and bedded in places. Bands rich in siliceous grit grading locally to dolomitic quartzites. Magnesite diggings (see Analysis Table I) on Sections 303 and 375, and extensive phosphate mineralization. .. .. upwards of	1,000
3.	-	
4.	Blue-grey and brownish calcareous siltstones, massive or laminated. Some bands characterised by abundant intraformational pellet structures	300
5.	Gritty purple siltstones grading downwards into yellow-brown dolomite and dolomitic gritty quartzite. Glacigene pebbly dolomites observed elsewhere (Section CC') in this member	300
6.	Pale cream-coloured arkosic quartzite, mostly massive and fine-grained, with clay shale partings; cross-bedded in places	100
7.	Purple to chocolate coloured shales. (Intersected in Clinton No. 8 coal bore at 75 feet) .. .. upwards of	50

Yararoo Section B-B'

Dips variable from 15 to 75 degrees easterly

	Members	
1.	Gritty arkosic quartzite with heavy mineral layers .. .. upwards of	300
2.	-	
3.	-	
4.	As in Section A-A', but thicker	400
5.	As in Section A-A'	300
6.	As in Section A-A', but grading upwards to coarse grit in Clinton No. 1 Stratigraphic Bore	100
7.	-	
8.	-	
9.	Grey crystalline dolomitic limestone with oolitic and gritty bands, overlying (5) in Clinton No. 1 Stratigraphic Bore (see Analysis,	

S. 1264.

Fig. 3. Correlation Chart of Tyne Sections, South Nunnocks Range.

1. Gritty quartzite with heavy mineral bands, and pebble conglomerate.
2. Dolomitic limestones and magnesites.
3. Greenish-grey phyllitic shales.
4. Dolomitic siltstones, with abundant intraformational pellets.
5. Gritty purple siltstones and pebbly dolomites.
6. Cream-coloured arkosic quartzite.
7. Purple to chocolate-coloured shales.
8. Red ferruginous quartzite with highly developed current bedding.
9. Blue-grey and cream-coloured dolomitic limestones.
10. Concretionary dolomitic shales with remains of Trilobites.

Railway Section C-C'

	Members	Approx. Thickness (Feet)
1.	As in section B-B', and locally observed to overly granitic bedrock .. .. upwards of	300
2.	-	
3.	Greenish-grey phyllitic shales, and interbedded dolomitic siltstones	300
4.	As in section A-A' (see analyses, Table I)	400
5.	As in section A-A', but with tillitic pebbly bands in chocolate siltstones. Interbedded blue cryptozoonic limestone. North of Kulpara, pebbly dolomite (Fig. 11), occurs within the same member	300
6.	As in section A-A', but with thin, interbedded purple to chocolate coloured shales	200
7.	Purple to chocolate coloured shales, with thin interbedded quartzites near the top. Locally highly drag-folded	200
8.	Red ferruginous quartzite with highly developed current bedding, odd clay pellet inclusions, and cut and fill structures (Figs. 9 and 10). Interbedded bands of massive cream-coloured quartzite. Uppermost exposure is notably gritty .... variable up to	300

Kulpara Section D-D'

	Members	
8.	As in railway section, but poorly exposed .. .. upwards of	200
9.	Blue-grey and cream-coloured crystalline dolomites and dolomitic limestones, mostly massive. Vague markings resembling Archaeocyathinae in the uppermost horizons (Analysis, Table I)..	250
10.	Concretionary dolomitic shales with remains of Trilobites. (Fig. 8).. .. upwards of	100

(b) Palaeontology

Trilobite remains have been identified in the upper members of the Kulpara section (D-D', No. 10). Samples obtained from an excavation in sections 230 and 231, Hundred of Kulpara, were described as follows by F. Chapman (Barnes and Kleeman, 1934):-

"They seem to represent a Middle Cambrian facies and are all referable to two species of the genus Ptychoparia. The species with the smaller cephalon bears a close resemblance to Woodward's (1884) Dolichometopus tatei, but as the original type specimen is very imperfect there is a doubt about it and it may be a new species. The other species is related to Ptychoparia howchini, but as the apex of the glabella in your specimen is much more pointed, this also is probably new."

Trilobites may also be observed in the same member where it is exposed by grading adjacent to the main Port Wakefield-Kulpara road.

(c) Correlation

The succession of sediments represented in the sections described above can be subdivided into four series.

(1) The lower unfossiliferous beds (or Torrensian) comprising a basal conglomerate (1)*, overlain by massive dolomitic limestones and magnesites (2), with recurrences of quartzitic conglomerate lenses and quartzites. These beds underly, with a definite stratigraphical break, the middle series which are tillitic in places. Because of this evidence as well as the presence of magnesite (Jack, 1922), the lower beds have been correlated with the Torrensian series.

(2) The middle unfossiliferous beds (or Sturtian) are tillitic in places. They are definitely transgressive on the Torrensian. The succession is as follows (from base to top):

Shales and dolomitic shales; phyllitic in places (3).

Green and brown siltstones and dolomitic siltstones (4).

Gritty dolomites and quartzite lenses, purple siltstones and shales with definite tillite in places (5).

The succession is comparable with that of the Kapunda area (Kapunda H.S. - Coats, 1956) except that at Clinton-Kulpara, the lower Tillite of Kapunda is absent. The tillite present is that of the Upper glacial sequence.

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*The numerals are a cross reference to particular members of the type sections, as numbered on the accompanying correlation chart (Fig. 3).

The absence of lower tillite in this region is in accordance with the unconformity between the Sturtian and the Torrensian; the basin of sedimentation had not reached this region during the lower glacials.

(3) The upper unfossiliferous series (or Marinoan). This succession comprises a lower quartzite (6; ?A.B.C.), purple shales (7), and an upper quartzite (8; ?Pound). The upper quartzite is very ferruginous in nature.

All stages of recurrences and lateral passage have been observed between the lower quartzite and the purple shales, as well as between the purple shales and the upper quartzite; this is considered sufficient justification for grouping these three members in the same series. The highly ferruginous beds are believed to represent a lateritised continental deposit as distinct from the glacial records of the Sturtian series.

(4) The Fossiliferous Cambrian Limestone Group overlies this succession. The lowest member, and the thickest represented in outcrop in this locality, is a dolomitic limestone (9) which has a strong resemblance to the Archaeocyathus facies, and in fact contains vague markings like Archaeocyathinae. The upper member (10) is a concretionary dolomitic shale containing numerous Trilobite fragments.

The Cambrian Limestone Group is believed to bear an unconformable relation to the Proterozoic System, on the chronological evidence of sections B-B' and D-D'. Evidence of an erosional contact at the base of the limestones has been observed in the outcrops at Kulpara (Horwitz, 1956) and small grade conglomerate and gritty partings are a feature at this level in the Clinton No. 1 Stratigraphic Bore.

(d) Structure

The South Hummocks Range is essentially an east-pitching monoclinal fold in Proterozoic and Cambrian sediments. Minor drag-folding occurs locally within this flexure as observed in Marinoan quartzites in the rail cutting south of Kulpara, but generally the beds dip regularly to the eastward at angles ranging from 30 to 40 degrees.

An overthrust fault with an easterly throw of some 2,000 feet and which passes to a fold has been identified to the north of Kulpara (Fig. 1). The possible presence of a major line of down-faulting at the foot of the South Hummocks Range is discussed in a later section dealing with tectonics in general.

(e) Stratigraphic Implications of the Kulpara-Clinton Section:

Conglomerates and conglomeratic quartzites are to be observed overlying the Archaean crystalline basement in numerous places on Yorke Peninsula, and are in turn commonly overlain by purple shales and crystalline dolomites.

Cambrian fossils have been found in the highest levels of the dolomitic member at Dowlingville and Ardrossan, and in the latter locality, a thin layer of purple shales occurs between the dolomite and basal conglomerate. A similar but unfossiliferous sequence has also been identified at Urania, Maitland and Warburto Point (near Moonta - Jack, 1917).

On the above evidence, the dolomitic limestones found beyond the Clinton-Kulpara area are all tentatively assigned to the Cambrian Period. The conglomerates which underlie the limestones are considered to be a shoreline facies representing whole or part of Adelaide System sedimentation, this dating being largely based upon the presence of intervening purple shales which are a feature of the Upper Proterozoic Marinoan Series. However, this correlation cannot be confirmed because of poor outcrop conditions, and it may be that in many places the conglomerate marks the base of the Cambrian transgression as represented by gritty horizons at Clinton and Kulpara.

Another important implication of the Kulpara-Clinton section is that the Cambrian System sediments can be expected to underly St. Vincent Gulf, irrespective of whether the Gulf occupies a zone of trough-faulting (Fenner, 1930) or a broad synclinal environment (see Section II, 4). The results of a deep borehole at Port Wakefield (No. 1), which intersected "blue pyritic slate" from 310 to 765 feet (Rutt, 1882) are inconclusive in this respect because of the inadequate descriptions of the bore cuttings. A generalised section based on al[illegible]ting evidence

6. Winulta-Ardrossan Area.

(a) Basal Grits:

The Basal Grits of the Proterozoic-Cambrian sequence are well developed at Winulta, about ten miles southwesterly of Port Clinton. A particularly good exposure of interbedded gritty and pebbly quartzite with thin conglomerate bands occurs on high ground in section 354, hundred of Tippara, where it has a gentle dip to the southeast, unconformable with outcrops of Archaean crystalline rocks to the westward.

The basal formation (and unconformity) retains its definition and a gentle easterly dip along the eastern fringe of the Peninsula to near Ardrossan, and extends beyond in an embayed course to within one mile north of Pine Point. Here it strikes southeasterly into the Gulf, and is underlain in the coastal cliffs by Archaean aplitic rocks; this being the only occurrence of the shield rocks along the eastern shore of Yorke Peninsula.

In the Ardrossan district the basal quartzite and conglomerate has been used extensively as building stone, and quarries for this purpose provide the most instructive exposures. Notable among these are Whittaker's, Canes, and Dinham's quarries on Sections 141, 95 and 77 respectively, Hundred of Cunningham, and Henderson's Quarry, on Section 53, Hundred of Muloowurtie.

(b) Cambrian Limestone Group:

A much attenuated and incomplete record of Upper Proterozoic-Cambrian sedimentation occurs above the basal grits in this area. The sequence is best known southward of Ardrossan where the outcrops were first described by Howchin (1918; 1925). The stratigraphic column reported by Howchin has subsequently been confirmed by detailed mapping and boring conducted by the B.H.P. Coy. Ltd. (Armstrong, 1949; Sprigg, 1946), and is adopted in this report as follows:-

Limestones: Upper: Dark-coloured impure, Pteropod-Trilobite limestones.

Middle: Light coloured marble (Archaeocyathinae marble, in part).

Lower: White and yellow granular crystalline dolomites.

Slates: Purple Slates ..... 20 feet thick.

Basal grits and conglomerates ..... 51 feet thick.

The limestone members outcrop extensively but usually in a massive form without any evidence of bedding. However, in the few cases where bedding has been observed, it generally dips to the eastward at low angles (0-10 degrees) - in apparent conformity with the underlying grits. Local minor folds about north-south axes have been established by detailed mapping (Armstrong, 1949), and a steepening of dip to 40 degrees is a feature of the mostly easterly exposures along the coastline at Sliding Rocks.

The minimum thickness of the limestones is of the order of four hundred feet, the greatest proportion of which is contributed by the lower dolomite member. No fossils have been found in the dolomites, but Archaeocyathinae are recorded in overlying pale grey and pinkish marbles near Horse Gully, in Section 22, Hundred of Cunningham. Grey limestone containing remnants of Pteropods and Trilobites occurs above the Archaeocyathinae limestone in Horse Gully, and has also been observed at Rogue's Gully.

On this palaeontological evidence and general lithological grounds, the limestones are correlated with the Cambrian Limestone Group of the South Hummocks Range, while the underlying purple slates which have been recorded only in boreholes are referred to the Upper Proterozoic Marinoan Series.

The dolomite is being quarried on a large scale by the B.H.P. for use as a refractory. Rock phosphate has been mined on a small scale in the limestone on section 30E, Hundred of Cunningham.

The limestone group are also represented but poorly exposed in the coastal area bounded by Ardrossan, Winulta and Port Clinton. At Dowlingville, a small outcrop of bluish-grey nodular limestone may be observed along the roadside in Section 128, Hundred of Cunningham.

TABLE I.

CHEMICAL ANALYSES OF PROTEROZOIC - CAMBRIAN LIMESTONES AND DOLOMITES.

Sample No.	Description	Analysis		Remarks
		Calcium Oxide (CaO) per cent	Magnesium Oxide MgO per cent	
A942/56	Fossiliferous limestone Sec. 54S. Hd. Curramulka	49.0	2.98	Cambrian
A947/56	Blue limestone. Sec. 83N Hd. Ramsay	52.1	13.5	Cambrian
A950/56	Nodular limestone Cave. Sec. 4, Hd. Curramulka	45.2	2.55	Cambrian
A948/56	Blue nodular limestone Sec. 128, Hd. Cunningham	48.9	1.86	Cambrian
A949/56	Yellow limestone, Quarry Sec. 32, Hd. Cunningham	28.7	4.15	Cambrian
A946/56	Blue dolomitic limestone Sec. 182E, Hd. Cunningham	30.4	20.6	Cambrian
A943/56	Cream dolomitic limestone Quarry. Sec. 230., Hd. Kulpara	29.6	21.5	Cambrian
A984/56	Clinton Strat. Bore 313 to 317 feet	22.6	15.9	Cambrian
A957/56	Blue Marble Sec. 321, Hd. Clinton	35.6	0.95	Sturtian
A958/56	Brown limestone Sec. 321, Hd. Clinton	44.2	4.3	Sturtian
DH544/19	Magnesite Sec. 383, Hd. Clinton	1.46 $CaCO_3$	97.66 $MgCO_3$	Torrensian

29.8.56

Here the bedding is well shown, and dips easterly at 20 degrees. Trilobite fragments have been recorded from this exposure by Howchin (1925), but none were seen during a recent brief examination.

An extensive sheet of sub-outcropping buff to dark grey dolomitic limestone characterised by abundant sink-holes occurs to the east of Winulta within a mile east of grits and conglomerates described above. This is tentatively correlated with the dolomites of the Cambrian Limestone Group.

C. Curramulka-Urania-Minlaton Area

As a result of current regional mapping and study of borehole records, it has been established that a very thick succession of Proterozoic-Cambrian sediments is represented over a considerable area within the Curramulka, Urania and Minlaton districts.

In accordance with observations elsewhere, the basal formation of the sequence consists of conglomeratic quartzite which unconformably overlaps the Archaean basement rocks. This formation has been identified following the unconformity at the western and eastern margins of Yorke Valley (at Urania) to Mount Rat, and extending easterly from there to south of Pine Point (Fig. 1).

The northern and northwestern limits of the Proterozoic-Cambrian basin* have thus been accurately delineated. A western boundary can be inferred in the vicinity of Minlaton, and to the east of Warooka where Archaean gneisses were intersected in a deep borehole (Nos. M12; M91). Evidence from

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* The term "Curramulka basin" is adopted in this report for the area defined above which is underlain by Proterozoic and Cambrian sediments. The use of the word basin is appropriate in respect to structural relations to the basement rocks as described in a later section of this report.

other boreholes has shown conclusively that the Proterozoic-Cambrian basin increases appreciably in depth in a southeasterly direction, but observations are restricted a few miles north and west of Port Vincent where fossiliferous limestones high in the sequence become obscured by Tertiary marine deposits and/or Permian glacigene sediments.

Geophysical exploration in the area has indicated possible boundaries of the Curramulka basin. A magnetic survey conducted by the Mines Department in 1955 revealed a magnetic low in the portion of the Peninsula east of Curramulka, Brentwood and Yorketown (Plan No. 55-164). The area of low magnetic intensity can be reasonably assumed to represent a depression in the relatively more highly magnetic basement rock, and to coincide with the distribution of thick Cambrian and/or Permian sediments. Gravity observations which are now being undertaken by K. Seedsman indicate an anomaly high extending from Curramulka to Stansbury, which on the evidence of the Ramsay borehole (Ri), is believed to be coincident with a thick Proterozoic-Cambrian sequence.

On the above geological and geophysical evidence, it may be predicted that much of the coastal area of Yorke Peninsula, south of Port Vincent, is also underlain by Adelaide System and Cambrian rocks. In this connexion, some indefinite information is to hand which is worthy of consideration:-

An early geological report by Brown (1884) contains an ambiguous statement which can be taken to mean that Cambrian limestones also occur along the coast near Port Vincent. This has not been confirmed despite a thorough field investigation. Also relevant is the result of a borehole in Tocchi Lagoon, east of Yorketown (Me1), in which several feet of "blue rock" were recorded in the bottom of the bore, below, or within, Permian glacial sediments.

(a) Basal Grits:

In this central portion of Yorke Peninsula, the basal grits are represented by reddish-coloured pebbly or gritty arkose, with local developments of pebble conglomerate. The red colouration is a characteristic feature, and although contributed to by the high content of pink feldspar grains, is essentially due to impregnations of haematite iron oxides.

The unconformity at the base of the grits has been observed only at one place, in a cutting on the main road two miles south of Maitland (Section 43, Hd. Maitland). Here the grits are practically identical in composition and grain size to the underlying red aplitic granite and pegmatite from which it has evidently been wholly derived. The effect of weathering has increased this resemblance so that the actual contact cannot be accurately placed in some portions of the exposure, but in general, the unconformity is clearly represented.

Noteworthy outcrops of pebble conglomerate and interbedded gritty arkose occur extensively to the northeast of Curramulka, in Section 7, Hundred of Muloowurtie, dipping easterly at about 10 degrees beneath a cover of Tertiary marine sediments. Other outcrops of the basal formation which have been observed at the limits of the Curramulka basin, as distinct from outliers, are to be seen in sections 119, 108, 99, hundred of Muloowurtie, sections 11, 43, 56, 52, 19 and 17, hundred of Maitland, and sections 55, 8, 9, hundred of Wauraltee.

(b) Upper Proterozoic (Adelaide System)

Apart from the basal grits, which are of indefinite Proterozoic-Early Cambrian age, there are no known outcrops of Upper Proterozoic Adelaide System sediments in the central and southern portions of Yorke Peninsula; it is also true that no sediments of the Upper Proterozoic facies have been observed among the numerous Permian glacial erratics of the region.

A thick succession of sediments which can probably be referred to the Epoch, however, has been intersected in a number of boreholes in the Urania-Curramulka districts.

A particularly valuable account of the Upper Proterozoic sedimentary record is available from a deep percussion borehole sunk in Section 112, Hundred of Ramsay (Serial No. R1), samples from which were made available to the Mines Department and were described in very considerable detail by Dr. L.K. Ward. The main subdivisions noted by Dr. Ward, together with a tentative correlation on lithological similarities with the South Hummocks sequence are tabulated Hereunder*.

Depth in ft.		Description	Correlation
From	To		
0	35	Gritty sandy clay and gritty fine sand. Note: Granite erratics occur at the surface.	(Permian)
35	276	Dark grey limestone with Archaeocyathinae, cavernous in places.	Cambrian Limestone Group
276	372	Siliceous grit and ferruginous sandstone, with bands of limestone and phyllite.	Pound Quartzite
372	532	Purple calcareous slate with thin bands of white limestone.	Chocolate Shale Group (Marinoan)
532	1520	Pink, white and grey crystalline dolomitic limestone.	Lower Dolomite Group (Torrensian)

End of bore at 1520 feet.

An abridged log of this borehole appeared in Bulletin 22 (Ward, 1944), but a detailed account is appended to this report (Appendix IV). A sample of dolomite from 861 feet depth is retained in the Mines Department stratigraphic museum.

Two miles south of this site, another borehole on Section 153, Hundred of Ramsay (R2) intersected brown clays at 237 feet depth, described by Ward (1944) as "possibly Upper Precambrian chocolate shales". This assumption is questioned in a subsequent part of the report in which additional current boring information at a nearby site is presented.

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*No evidence of the bedding attitude was obtained from boring, but outcrops of Cambrian limestone near the site are practically horizontal. The widths indicated may therefore be true thicknesses.

At Urania, purple shales are reported to have occurred in a number of water bores sunk to bedrock (Barnes, 1949).

(c) Cambrian Limestones:-

Previous reference has been made to exposures of fossiliferous Cambrian limestone in the vicinity of Curramulka Township (Pritchard, 1890; Howchin, 1925). Dense, grey-coloured Archaeocyathinae limestone outcrop on the west side of the Curramulka Township Well, and a few hundred yards to the east are overlain by horizontally bedded dark blue limestone carrying remains of numerous Pteropods and fragments of trilobites.

Identical fossiliferous limestones were also found to outcrop over a wide area in high country from four to six miles southerly of Curramulka.

The limestones, locally termed "blue rock", have been proved by boring to occur between three known outcrops, and to extend laterally about Curramulka over many square miles (Fig. 1). Throughout this area the limestones are featured by a highly developed cavernous condition, and serve as a useful aquifer.

There are two deep caves at Curramulka which intersect a considerable width of horizontally-bedded Cambrian limestones, and which may be descended by properly equipped parties. One is located on a high hill on section 34, hundred of Curramulka (Correll's Cave), at two miles southwesterly of the Curramulka, and the other is at a much lower elevation in the Township. The limestones in both caves have been observed and related to the outcropping fossiliferous beds by D. Taylor, of the Geology Department, Adelaide University, and the sequence as described by him is reproduced diagrammatically in Fig. 5.

The stratigraphic column proposed by Taylor, namely nodular intraformational limestones over Tribolite, Pteropod and Archaeocyathinae limestones, and lower dolomites, can be readily accommodated within the type section of South Hummocks. It is also apparent that the cream-coloured dolomites below the fossiliferous

limestones is referable to the so-called "yellow rock", which is reported at deeper levels from a number of boreholes in the district. Dolomites fitting this description also outcrop in several places near Urania (Fig. 1), immediately overlying the Basal Grit, and a similar sequence is reported from boreholes in that district (Nos. W1, W2, W3).

Sinkholes formed by the collapse of underground caverns have played a minor role in developing the present topography, but the evidence depicted in Fig. 5 does not support the conclusion of Howchin (1925) that such subsidence accounts for the extensive natural depression in which Curramulka is situated.

(d) Structure:

There is only scanty structural evidence in the area, but that which exists points to a generally undisturbed condition, at least in the case of the fossiliferous Cambrian Group. The Cambrian limestones are horizontal in the two caves near Curramulka, and similar limestone ("blue rock") reported in boring throughout the district suggest that this is the general rule. However, a linear and arcuate arrangement of limestone outcrops six miles south of Curramulka gives the impression of a fold structure, but this could not be verified because of the absence of reliable bedded outcrops.

It is assumed on the present state of knowledge that the Adelaide System and Cambrian sediments in the Curramulka-Urania-Minlaton districts occupy a deep natural basin within an eroded surface of Archaean rocks. The intensity of tectonic effects within the basin can be expected to increase towards the east.

Yorke Valley, in the Urania district, defines a shallow embayment of the Curramulka Basin which was subject to marine conditions only in the later stages of the Proterozoic-Cambrian marine transgression comparable in this respect with the Cunliffe and Ardrossan occurrences.

4. Tectonics

(a) Structural Features:

The rocks of the Proterozoic and Cambrian Systems which lie unconformably upon the Precambrian basement of Yorke Peninsula are featured by relatively minor tectonic disturbance in which the major element is very broad and gentle folding. Erosion has denuded the anticlinal areas to the level of basement rock, leaving outliers of the Proterozoic-Cambrian sequence occupying synclinal depressions (or even natural, undisturbed basins), such as at Urania and Cunliffe.

Along the eastern fringe of the Peninsula, beyond the most easterly limits of outcropping shield rocks, the Adelaide System and Cambrian sediments are affected to a measurable degree by tectonic activity, and all exposures are characterized by a regular easterly dip. An escarpment which defines this monoclinal flexure - and provides most of the outcrop data - may be traced from Ardrossan, in the south, to Dowlingville and South Hummocks, and continues in Basal Cambrian rocks in a northerly direction to Snowtown and Mundoora. Easterly of the South Hummocks, at the head of the Gulf between Goyder and Whitwarta, the same formations occur over a wide area with a general horizontal attitude, but finally assume a predominantly westerly dip in an area of pronounced faulting near Whitwarta (Fig. 4).

A broad south-pitching synclinal zone (with minor fault displacements) can be inferred from the structural data outlined above, and it is probably of distinct morphological significance that this major structure conforms in plan to the periphery of St. Vincent Gulf. This conception of the Gulf occupying a synclinal environment is not in accordance with earlier views, as will be indicated in the succeeding section.

(b) A Review of the Evidence of Trough-Faulting in St. Vincent Gulf:

Numerous published references can be cited which describe trough-faulting as responsible for the submergence of St. Vincent

Gulf. Actual observations of faulting on which definition of this sunkland is based is restricted to the eastern side of the Gulf, near Adelaide; elsewhere their presence is evidently inferred from topographic features.

The original description of the Gulf as a "rift valley" is attributed to Gregory (vide Fenner, 1930), and the existence of trough-faults following the coastline on respective sides of the Gulf is accepted without question in later reports. (Jack, 1919; Howchin, 1925).

In describing the area of the Clinton lignite deposits, on the eastern side of the gulf, for example, Howchin (1925) states:-

> "The extensive lignite deposits proved in this neighbourhood rest on a platform of the Cambrian limestone series that is thrown down on the eastward side to a depth of several hundreds of feet. This step-faulting on the westward side of Gulf St. Vincent can be correlated with similar earth movements on the eastward side, thereby defining the boundaries of the great Adelaide Rift-Valley in the respective areas".

The role of faulting in relation to the present physiography was elaborated upon by Fenner (1931), who describes the "Yorke Peninsula Horst" as an uplifted block in the "Spencer-Vincent Sunkland". The positions of fault lines on the western and eastern shores of Yorke Peninsula are indicated on his tectonic map, without reference to any geological evidence in support of their presence.

In recent years, a gravity survey of the area at the head of the Gulf was carried out by the Mines Department. A complex system of down-faulting towards the Gulf was interpreted from the results (Kerr Grant, 1949), and thus provides some speculation in favour of the trough-faulting theory.

A stratigraphic borehole which has recently been completed at Clinton, and the details of which are given elsewhere in this report, shows in fact that no down-faulting does occur immediately to the east of the South Hummocks scarp.

(c) Orogenesis - Observations and Conclusions of the Current Survey:

Evidence of periodic subsidence and emergence of the shoreline during Upper Proterozoic and Cambrian sedimentation has been noted in the South Hummocks Range Section. No interformational folding has been observed throughout the whole Proterozoic-Cambrian sequence, however, and although it is not denied that such may exist without detection in the limited exposures examined, no angular relationships have been observed as in the case of the Yankalilla Sheet (Campana, 1954). The alternations of sea level as recorded in the sequence are therefore believed to reflect overall geosynclinal adjustments, which may be expected to be a predominant effect in this marginal shield area.

An Early Palaeozoic Orogeny has evidently been mainly responsible for the broad fold structures which are characteristic of the observed tectonic features of the region. The dating of this orogenic cycle is placed prior to the Permian Period on the basis of regional tectonic (Campana, 1955) and stratigraphic considerations (Campana, 1953) and supported by the presence of an apparent unconformity at the contact of the Permian and Cambrian Systems south of Curramulka. A more marked overlap occurs at the Tertiary-Cambrian contact at Kulpara, and Ardrossan (Howchin, 1918).

Upper Tertiary or later tectonic activity is represented by minor coincident buckling in the Permian and Tertiary sediments of southern Yorke Peninsula*, such as observed along the coastline north of Port Vincent (Fig. 1), and by suspected faulting of Tertiary lignites in the Inkerman-Balaklava coalfield (Kerr Grant, 1949). Overthrust faulting observed in the Adelaide System and Cambrian rocks near Kulpara, and other faults which have been recognised but not fully investigated at Whitwarta, may be a reflection of the same tectonic disturbance.

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*A more detailed treatment of the structural evolution of Yorke Peninsula is given by Howchin (1918). The evidence and interpretation presented by Howchin required very little modification in terms of present knowled e.

5. Palaeogeography

The following Precambrian - Cambrian palaeogeographic events are revealed by the stratigraphic and structural features outlined above.

1. Continental conditions prevailed immediately prior to the Upper Proterozoic Epoch, and was responsible for the peneplanation of an Archaean chain witnessed by the angular unconformity at the base of the overlying sedimentary sequence.

2. A marine transgression is indicated by the sedimentary record of the Torrensian Epoch, being represented by a shoreline facies of resorted continental waste of the Archaean rocks (Basal Grit), and a shallow marine (epi-continental) facies of dolomitic limestones and magnesites with abundant intraformational structures.

3. A temporary emergence of the land is marked by the erosion disconformity at the upper limit of the Torrensian Series (2).

4. A sub-aqueous environment accompanied by glaciation prevailed during the latter part of the Sturtian Epoch.

5. A gradual emergence to sub-continental and continental conditions (and a marked increase in prevailing temperatures) is clearly revealed by the lithology of the Marinoan Series, at the upper limit of Proterozoic sedimentation. The uniformly red colour and the highly developed cross-bedding are diagnostic in this respect.

6. As might be expected from the terrestrial facies of (5), there is strong supporting evidence that an erosion disconformity marks the base of overlying Cambrian sediments (Fig. 3). The overlap is possibly represented by conglomerates of Moonta and Winulta.

7. Marine conditions, grading with gradual submergence from epicontinental (Archaeocyathinae facies) to deeper marine (Trilobite shale facies) is revealed by the Early Cambrian Limestone Group.

8. Summation: The eastern shore of Yorke Peninsula coincides broadly with the proposed western boundary of the Adelaide Eugeosyncline - and Adelaide System sedimentation (Sprigg, 1952), while the Cambrian marine transgression is recorded to have extended farther to the west, and at least to the longitude of Moonta.

The periodic submergences and emergences of the land in relation to sea level as described above (1-7) are according to expectations in this marginal geosynclinal environment. For the same reason, tectonic effects are at a minimum where the sediments overlap the foreland of Archaean rocks.

III OIL EXPLORATION

1. Past Reports of Oil and Gas Showings

There have been numerous claims to the discovery of mineral oil or natural gas on Yorke Peninsula and in the adjoining areas treated in this report, but in none of these instances have such reports been substantiated by genuine in situ samples of mineral oil or related gas products. Most of the supposed oil occurrences are simply cases of incorrect identification, while there are others which reported by former oil exploration syndicates which are known to be fictional.

The nature of the various reports and their origin (or credibility) are dealt with briefly hereunder:-

(a) Swamp Associations:

Reports of oil have been particularly prevalent from the saline swampy areas of Recent age at the head of St. Vincent Gulf where the presence of iron hydroxide films on the ground water (Wade, 1915) and inflammable marsh gas (Jack, Bull. 8) have been mistaken for oil traces. Such claims have attained undue prominence as it is a common local belief that the swampy environment is itself a promising indication of oil.

During the course of the present investigation it was reported by the Port Wakefield Council, on the evidence of local resident J. Robinson, that kerosene shale which readily burned

was encountered at 40 feet depth in a well sunk many years ago in the bed of Port Wakefield River on section 2116, hundred of Inkerman. An examination revealed no evidence which could substantiate this report as the well has subsequently been timbered and the waste dump removed by floodwaters of the Wakefield River. No oil can be detected in the water.

(b) Carbonaceous Deposits:

The Tertiary lignite and associated black carbonaceous oozes which are encountered in boring and well sinking at Clinton and near Balaklava have been variously misreported as bituminous in composition, as for example in the following extract of the prospectus of the North Western Syndicate N.L., 1922:-

> "The log of the Inkerman Bore affords some very interesting information in respect of substantial seams of bituminous shale and brown coal. Thus from 128 feet we find a 25 feet seam of 'dark bituminous shale'.....while at 221 feet comes a 23 feet seam of brown coal, resting on 12 feet of hard brown clay shale, which latter, no doubt, would also yield a small percentage of oil on distillation."

(c) Asphaltic Bitumen on Beaches:

The periodic discoveries of bituminous substances washed up along the coastline of Yorke Peninsula (and elsewhere on the southern coast of Australia) has naturally promoted considerable local interest. Boring was undertaken at Cape Spencer (1900), and at Carribie (1927-1928) in an area where such materials were found to be particularly abundant, and stated to have occurred in a soft state as though from a nearby source.

As a result of laboratory determinations, involving infra red spectroscopy, the bituminous material is believed to be residue of refined asphalts (D.M.1748/54), such as commonly jettisoned from tankers.

(d) Hydrogenous Gas:

Inflammable gas consisting chiefly of hydrogen and a small proportion of methane were obtained from the sludges of two deep boreholes in Proterozoic-Cambrian rocks near Minlaton. Similar gas has been observed (and in one case analysed) in other deep

boreholes throughout the State - in some cases within Archaean basement rocks - and are believed to be generated by boring rather than having any genetic relationship with oil (Ward Bull. 22).

(e) Fictional Reports:

A number of false claims were made by the Adelaide Oil Exploration Co. Ltd., which conducted boring at Maitland and Minlaton during the period 1930-1933. At Maitland the company took over an oil search licence in the Showground area where oil had been introduced, probably inadvertently from the drill rods, into a bore sunk by the Maitland Water Trust (Ward D3818/30). A second borehole sunk by the Company in Archaean rocks was reported to have yielded a large supply of an asphaltic base crude petroleum, while at Minlaton, petroleum wax, oil saturated sands, and petroleum gas were stated to occur between 338 and 1700 feet depth. Extracts from the report of the Company are included herein (Appendix III) from which it is readily apparent that the claims do not justify any further comment or consideration.

2. History of Oil Exploration

The earliest oil exploration known to have been carried out on Yorke Peninsula dates back to 1900, when the Warrenben Oil Company arranged with Johnson Bros. to drill four boreholes in the vicinity of Stenhouse Bay (Dickinson & King, 1949). These operations were instigated by the discovery of kerosene odours in caverns in the coastal cliffs (Wade Bull. 4), but boring was unsuccessful and intersected bedrock at depths varying from up to 200 feet.

A few years later (prior to 1914), the Wakefield Oil Shale company sank two boreholes to between 200 and 300 feet in the swamps near South Hummocks Railway Station.

An oil exploration borehole was sunk about the year 1908 on section 176, hundred of Ramsay, situated five miles southeast of Minlaton. The driller (Sgt. Stubblety) subsequently reported that although the bore was abandoned at 253 feet, black greasy substances and strong odours of kerosene had been observed at the lower levels. On this evidence, the Peninsula Oil Company was registered in 1920 and shortly afterwards a bore was drilled for them by driller A. Giles to 450 feet depth on the same property (R4); only glacial sands and clays of the Permian System were intersected, and no oil indications were observed. The company then transferred to a second site on Section 153, hundred of Ramsay, and drilled to a depth of 315 feet (R2).

During 1922-24, the search for oil centred about the coalfield areas to the east of St. Vincent Gulf. The North West Syndicate operated for some time in the Inkerman area, where lignite encountered in boring was incorrectly identified as bituminous shale. Another borehole was sunk in tidal swamps in section 9, hundred of Port Gawler. The Government also sank an exploration borehole in the hundred of Grace, near Mallala, and established the presence of lignite, but not oil.

The Carribie Oil Boring Coy. Ltd. was formed in 1927 for the purpose of test-boring near Daly Head, where abundant bituminous materials were found in the coastal wash. As a result, four boreholes were sunk to shallow granite bedrock on section L, hundred of Carribie. The boring was carried out by A. Hickman of Port Vincent (King, 1956).

Interest and activity in oil exploration reached a peak during the period 1930-33, when oil search licences embracing a large part of Yorke Peninsula were granted and four deep exploratory boreholes were sunk by various interests. No geological guidance was sought, however, with the result that a large proportion of the available capital was spent on useless bedrock drilling.

The location of several of the bore sites were selected or influenced by the divining "magnetic tracer" methods of a local resident (Mr. F.S.P. Staer).

In 1930 a water bore put down by the Maitland Water Trust in the town showgrounds (Serial No. Ma.4) was abandoned at 404 feet, having intersected entirely Archaean rocks. The driller reported oil traces and bitumen in the lower section of the hole, and the Peninsula Oil Syndicate was formed to investigate these claims; shortly afterwards the Government Geologist reported that no oil had originated from the borehole (Ward, 1931a), and the company surrendered the Oil Search Licence. In 1934 the licence to search was taken over by the Adelaide Oil Exploration Company Ltd. which sunk a borehole in the adjacent section (Serial No. Ma.5) in bedrock to a depth of 1,549 feet (Ward, 1931b), and made repeated claims of oil intersections (Appendix III). The Goldfields Diamond Drilling Company Pty. Ltd. contracted for the greater part of the boring.

The Minlaton Oil Boring Syndicate, formed in 1931, was subscribed largely by local pastoralists with a view to testing a divined site for oil on section 112, hundred of Ramsay (Serial No. R1). Percussion boring was undertaken by Lee and Dignan during the latter part of 1931 and progressed to a total depth of 1520 feet in Cambrian and Upper Proterozoic sediments (Ward, 1932 and 1944). Inflammable gas consisting of hydrogen and methane were obtained from the sludges at various depths. Lack of capital caused suspension of boring.

The Peninsula Oil Syndicate subsequently (1931-33) directed its attention to boring at Peesey Swamp (Section 121, Hundred of Moorowie) where a percussion hole 1132 feet deep (Serial No. Mo1) was sunk to bedrock by Johnson Bros.

During the period 1931-33, the Adelaide Oil Exploration Co. Ltd. entered into a contract with Price Brothers and drilled a second borehole (Serial No. Mi.1) to a depth of 1942 feet at Minlaton township. Percussion was superseded by diamond drilling at about 1700 feet depth.

3. Oil Possibilities of the Cambrian Group.

(a) General Considerations:

The present investigation of Yorke Peninsula has been directly concerned with assessing the oil possibilities of Cambrian rocks, and it is therefore appropriate to review the present state of knowledge on oil distribution in rocks of this System.

In a tabulation of oil production and reserves, Lavorsen (1956) indicates that 15 per cent of the world oil may be related to rocks of the Palaeozoic Era. Further particulars based on United States records show that while Upper Palaeozoic sediments are significant oil producers, only 0.1 per cent of the total ultimate production is referred to rocks of the Cambrian System. This low order record of Cambrian strata as regards petroleum prospects applies generally throughout the world.

In Australia, hydrocarbons have been identified in or related to Cambrian sediments in three widely separated portions of the continent.

(1) Asphaltic petroleum is reported as vesicle-fillings in lava which overlies fossiliferous Cambrian sediments in the Ord River region of northwestern Australia (Woolnough, W.C., 1938).

(2) A bore in Cambrian limestones near Camooweal (Queensland) intersected several thin beds of low grade oil shale (Bryan and Jones, 1945).

(3) Boring which is in progress at Wilkatana, South Australia, has established the presence of crude petroleum oil in Cambrian limestones (Archeocyathinae horizon).

Previously Mawson (1939) made the following comments on the presence of carbon and hydrocarbonaceous substances in Cambrian sediments in South Australia.

"A notable feature of certain horizons of the late Precambrian and Cambrian sequence of South Australia is the presence therein of uncombined (apparently graphitic) carbon, and traces of hydrocarbonaceous substances. It is probable that in the long past these horizons were source rocks of petroleum oil, but now only the merest vestiges remain. The following cases may be mentioned:

1. A black argillite of Precambrian age in Aroona Valley, item (55) of the Brachina Creek section as recorded in a previous publication (Mawson, 1939), emanates a faint bituminous odour on freshly quarried faces.

2. Black calcareo-argillaceous shales and impure limestones of Cambrian age which overlie the Archaeocyathinae marbles in several localities in South Australia, owe their colour to the presence of carbon. Such are recorded in the Ten-Mile Creek Section of this report as items (32) to (34). The equiva-of these beds in the neighbourhood of Adelaide is met with as black calcareoargillaceous shales above the Archaeocyathinae marbles at Sellick's Hill.

3. The fossiliferous limestones of the upper divisions of the Cambrian in the Wirrealpa basin carry traces of hydro-carbon oils. This is especially to be remarked in item (47) of the Ten-Mile Creek Section. The same feature has been observed where this same limestone was met with in traversing the Balcoracana Creek Section.

W.B. Dallwitz, when determining the lime-magnesium content of the rocks, as recorded above, was the first to observe the presence of traces of hydro-carbon oils in these limestones. He later notes that a bituminous odour was emitted when grinding certain of the limestones.

With a view to ascertaining the carbon and hydro-carbon contents, T.W. Dallwood, analyst to the South Australian Mines Department, kindly examined specimens of several of these and reports as follows: Black shale from Aroona Valley (No. 1 locality) contains a trace of hydrocarbonaceous matter and 2.05% of uncombined carbon. Black shale from Sellick's Hill (No. 2 locality) contains, besides a trace of hydrocarbonaceous substances, uncombined carbon to the extent of 1.96%. Limestone of item (47) of the Ten-Mile Creek section is reported as containing a trace only of hydrocarbons. The same also is reported from the corresponding limestone of the Balcaracana Creek Area."

On the evidence outlined above, it may be concluded that at least low grade source beds of hydrocarbon oils do occur at or about the archaeocyathinae limestone horizon of the Cambrian System in South Australia.

(b) Yorke Peninsula:

The Cambrian limestones of Yorke Peninsula are similar lithologically to those containing oil traces elsewhere in the State, and therefore warrant consideration as possible source beds of hydrocarbons. Assuming this possibility, then a number of other important conditions revealed by the geological survey must be considered in assessing the commercial prospects of the source beds - or the associated rock types which may be more favourable as a reservoir rock.

(1) The Cambrian sequence represented on Yorke Peninsula has a maximum observed thickness of approximately 300 feet, but it is possible that a thicker succession may occur in places beneath younger sediments e.g. Port Vincent and east of Clinton.

(2) The Cambrian Limestone Group consists essentially of dense, microcrystalline marbles, with a low degree of inherent porosity, and thus cannbt be regarded as favourable storage rocks for petroleum. The known occurrences of Cambrian rocks are in outcrops and in boreholes all elevated above sea level, and have been subjected to intense groundwater percolation and solution. The cavernous limestones cannot be expected to retain any free hydrocarbon that may have been originally present.

(3) The Cambrian Limestones are unconformably overlain by continental glacial deposits of the Permian System (e.g. Curramulka) and/or Tertiary marine Sediments (Ardrossan and Clinton). It can therefore be inferred in the absence of other evidence, that the Cambrian sediments were exposed as a land surface after Early Palaeozoic folding, at least until the Permian Period.*

(4) The Cambrian limestones of Yorke Peninsula overlap the Archaean Shield and have thus been subjected to a minimum of folding and other tectonic movements which can facilitate oil accumulation.

The observations outlined above seriously minimise the importance which can be attached to the Cambrian limestones of Yorke Peninsula in connexion with oil exploration. These conclusions, however, are based upon scanty outcrop information, and may not be applicable to some large areas where the Precambrian-Cambrian succession is obscured by younger sediments (e.g.

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*At Wilkatana, there is no record of sedimentation in the Palaeozoic or Mesozoic Eras.

Minlaton-Port Vincent area and Clinton-Port Wakefield area). Accordingly, a programme of boring was undertaken by the Government to provide further stratigraphic and structural evidence which was required for a thorough appreciation of the oil prospects.

4. Results of Current Boring Programme

Sites for stratigraphic boreholes were selected north of Port Clinton and east of Minlaton. Drilling was commenced at the Clinton site on the 19th March, 1956, and at Minlaton in May, 1956. Soft rock drilling in the upper Tertiary or Permian sediments was undertaken using a percussion plant, followed by diamond drilling in bedrock.

Boring at Clinton was suspended at a total depth of 515 feet, while the Minlaton Bore is still in progress.

The results of the drilling to date are briefly described hereunder, and will be fully recorded in a subsequent associated report.

(a) Port Clinton Stratigraphic Bore:

Situation: Section 336, hundred of Clinton (Fig. 2). The generalised rock section encountered by boring is as follows:-

0-290 feet.		Quaternary clays over Tertiary sands and lignite.
290-339	"	Grey dolomitic limestone, with intra-formational slump structures and oolitic bands. (Cambrian Limestone Group)
339-406	"	Interbedded dolomitic siltstone and quartzite, with quartzite conglomerate at base. (Disconformity - Basal Cambrian)
406-494	"	White arkosic quartzite. (Marinoan, A.E.C. Quartzite)
494-516	"	Purple and grey siltstones. (Sturtian)

Bedding in the drill core varied from 10 to 45 degrees.

A detailed geological log of the borehole is presented in Fig. 6.

The above correlation of the bedrock intersections with the Upper Proterozoic (Marinoan Series) and Cambrian succession, which outcrop east and north of the bore, is based upon strictly identical lithology and sequence. No fossils were observed in the Upper (Cambrian) dolomitic limestones.

Important conclusions to be drawn from the bore information are as follow:-

(1) The bore result supports outcrop evidence of an erosional disconformity at the base of the Cambrian limestone. The highly ferruginous and typically continental Pound Quartzite which outcrop at Kulpara is removed by erosion in the area of the borehole, while a Cambrian transgression is indicated by quartzite conglomerate at the base of the limestones.

(2) The cross-section revealed by the bore does not support earlier conclusions of downfaulting along the eastern fringe of the South Hummocks escarpment (see Fig. 7).

(3) No oil traces were observed in the Cambrian limestones, which, however, were found to be only partly represented in the area tested. On the evidence of the boring, the thickness of the Cambrian limestone sequence can be expected to increase towards the east.

(b) Minlaton Stratigraphic Bore:

Situation: Section 153, hundred of Ramsay.

Boring with a percussion plant has progressed to 620 feet, at which depth a pale brown shaley limestone was intersected, and the rig is being replaced by a diamond drill (15/8/56).

Unconsolidated sands and clays with embedded pebbles were encountered to at least 550 feet. These are apparently glacial sediments of the Permian System.

Below 300 feet the glacial deposits mainly consist of chocolate-coloured sandy shales, with pebbles. Similar chocolate shales which were encountered at this depth in a previous bore on the same property (R2) were described as probably Proterozoic in age (Ward, 1944). This conclusion now seems incorrect.

Traces of grease were observed in the sludge from the Minlaton Bore between 500 and 620 feet, and samples have been forwarded for analysis. An investigation of these showings is in progress.

IV. SUMMARY AND CONCLUSIONS.

The first part of the report describes the results of a detailed investigation of the Proterogoic - Cambrian succession on Yorke Peninsula, based upon several months of field work and a comprehensive survey of all previous geological work and borehole records.

The most significant results of this investigation are listed hereunder :-

1. A reasonably thick and complete succession of Proterogoic (Adelaide System) sediments were recognised and mapped beneath the fossiliferous Cambrian beds of Kulpara. These were previously recorded as part of the Cambrian succession.
2. Several important stratigraphic features were recognised within the Adelaide System sequence at Clinton and Kulpara, viz. (a) An unconformity at the base of the Sturtian Series;
   (b) a gradual emergence to sub-continental and continental conditions is clearly revealed by the lithology of the Mavinnan Series. Evidence is also presented which indicates that the Pound quartzite (previously regarded as the base of the Cambrian) is of continental origin and comprises an upper member of the Mavinnan Series.
3. A disconformity has been recognised at the base of the Cambrian limestone group at Kulpara.
4. Previously unrecorded outcrops of fossiliferous Cambrian limestone were mapped east of Minlaton.
5. Conglomerates marking the northern and western margins of Proterogoic - Cambrian sedimentation in the Curramulka Basin were mapped.
6. Evidence of Early Palaeogoic and Upper Tertiary (or later) tectonics is described.
7. The evidence of trough-faulting in St. Vincent Gulf is reconsidered and an alternative theory that the Gulf occupies a major synclinal environment is proposed.

In the second part of the report, the past results and oil exploration on Yorke Peninsula are discussed.

The main conclusions are as follows :

8. No authentic reports of oil occurrences have been recorded from Yorke Peninsula. Natural gas of inorganic composition has been noted in several bores.

9. Cambrian limestone in various parts of Australia have been found to contain small amounts of hydrocarbon oils and may be tentatively regarded as potential source rocks of petroleum. However, the prospects of finding oil accumulations in the Cambrian rocks of Yorke Peninsula are not highly regarded on existing information for several reasons :

(a) Insufficient thickness, at least in known areas;

(b) Evidence that the Cambrian formations comprised a land surface during much of the Palaeogoic Era;

(c) Absence of any known suitable trap structures;

10. The results to hand from two stratigraphic boreholes being sunk by the Government are summarised.

11. Geological logs of all deep boreholes on Yorke Peninsula are appended to the report.

D. King
Geologist
15/8/56

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(a)

(b)

Fig. 8. Concretionary dolomitic shales at the uppermost level of the Cambrian Limestone Group. Main Road cutting on the eastern side of the South Hummocks Range. Trilobite fragments are plentiful in the shale matrix.

(a)

(b)

Fig. 9. Laminated quartzite of the Upper Marinean Series (Round Quartzite), in a creek bed south of the South Hummocks railway cutting. Dark bands are highly ferriginous red quartzite.

(a)

(b)

Fig. 10. Close views of highly current-bedded ferriginous quartzite of the Upper Marinoan Series (? Pound Quartzite) where exposed in the South Hummocks railway cutting.

(a)

(b)

Fig. 11. Pebbly dolomite of the Upper Stuartian Fillite, exposed in creek two miles north-west of Kulpara (section 238, Hundred of Kulpara). Photographs reproduced from colour transparencies.

Fig. 12. Site of the Ramsay Oil Bore on Section 112, Hundred of Ramsay, at the official opening by the Minlaton Oil Boring Syndicate in 1931.

A P P E N D I X I.

GEOLOGICAL LOGS OF BOREHOLES.

PORTIONS COUNTIES FERGUSSON, DALY, STANLEY & GAWLER.

- Explanation -

1. The following system based on location within hundreds has been adopted in allotting reference symbols to boreholes:-

Initial letter or letters are an abbreviation of hundred
e.g. Mi ..... Hd. Minlacowie

Numeral refers to serial number within each hundred.

2. The sources of information from which the logs were obtained are listed in each case as a guide to their order of reliability.

Bore Serial No. Bal. 1.

S.A. GOVERNMENT

Reference D.M. 887/48
Mining Review 90

WHITWARTA COAL FIELD

Section 395

Hundred Balaklava

Bore No. 15 Date Drilling commenced - 23/6/49

L O G

0 - 5'	Brown sand and travertine
5' - 79'	Red and brown sandy clay
79' - 105'	Red-brown sand and gravel
105' - 122'	Lignite and lignitic clay

Bore logged by E. Anderson

Bore Serial No. Bal. 2.

S.A. GOVERNMENT

Reference D.M. 887/48
Mining Review 90

WHITWARTA COAL FIELD

Hundred Balaklava

Section 217

Bore No. 16 Date Drilling commenced - 27/6/49

L O G

0 - 3'	Brown loam
3' - 7'	Dark red travertinous log
7' - 69'	Reddish brown sandy clay
69' - 103'	Yellow and red sandy clay
103' - 121'	Red-brown medium sand
121' - 126'	Sandy carbonaceous clay
126' - 157'	Grey sand.

Bore logged by E. Anderson

Bore Serial No. Bal. 3

S.A. GOVERNMENT

INKERMAN-BALAKLAVA COALFIELD

Hundred Balaklava — Section 81

Bore No. 2 — Date Drilling commenced - 24/4/29

L O G

0 - 5'	Nodular limestone
5' - 185½'	Unconsolidated clay and sand
185½' - 186½'	Hard quartzite
186½' - 204'	Dark sandy clay
204' - 218'	Hard quartzite.

Bore Serial No. Bar. 1

SNOWTOWN BORE — Reference Engineer in Chief Dept. See Bull. 8, p. 50.

Hundred Barunga

Date Drilling commenced - 1882

L O G

0 - 23'	Loose sandy clay
23' - 37'	Black clay
37' - 66'	Red sandy clay
66' - 94½'	Sandstone
94½' - 95'	Sand
95' - 103'	Blue clay
103' - 117'	Black clay
117' - 181'	Sand
181' - 201'	Black clay
201' - 207'	Dark sand
207' - 230'	Black clay and sand
230' - 299'	Sand and quicksand

End of Bore at 299'

Water Cut	Water Level	Analysis grs./gall.
55		brackish
94½		brackish
117	92	fresh
230	30	fair

Remarks - Tertiary.

Bore Serial No. Ca. 1

PERCYTON GOVT. BORE

Reference 418/29

Hundred Cameron

L O G

0	- 60'	Gravel (possibly decomposed rock).
60'	- 84'	Hard rock
84'	- 146'	White sandstone
146'	- 184'	Hard rock
184'	- 194'	Blue rock
194'	- 372'	Hard grey rock
372'	- 385'	Soft red rock (clay)
385'	- 402'	Grey sandstone
402'	- 416'	Red clay slate
416'	- 442'	Brown rock.
442'	- 456'	Dark grey quartzite
456'	- 470½'	Dark grey sandstone
470½'	- 485'	Sandstone
485'	- 493'	Red clay slate
493'	- 523'	Light coloured slate
523'	- 837'	Red clay slate with layers of sandstone
837'	- 930'	Quartzite.

End of Bore at 930'

	Water Cut	Water Level	G.P.H.	Analysis
	230'		soakage	
	342'	327'	10	
	407'		1500/day	good stock
testing at	711'		total 2800/day	
	770'	300'		

Bore Serial No. Cl. 1

WAKEFIELD OIL SHALE CO. N.L.

SOUTH HUMMOCKS

REFERENCE See also Bull. 22, p. 28.

Hundred Clinton

Section 161 - close to railway about middle of west side.

Bore No. 1

L O G

0	- 20'	Blue clay	
20'	- 25'	Red clay	
25'	- 26'	Soft sandstone	
26'	- 30'	Hard conglomerate	
30'	- 35'	Coloured clays	
35'	- 50'	Coloured sands	
50'	- 100'	Sand	
100'	- 101'	Seam of black greasy substance	
101'	- 110'	Brown clay	
110'	- 120'	Brown quick sand	
120'	- 121'	Seam of black greasy substance	
121'	- 125'	Hard blue-grey sandstone	bedrock ?
125'	- 133'	Hard brown sandstone	bedrock ?

Remarks - Lost pump in hole and abandoned bore

Bore logged by Company.

Bore Serial No. Cl. 2.

WAKEFIELD OIL SHALE CO. N.L.

SOUTH HUMMOCKS

Reference Bull. 22, p. 28

Hundred Clinton

Section 161

Bore No. 2

L O G

0 - 147½'

No details obtained.

End of Bore at 147½ ft.

Bore Serial No. Cl. 3

S.A. GOVERNMENT

CLINTON COAL BORING

Section 337

R.L. 112.0

Hundred Clinton

Bore No. 4 Date Drilling commenced - 1921.

L O G

0 - 9'	Friable nodular limestone
9' - 32'	Red sandy clay
32' - 69'	Clay with grit
69' - 202'	Dominantly coloured sands with some clay
202' - 269'	Gritty carbonaceous clay
269' - 305'	Lignite and lignitic clay
305' - 320'	Sandy clay
320' - 325'	Grey dolomitic limestone.

Bore Serial No. Cl. 4.

S.A. GOVERNMENT

CLINTON COAL BORING

Section 340

R.L. 102.6

Hundred Clinton

Bore No. 15 Date Drilling commenced 28/9/22 Completed 3/11/22

L O G

0 - 10'	Soil and friable nodular limestone
10' - 14'	Stiff red clay
14' - 24'	Red clay with ironstone grit
24' - 50'	Sandy clay
50' - 70'9"	Red clay with ironstone and quartz grit
70'9" - 76'9"	Turritella bed
76'9" - 83'0"	Yellow clay
83'0" - 87'0"	White sand
87'0" - 89'0"	Yellow clay with some sand
89'0" - 112'0"	White sand
112'0" - 184'0"	Yellow, red and white sands
184'0" - 245'6"	Lignitic clay and lignite
245'6" - 292'0"	Pale grey sandy clay
292'0" - 334'0"	Lignitic clay, lignite and pyrite
334'0" - 335'4"	Dark grey quartzite
335'4" - 340'0"	Blue clay
340'0" - 345'3"	Pale grey dolomitic limestone

Bore Serial No. Cl. 5

S.A. GOVERNMENT
CLINTON COAL BORING
Hundred Clinton — Section Pt. 352
Bore No. 1 — R.L. 86.75

L O G

0	- 9'	Soil and friable limestone
9'	- 22'	Red sandy clay
22'	- 47'	Sandstone and grit
47'	- 59½'	Fine yellow sand
59½'	- 75'	Sandstone, fossiliferous - Turritella bed
75'	- 178½'	Sand and sandstone
178½'	- 343'	Carbonaceous clay and sand, and lignite
343'	- 344½'	Reddish sandstone.

Bore Serial No. Cl 6

S.A. GOVERNMENT
CLINTON COAL BORING — Section 352
Hundred Clinton
Bore No. 6 — R.L. 53.25

L O G

0	- 12'	Soil and friable limestone
12'	- 17'	Ironstone, and quartz grit
17'	- 57'	Stiff red clay.
57'	- 101'	Sandstone and clay
101'	- 140'	Sandstone and grit, fossiliferous in part - Turritella bed
140'	- 208'	Sandstone and clay
208'	- 478'	Lignite and lignitic sand and clay

Bottom on hard rock.

Bore Serial No. Cl. 7

S.A. GOVERNMENT
CLINTON COAL BORING

Section 351

Hundred Clinton

R.L. 160.5

Bore No. 8 Drilling commenced 22/5/22 Completed 27/5/22

L O G

0	- 4½'	Friable nodular limestone
4½'	- 23'	Fossiliferous sandstone and limestone
23'	- 46'	Friable sandstone
46'	- 57'	Coarse friable sandstone with quartz grit
57'	- 62'	Friable white sandstone with a little clay
62'	- 68'	Iron-stained clayey sandstone
68'	- 70'	Stiff yellow clay
70'	- 75'	Purple slate (soft). Dip 40 degrees.
75'	- 118'	Pale green and iron-stained slate with some bars of ironstone. Dip 35-40 degrees.

End of bore at 118'.

ARDROSSAN NO. 2 BORE

Bore Serial No. Cun. 2.

B.H.P. Co. LTD.
WHYALLA.

Reference D.M. 195/46

Hundred Cunningham

Bore No. 2

Remarks: Vertical diamond drill. Sediments dip at low angle to east.

L O G

0	- 33'	Soil, travertine, clay and weathered dolomite
33'	- 80'	Dolomite
80'	- 125'7"	Impure dolomite
125'7"	- 127'5"	Impure dolomite and fine grained hard quartzite - poor recovery.
127'5"	- 128'10"	Fine grained hard quartzite.
128'10"	- 130'6"	Purple slates.
130'6"	- 131'6"	Fine grained hard quartzite.
131'6"	- 181'0"	Purple slates with grits near base.
181'0"	- 190'4"	Medium-grained micaceous grit.
190'4"	- 193'1"	Siliceous grit and conglomerate.

End of Bore at 193'1"

Chemical analyses shown in docket.

Bore logged by B.H.P. geologists.

Bore Serial No. Cun. 3

ARDROSSAN NO. 3 BORE

B.H.P. CO. LTD. Reference 195/46

WHYALLA. Section 31 E

Hundred Cunningham

Bore No. 3 Date Drilling completed 1947.

Remarks: Vertical diamond drill. Sediments dip about horizontal.

L O G

0 - 25'7"	Dense cryptocrystalline limestone with bands of dolomite.
25'7" - 398'	Dolomite.

End of Bore at 398'

Water Level (Ft. below surface) - 242 ft.

Chemical analyses shown in docket.

Bore logged by - B.H.P. geologists.

Bore Serial No. Cun. 4

GOVT. BORE, CUNNINGHAM

Reference T.R.S.S.A., Vol. 42, p. 211.

Hundred Cunningham Section 83

L O G

0 - 46'	Clay and gravel
46' - 57'	Red and white clay
57' - 74'	White clay with gravel
74' - 104'	White clay
104' - 106'	Coarse gravel
106' - 502'	Granite

End of Bore at 499'.

Bore Serial No. R. 8

STANSBURY SCRUB BORE

Reference 799/56

Hundred Ramsay

Section 176

Date Drilling commenced 1908

Driller Stubblety

L O G

0	- 80'	Easy boring - sands?
80'	- 90'	Sandstone
90'	- 110'	Easy boring - sands?
110'	- 130'	Sandstone
130'	- 140'	Blue sand
140'	- 160'	Good boring
160'	- 175'	Sandstone
175'	- 195'	Blue clay
195'	- 200'	Blue shale
200'	- 210'	Sandstone - with black greasy substance
210'	- 230'	Dark brown substance
230'	- 253'	Mullock with kerosene smell

Bore Serial No. Cur. 1.

WATER BORE

Section 86W

Hundred Curramulka

Driller J. Hickman

L O G

0	- 180'	Blue Cambrian limestone over basal quartzite (or granite)

Bore Serial No. Cur. 2.

WATER BORE

Hundred Curramulka

Section 93

Hirer A.W. Jones

Driller J. Hickman

L O G

0	- 280'	Blue Cambrian limestone.

WATER BORE

Hundred Curramulka

Hirer Campion

Bore Serial No. Cur. 3

Reference Information from J. Hickman

Section 49

Driller J. Hickman

L O G

0 - 80' Clay

80' - 380' Blue Cambrian limestone

WATER BORE

Hundred Curramulka

Hirer Kirby No. 2

Bore Serial No. Cur. 4

Reference Information from J. Hickman

Section 32

Driller J. Hickman

L O G

0 - 557' Blue Cambrian limestone over soapy clay.

WATER BORE

Hundred Curramulka

Hirer J. Parsons

Bore Serial No. Cur. 5

Reference Information from J. Hickman.

Section 28

Driller J. Hickman

L O G

0 - 100' Clay

100' - 524' Blue Cambrian limestone

WATER BORE

Hundred Curramulka

Bore Serial No. Cur. 6

Section 27[N]

Driller J. Hickman

L O G

0 - 300' Blue Cambrian limestone

End of Bore at 300'

Cur. 7 see p. 23.

Bore Serial No. D. 1.

KLEIN POINT
ADELAIDE CEMENT COY.

Reference D.M. 770/46

Hundred Dalrymple

Section 8

Bore No. 1

Driller W.G. Noble

Date Drilling commenced 29/10/47 Date Drilling completed 20/11/47

L O G

Vertical diamond drill

0 -	5'	Travertine limestone and soil
5' -	5'10"	Travertine limestone
5'10" -	7'	Friable travertine limestone with a few nodules of travertine (For assay ?)
7' -	8'	Hard band of fine-grained dense travertine limestone (For assay ?)
8' -	16'6"	Travertine limestone (For assay ?)
16'6" -	25'0"	Red clay
25' -	29'	Miocene limestone friable, poor core (For assay)
29' -	44'	Fossiliferous limestone light brown, porous texture, medium grain, good core, becoming more compact at 44'. (For assay).
44' -	46'	Reddish brown porous fossiliferous limestone good core, medium grain . (For assay).
46' -	66'10"	Fossiliferous limestone, good core, light brown to pink, porous texture, medium grain. (For assay).
66'10" -	89'6"	Reddish brown fossiliferous limestone, medium grain poor core from 72'. (For assay).
89'6" -	96'	Fine-grained fossiliferous limestone, ferruginous staining in part with clay parting at 96'9". (For assay).
96' -	101'3"	Fine-grained fossiliferous limestone light brown coloured but ironstained near clay inclusion at 96'. (For assay).

End of Bore at 101'3"

Remarks: One of six boreholes in same section. See palaeontological Notes in D.M. 322/48.

COAL BORE

Bore Serial No. G. 1

Hundred Grace

Section 534

Date Drilling completed - 1924

L O G

0 -	505'	Sandy and clay beds, with traces of lignite.
505'		Coloured clays - decomposed bedrock ?

End of Bore at 505'

Remarks: 3 miles N.W. of Mallala.

Bore Serial No. I. 1.

PORT WAKEFIELD BORE
S.A. RAILWAYS

Reference T.R.S.S.A. Vol. 4, p. 41, 45.

Hundred Inkerman

Section S. end of Railway Workshop Area, Pt. Wakefield Township

Date Drilling commenced 23/9/1879

L O G

1'	- 12'	Grey sand and shell
12'	- 17'	Red clay.
17'	- 22'	Yellow clay and pebbles
22'	- 27'	Limestone and pebbles
27'	- 32'	Pipeclay
32'	- 34'	Red clay
34'	- 37'	Limestone and pebbles
37'	- 43'	Red clay and pebbles
43'	- 46'	Orange-coloured clay
46'	- 56'	Yellow clay, gravel and shell
56'	- 66'	Sand, gravel and shell
66'	- 72'	Red sandy clay
72'	- 85'	Yellow quicksand
85'	- 124'	White quicksand
124'	- 131'	Soft black clay
131'	- 140'	Brown quicksand with much decayed wood
140'	- 150'	Coarse grey quicksand with large ironstone pebbles and decayed wood.
150'	- 155'	Grey sandy clay with ironstone.
155'	- 192'	Fine grey quicksand.
192'	- 195'	Decayed wood
195'	- 198'	White quicksand.
198'	- 205'	Grey quicksand.
205'	- 207'	Black clay.
207'	- 207½'	Ironstone
207½'	- 210'	Quicksand, grey.
210'	- 211'	Black sand and coarse gravel
211'	- 219'	Black clay
219'	- 221'	Ironstone and hard black rock.
221'	- 230'	Stiff brown clay
230'	- 231'	Grey sand
231'	- 260'	Brown clay
260'	- 298'	White pipeclay
298'	- 302'	Grey sandstone
302'		A thin layer of soft brown rock.
302'	- 310'	Blue clay, very hard.
310'	- 520'	Hard blue slate with veins of quartz and ironstone.
520'	- 550'	As above, with more quartz, grey and crystallised and mundic.
550'	- 705'	As above, with quartz, mundic and mica.
705'	- 765'	As above, but softer, and no quartz.

Water Cut Ft. below surface	Water Level Ft. below surface	Supply G.p.h.	Analysis grs./gall.
34	surface	Large	salt
56	40	large	salt
131	60	-	salt
155	surface	-	salt
230	-	large	salt

Remarks: Log recorded above extracted from Royal Society Transactions - percussion hole.

Bore Serial No. I. 2.

S.A. GOVERNMENT
INKERMAN-BALAKLAVA COALFIELD
Hundred Inkerman
Section 365
R.L. 44.0
Bore No. 1 Date Drilling commenced 16/1/23

L O G

0	- 4'	Surface soil and nodular limestone
4'	- 46'	Stiff red clay with grit
46'	- 90'	Yellow siliceous sand and sandy clay
90'	- 92½'	Yellow fossiliferous sandy limestone
92½'	- 170½'	Siliceous sand and sandstone
170½'	- 249'	Lignitic clay and lignite
249'	- 290'	Siliceous sand
290'	- 323'	Grey clay (decomposed slate)
323'	- 343'	Hard bluish grey slate

Bore Serial No. B. 4.

S.A. GOVERNMENT
WHITWARTA COAL FIELD
Reference D.M. 887/48
M.R. 90
Hundred Balaklava
Section 304
Bore No. 18 Date Drilling commenced 21/7/49

L O G

0	- 18½'	Light brown sandy clay
18½'	- 31½'	Brown-red sandy clay
31½'	- 37'	Light brown sand and gravel
37'	- 43½'	Parti-coloured sandy clay
43½'	- 54'	Red-brown sandy clay
54'	- 64'	Coarse-grained dark red sand
64'	- 84'	Dark red sandy clay
84'	- 97'	Brownish grey coarse sand
97'	- 114½'	Grey, brown sand and gravel
114½'	- 116'	Light grey clay with some gravel
116'	- 134½'	Grey sand and grey quartzite fragments
134½'	- 147'	Quartzite

Bore logged by - E. Anderson.

Bore Serial No. Ki. 1.

BALGOWAN MAGNETIC ANOMALY
GOVT. D.D. BORE

Reference 620/53

Hundred Kilkerran

Section 153

Bore No. 1

Driller Noble

Date Drilling commenced 26/1/55 Date Drilling completed 30/3/55

L O G

Depressed 60° to the north

0 - 33'4" Travertine and red clay

33'4" - 505' Granite, gneiss, schist etc.

Note Bore No. 2 on same section has similar log

Remarks: Complete logs filed in docket.

Bore logged by - A.R. Crawford.

Bore Serial No. Ko. 1.

WATER BORE

Reference Bore folder, Records

Hundred Koolywurtie

Section 73

L O G

0 - 20' Clay

20' - 140' Sandstone and clay

140' - 168' Cambrian limestone

168' - 175' --- bottom of bore

Bore Serial No. Ko. 2.

WATER BORE

Hundred Koolywurtie

Section 41

Hirer A.M. Mahar

Driller J. Hickman

L O G

0 - 287' Blue Cambrian limestone.

Bore Serial No. Ko. 3

WATER BORE

Hundred Koolywurtie

Section 75

Hirer G. Clift

Driller J. Hickman

L O G

0 - 180' Blue Cambrian limestone over yellow limestone.

KULPARA NO. 1. BORE

Bore Serial No. Ku. 1.

B.H.P. CO. LTD.

WHYALLA. S.A.

Reference D.M. 195/46

Hundred Kulpara

Section Northern part of section 498

Bore No. 1 Remarks: - vertical diamond drill.

L O G

0 -	229'6"	Dolomite
229'6" -	239'11"	Poor recovery of chert only
239'11" -	242'11"	Poor recovery of weathered sandstone.

End of Bore at 242'11".

Remarks: Bore discontinued because of broken ground. Chemical analyses in docket.

Bore logged by - B.H.P. geologists.

WATER BORE

Bore Serial No. Ma. 1.

Reference Jack R.B. 4, 1913

Hundred Maitland Section 22

L O G

0 -	62'	Coloured clays
62' -	238'	Cambrian limestone - buff and grey
238' -	374'	Dense impervious reddish quartzite
374' -	414'	Sandstone.

Water Cut Ft. below surface	Water Level Ft. below surface	Supply g.p.h.
238	180	
below 374	150	main supply

MAITLAND NO. 1 GOVT. BORE
ENGINEER IN CHIEF'S DEPT.

Bore Serial No. Ma. 2

Reference T.R.S.S.A. Vol.42, p.202

Hundred Maitland

Section north end of 72B.

L O G

0	- 3'6"	Surface soil
3'6"	- 35'6"	Clay and limestone
35'6"	- 128'0"	Grey crystalline limestone
128'	- 148'	Purple slates
148'	- 199'	Coarse gritty sandstone
199'	- 266'	Granite and gneiss.

End of Bore at 266'.

Bore logged by - W. Howchin.

GOVT. BORE, MAITLAND WEST PARK LANDS
ENGINEER IN CHIEF

Bore Serial No. Ma. 3.

Reference T.R.S.S.A., Vol. 42, p. 211.

Hundred Maitland

Section West Park Lands

L O G

0	- 16'	Clay with limestone
16'	- 51'	Red and white indurated sandy clay
51'	- 232'	Granite

End of Bore at 232'.

Bore Serial No. Ma. 4.

MAITLAND SHOW GROUND
MAITLAND WATER TRUST

Reference Bull. 22; M.R. 53; Ward Field Book 2P

Hundred Maitland

Section Show ground Reserve

LOG

0 - 9"	Clay
9" - 66'	Oxidized felspathic gneiss
66' - 136'6"	Felspathic gneiss
136'6" - 145'	Fine grained gneiss
145' - 149'	Reddish gneiss
149' - 152'	Grey gneiss - some mica.
152' - 154'	Coarse granitic gneiss.
154' - 166'	Coarse gneiss - non schistose. Finer grained at 159'
166' - 181'	Red gneiss
181' - 210'	Red felspathic gneiss
210' - 225'	Gneiss with black mica and quartz.
225' - 242'	Mica schist
242' - 251'	Red gneiss
251' - 263'	Dark mica schist
263' - 298'	Red gneiss
298' - 309'	Dark grey mica quartz schist
309' - 404'	Red and brown gneiss. Bitumen at 390'? Fragments of slag said to be associated with bitumen at 385 feet.

Water Cut Ft. below surface	Water Level Ft. below surface	Supply G.P.H.	How tested	Analysis Grs./gall.
166		900	pump test	453
400	45			

Remarks: Bitumen not regarded as authentic. (Ward, Bull. 22).
See full chemical assay of water D.M. 818/30.

Bore Logged by - L.K. Ward Date 7/12/30.

MAITLAND OIL DD BORE
ADELAIDE OIL EXPLORATION COMPANY

Bore Serial No. Ma 5.

Reference Bull. 22; MR 55; Field Bk 2 P, Ward; Company Reports D.M. 295/33

Hundred Maitland

Section S.W. portion of 107

Date Drilling commenced 1930-33

L O G

0	-	1,549'	Gneiss and mica schist

End of Bore at 1,549'

Remarks: Oil reported at 827 feet, but shown to be from drill rods. (Ward, Bull. 22). Deliberate attempt to salt hole (Field Book 2P.).

TOCCHI LAGOON BORE

Bore Serial No. Me. 1.

Reference Engineer in Chiefs Dept., Bulletin 8, p. 19.

Hundred Melville

Section ML 49

Date Drilling commenced 1890

L O G

0	-	2'	Black mud
2'	-	30'	Dark clay with gypsum
30'	-	300'	Dark clay
300'	-	303'	Hard sandstone
303'	-	304'6"	Sandy clay
304'6"	-	305'5"	Very hard blue rock

Note - not known whether last intersection is bedrock or glacial erratic.

End of Bore at 305'5".

MINLATON BORE
ADELAIDE OIL EXPLORATION CO. LTD.

Bore Serial No. Mi. 1.

Reference Ward, Bull. 22, p. 25; Ward, Field Book 2P; Company Report & Log D.M. 295/33.

Hundred Minlacowie

Section Immed. west of Minlaton.

L O G

0	- 56'	Limestone and clay (fossiliferous marine - vide D.M. 295/33
56'	- 1696'	Glacial clay and erratics.
1696'	- 1876'	Red calcareous sandstone
1876'	- 1886'	Glauconite (?)
1886'	- 1942'	Limestone

Ward (Field Book 2P) reports bottomed in pink crystalline limestone with green streaks.

Hd. Minlacowie Bore Record Cover: 0-56, Marine fossiliferous limestone.

End of Bore at 1942'

Remarks: No samples submitted to Mines Department. Collected gas samples from 861 ft. Gas bubbled freely from sludge. Drilledn by Mr. S. Price, now residing at 3 McGilp Ave., Glenelg.

Bore logged by - Company Date 1930-33 ?

WAROOKA OIL BORE
PENINSULA OIL SYNDICATE LTD.

Bore Serial No. No. 1.

Reference Bull. 22, p. 25, Ward Field Book 2P.

Hundred Moorowie

Section 121 Peesey Swamp

Date Drilling commenced 1931 Date Drilling completed 1933

L O G

0	- 138'	Recent marine sediments, clay and sand, with shells
138'	- 650'	Permo-carboniferous tillite. Clay and boulders.
650'	- 661'	Reddish brown limestone sand and siliceous sand.
661'	- 1132'	Pre-Cambrian mica schist and gneiss.

End of Bore at 1132'

Water Cut Ft. below surface	Supply g.p.h.	Analysis grs./gall.
in tillite	just flows	11.87 oz.
650	1000 flows	1.08 oz.

Bores Serial No. Mu. 1.

WATER BORE

Hundred Muloowurtie

Section 148

Driller J. Hickman

L O G

0 - 400' Red sandstone over granite.

ARDROSSAN NO. 1. BORE

B.H.P. CO. LTD.,

WHYALLA.

Bore Serial No. Mu. 2.

Reference D.M. 195/46

Hundred Muloowurtie

Bore No. 1.

Remarks: Vertical diamond drill hole. Sediments dip 10° east.

L O G

0 - 2' Soil

2' - 166' Dolomite.

End of Bore at 166 ft.

Remarks: Chemical analyses shown in docket.

Bore logged by - B.H.P. geologists.

OIL BORE

Bore Serial No. R. 1.

Hundred Ramsay

Reference Bull. 22, M.R. 55, p. 40. D.M. 799/56

Section 112.

L O G

0 -	253'	Cambrian limestone with archeocyathinae
253' -	292'	Shale, sandstone and grit - Basal Cambrian according to Ward (M.R. 55).
292' -	548'	Limestone with some phyllite and calcareous and siliceous slate.
548' -	855'	Crystalline limestone.
855' -	1,800'	Light and dark grey limestone.

Note - Sample of pale grey finely-crystalline limestone from 861 feet stored in Departmental Stratigraphic Museum.

End of Bore at 1,800'

Water Level Ft. below surface	Analysis grs./gall.
160	551

Remarks: Site selected by divining. Inflammable gas observed in sludgeat depths below 370 feet (see sample assays in text).

Bore logged by - L,K. Ward.

OIL BORE
PENINSULA OIL CCY.

Bore Serial No. R. 2.

Hundred Ramsay

Reference Bull. 22, p. 26.

Section 153

L O G

0 -	105'	Sands (reported as Tertiary but probably upper Permian)
105' -	237'	Glacial clay and erratics.
237' -	315'	Chocolate Shales with hard bands.

End of Bore at 315 feet.

Bore logged by - L.K. Ward.

WATER BORE

Bore Serial No. R. 3.

Reference Bull. 8, p. 61.

Hundred Ramsay

Section 195 - south of Salt Lagoon.

L O G

0 - 320 Glacial tillite

End of Bore at 320'.

OIL BORE

Bore Serial No. R. 4.

Hundred Ramsay

Reference Information from S. Hickman, Pt. Vincent.

Section 176

Date Drilling commenced 1920

Driller S. Giles

L O G

0 - 450' Glacial clay with granite boulders.

End of Bore at 4508

Remarks: Bore abandoned. Date 1920.

WATER BORE

Bore Serial No. Cur. 7. ~~R. 5.~~

Hundred ~~Ramsay~~ Curramulka

Reference Information from J. Hickman.

Section 23

Driller J. Hickman

L O G

0 - 60' Blue clay - Permian

60' - 280' Blue Cambrian limestone

End of Bore at 280'

Remarks: Salt water.

WATER BORE

Bore Serial No. R. 6.

Reference Information from J. Hickman

Hundred Ramsay

Section 85

Driller J. Hickman

L O G

0 - 130' Black clay with pebbles - Permian.

End of Bore at 130'

WATER BORE

Bore Serial No. R. 7.

Hundred Ramsay

Section 116

Hirer A. McKenzie

Driller J. Hickman

L O G

0 - 445' Glacial clay and boulders.

Remarks: Salt water.

GOVERNMENT BORE

Bore Serial No. T. 1.

Reference Howchin, T.R.S.S.A Vol. 42, p. 194.

Hundred Tiparra

Section 342

L O G

0 - 20' Soil and red clay

20' - 36' Conglomerate

36' - 76'9" Granite

Water Cut

Dry.

Bore Serial No. T. 2.

S.A. GOVERNMENT EXPLORATORY D.D. BORE
WEETULTA

Reference 1333/55

Hundred Tiparra

Section 201

Bore No. 1.

Driller Noble

Date Drilling commenced 11/8/55 Date Drilling completed 7/10/55

L O G

0	- 57'6"	Travertine and red clay
57'6"	- 100'	Ferruginous quartzitic sandstone.
100'	- 500'2"	Archean gneiss, schist etc.

Remarks: No. 2 Bore with similar log.

Bore Serial No. T. 3.

Hundred Tiparra

Reference Jack, Bull. 6, P. 31.

Section 354

L O G

Quartzite
Slate
Fine grained sandstone
Conglomerate

Bore Serial No. W. 1

URANIA NO. 1 WATER BORE

Reference Jack, R.B. 4, 1913

Hundred Wauraltee

Section 69 - half mile NNW of Urania

L O G

0	- 200'	Cambrian limestone
200'	- 237'	Hard red quartzite

End of Bore at 237'

Water Cut
dry.

URANIA NO. 2 WATER BORE

Bore Serial No. W. 2.

Reference Jack, R.B. 4, 1913

Hundred Wauraltee

Section 90N - western slope of Yorke Valley

L O G

0	- 70'	Cambrian limestone
70'	- 125'	Hard impervious quartzite.

Water Cut

dry

URANIA NO. 3 WATER BORE
GERSCH'S BORE

Bore Serial No. W. 3

Reference Jack, R.B. 4, 1913

Hundred Wauraltee

Section 91

L O G

0	- 170'	Cambrian limestone
170'	- 215'	-

End of Bore at 215'

Water Cut(ft. below surface)	Analysis grs./gall.
170'	2-3 ozs.

WATER BORE

Bore Serial No. W. 4.

Reference Bore folder, Records

Hundred Wauraltee

Section 12 or 13

L O G

0	- 92'	Yellow and red clay
92'	- 120'	Sand and red and yellow clay
120'	- 150'	Sandstone
150'	- 180'	Hard rock. Yellow in bottom, with quartz.

End of Bore at 180'

Remarks: Probably Permian to 150 feet, overlying Archean.

Bore Serial No. W. 5.

WATER BORE

Reference Wauraltee bore folder, Records.

Hundred Wauraltee

Section 28

L O G

0	- 25'	Tertiary fossiliferous limestone
25'	- 98'	Sandstone - Permian ?
98'	- 190'	Hard grey rock, probably Cambrian limestone
190'	plus	Red quartzite.

APPENDIX ~~XXX~~ II

YORKE PENINSULA OIL EXPLORATION.

EXTRACTS FROM REPORTS OF THE ADELAIDE OIL EXPLORATION COMPANY LIMITED.

1931 -- 1934.

DIRECTOR'S REPORT TO 30/7/31.

OIL AT MAITLAND, YORKE PENINSULAR, S.A.

During the past year oil was reported to us as having been accidentally discovered at Maitland, Yorke Peninsular -- about 100 miles from Adelaide by road, or 60 miles directly North-West. The oil was reported to us as having been found in a bore-hole being sunk for Water, by Mr. Charles Rasmussen, in the Maitland Showground, being part of the Park Lands of that town. A sample of the oil being handed to us by Mr. W. H. Sanderson, of Colton, Palmer & Preston, Ltd., I immediately applied myself to make the severest possible test of it, and did so with the result that I became convinced, beyond a shadow of doubt, that it was a crude oil of superior quality, of which I am prepared to say that nothing corresponding to it has ever been found in Australia, and that nothing of the kind is now being imported into Australia. With this satisfactory test before me, I at once proceeded to Maitland to examine the site of the occurrence and to obtain quantative samples of the oil, and which was done with the greatest possible ease. There is unquestionably an abundance of oil there, from a seepage point of view, and it is ever on the increase. We have proved this by repeatedly bailing the well, with the result that a few days after each bailing the supply was greatly increased.

In reference to the discovery of the oil, the driller, Mr. Charles Rasmussen, states that at 381 feet he cut a bed of Bitumen about four feet in thickness, and that when this was passed through, and which was done only with great difficulty on account of its plasticity, oil was obtained in the bore. Obviously this was the end of boring for water, but the story told by Mr. Rasmussen was of great interest to us, and led to a careful geological examination of the whole of the surrounding country, and which led us to the conclusion that Yorke Peninsular embraces:

As soon as a definite conclusion was reached regarding the obvious possibilities of Maitland, as an oil field, we immediately called tenders to drill there, and after receiving several responses we accepted that of the Goldfields Diamond Drilling, Pty., Ltd., of South Melbourne, Victoria. That Company is now at work with an efficient diamond drilling plant, and experienced drillers working day and night shifts, on the property of Mr. F. Bowman, adjoining the town of Maitland on the North, and good progress is being made with the work. A depth of approximately 300 feet has already been drilled and the strata passed through is quite satisfactory from an oil indicating point of view.

As you may all well imagine, the great work we have done at Maitland, and the preparations for it, were carried out quietly and with the greatest possible discretion. As soon as we knew that we had discovered a great oil field we immediately got quietly to work and secured a large area of the surrounding country and the Park Lands of Maitland, including the Showground where oil was first found. Leases over thousands of acres of well-selected potential oil lands have been secured for long terms from the farmers of Maitland and elsewhere on Yorke Peninsula, and a Search Licence Permit from the Government for the Maitland Park Lands and Showground. In this connection, the Mayor, C. H. King, Esq., and Councillors of Maitland were most helpful to us, and, in fact, facilitated our advent to Maitland most courteously in every possible way.

To give you an idea of the quality of the Maitland oil we reprint in this report a copy of the Analysis made by the Victorian Mines Department for the Federal Government. It is as follows, viz:--

COPY OF ANALYSIS OF MAITLAND OIL.

M. A. 31/2420
Geological Survey Laboratory,
Department of Mines,
Melbourne,
20/8/31.

REPORT NO. 539.

Sample	Oil.
Locality	Maitland Bore, Yorke Peninsular.
Depth	385 feet.
Sender	Dr. Woolnough, Geological Adviser Department of Affairs Canberra.

Sample, which was received in a metal container, the lid of which was soldered on, measured 57 fluid ounces. The oil possessed the following properties:--

Colour	Dark brown
Flouresence	Dark green
Odour	Petroliferous.
Condition	Mobile.
Specific Gravity (60° F.)	0.904.
Viscosity (Redwood 70° F.)	.136 seconds
Water	5.8%
Asphaltenes	0.89%

Distillation Test (Engler Test) on Dehydrated Oil:--

Initial Boiling Point	110°C.

Fraction.	Boiling Point Range.	Remarks.
1. Light Oil*	- to 150° C.	3.0 Almost water white, mobile Sp. Gr. 0.766.
2. Intermediate Oil	150°-200° C.	7.8 Pale yellow, mobile, Sp. Gr. 0.804.
3. Kerosene fraction	200°-250° C.	19.0 Pale amber, mobile, Sp. Gr. 0.857.
4. Mineral Seal Oil	250°-300° C.	15.5 Strong amber, viscous, Sp. Gr. 0.879.
5. Heavy (lubricating)	Over 300° C.	56.7 Dark brown, viscous

* Petrol fraction.

This sample possesses the properties of an asphaltic base crude petroleum.

Straight-run fractional destillation shows the presence of 10.8% of petrol (motor spirit) fraction, which makes this class of oil of commercial value if existing naturally in large quantity.

The heavy fraction consisted of dark brown viscous oil, which should be capable of producing high-grade lubricating oils by distillation under vacuo.

A perusal of the above Analysis of the Maitland oil will show that it is of excellent quality, not-withstanding the fact that it was obtained near the surface and consequently that inspissation — drying up — may be expected to have had a deleterious effect upon it.

Ladies and gentlemen, as you may well guess, there is much more that may be said by us, in this Report, about our great find of oil at Maitland, but which, if said, may be fatal to our best interests. To give you full details of our geological survey work in this Report would put others in the possession of information that should be exclusively kept to ourselves for the time being. We have, perhaps, said more than enough already. At any rate, we believe that we have said sufficient to fully convince you that we have discovered, and are in possession of, and oil field that will, when properly developed, place us side by side with the great oil companies of the world. But, we must not forget that to develop and equip it will involve the use of a lot of money. Help us to get this money by telling all your friends of our great success, and advise them to take shares with us. Our terms are exceptionally easy, and the investment is evidently good — probably the best thing offering in Australia today.

DIRECTOR'S REPORT TO 27/1/31

Since our Annual Report to you our work has been almost exclusively confined to drilling for oil, and in the largely extended sale of our shares and options.

At Maitland our big diamond drill reached a depth of 1,384 feet over a fortnight ago, when work was temporarily stopped for repairs and the replacement of parts worn out. The indications of oil showing in this well, in the form of bitumen and oil saturated rock, are most excellent. These indications leave no reasonable doubt regarding the results of the future — the only difficulty being that there is a possibility of a comparatively hole having to be drilled before the big expected success is reached.

At Minlaton our Contractors for the big diameter bore there, Messrs. Price Brothers, of Peterborough, have made excellent progress considering the size of the bore, and the fact that a big and powerful plant, of excellent design, had to be installed during the period under notice. Up to the time of the latest report, from the bore, a depth of 1,322 feet had been reached, and the indications of oil were continuously favourable in one form or other. Rocks were met with such as are common on oilfields, and oil-field gas was present for about 900feet in the bore, although it was repeatedly cut off by the casing.

DIRECTOR'S REPORT TO 27/7/33

YORKE PENINSULAR HIGHLY FAVOURED FOR OIL.

In our recent reports to you we have strongly expressed ourselves as being in favour of Yorke Peninsular as a field in which to look for oil. The opinion given in them is the result of a most careful and efficient examination of the territory under notice, by

highly qualified oil experts of wide experience, and may well be accepted in preference to that of the ignorant obstructionists who ever stand in the way to hinder oil-finding in Australia by blurting out worthless opinions without knowing anything up to date about the highly technical science of oil-seeking. The country is famishing for development. We tread the grand and noble way of honourable progress and persistent effort that will eventually bring prosperity to it. The bombastic obstructionist treads the dishonourable way that he expects to lead to the bankruptcy and destruction of our Country, Nation, and Empire. Decide for yourselves whom it will pay you to hearken to. We have almost overwhelming opposition to fight against that you know nothing about, but fighting it honourably and honestly, and we are sure to win. We may be hindered for a time, but the result of our grand work is none the less sure. The oil is there, we know, but time is necessary to reach it, as well as to overcome the obstacles that are placed between it and us. Obviously, in view of Australia's hard times, it is a crime for anyone to hinder oil-finding here, either wilfully or ignorantly. If so-called experts (?) think we are wrong in drilling for oil on Yorke Peninsular, let them be discreetly silent, remembering that better qualified men than themselves strongly advised us to drill there. We cannot please everyone, and if we tried to do so, I am afraid we should soon find ourselves with the "old man and his ass -- in the ditch." However, we are content to go on as we are. We know what we are doing, and the drill will tell you its own tale in due course.

When oil is struck our shares will no longer be available at their present low price, but will doubtless be taken up quickly, at an enormous premium. Powerful capitalists are even now giving us close attention in the work we are doing and only a very limited number of shares are now available.

In this connection it should be particularly noted that the shares of this Company -- The Adelaide Oil Exploration Company, Limited -- carry an interest in all the other Companies named in this report.

Also, in the event of this report reaching the hands of some loyal person, alive to the best interests of this country, and not yet a shareholder in the Company, but who would like to help on the great and important work of oil seeking in Australia, we should be pleased to send a form of application for our shares, for the convenience of such a one, if desired to do so.

DIRECTOR'S REPORT TO 31/1/34.

OUR NEXT MOVE AT MAITLAND. Having successfully completed the test bore already mentioned, at Maitland we now definitely know there is oil there, and therefore our next move is to consider the drilling of a large diameter production bore, probably on the site of the test bore. In this connection a start has already been made with this object in view. Suitable drilling plant has been enquired for, on the one hand, and contract prices have been asked for on the other, some of which have been received already.

MINLATON. During the past half-year our bore at Minlaton has been advanced to a depth of 1,903 feet. In the course of drilling to this indications of oil were continuously present and most favourable in one form or another. At 538 feet petroleum gas was met with and continued until the bore reached its present depth of 1,903 feet. The gas now coming up is wet and very strong, and explodes when ligted. It condenses when placed in a cold chamber, which shows that it is a wet or petroleum gas. When condensed and thrown on water it shows rainbow colours. At 1,575 feet the drillers reported a fine grained RED sandstone which continued for well over two hundred feet. In reference to RED sediments being associated with oil bearing beds, Professor Emmons, and eminent American Geologist, writes in his latest book -- "Geology of Petroleum," page 91 -- as follows, namely:—

FOREMAN'S REPORT FOR WEEK ENDING 5/5/34.

Mr. Moote,

Dear Sir,

I have to report that we completed casing the bore at Minlaton with 4" casing to a total depth of 1,942 feet. The casing is now on a firm bottom. We also went down with a 3" bailer, 16 feet long, and had no trouble with same.

The gas in the bore is very good, and, being explosive, will light several times with one match. I feel sure that you will meet with good results in the near future. In addition to having plenty of gas, which is coming from the bottom of the well, there are distinct colours of oil with each bailer taken out.

I am,

Yours respectfully,

(Signed) H. LEE.

(What may we expect from the above mentioned indications is a dome structure similar to the Moroccan structure where a great well came in, a few weeks ago, with 100,000 gallons of oil every ten minutes. J. T. M.)

DIRECTOR'S REPORT TO 30/7/34

As is usual in all good oil bearing country we have met with some difficulties and consequently, some hindrances in the wells we are now boring on Yorke Peninsula, but which we are pleased to be able to tell you have been largely overcome. In this connection we may say that the experience of oil well borers, in every part of the world has been that good oil bearing country, particularly, is most difficult to drill. The risks generally associated with drilling in it, and the high cost of the same, are known to be very great, but must be borne before success is possible. The country in which we are now drilling, on Yorke Peninsular, provides rare exceptions to this rule. Like all good oil bearing country it is very much broken as a result of the excessive folding that formerly took place, and which is absolutely essential for the storage of oil now definitely proved to be present there. This condition was brought about in the ages long past as a result of the subsidence of the land where we now find Spencer's Gulf, and Gulf of St. Vincent, on each side of Yorke Peninsula and, in consequence of which, we find <u>rocks excessively folded there,</u> and many of them -- the rocks -- being incompetent were excessively broken in the process of folding. These conditions make the work of drilling on the Peninsular, most difficult; but, at the same time, we have, through them, the extreme gratification of knowing that they -- the conditions described -- are decidedly favourable indications of oil. Without the folding we could have no reservoir for the oil, and without the folding there would be no

broken rocks, and no indications of oilin larger quantities. Thus, what is now most troublesome, annoying and costly to us, indirectly provide indications that are entirely in our favour. These trying conditions and other prominent indications plainly tell us that the oil is there, and that is there, and that is what we want to know. With this knowledge we feel confident that we will eventually get oil, all being well, and provided we follow up the course we are now on. The remarks, in this report, about broken rocks, apply exclusively to Maitland.

TEST DRILLING. In the development of new oil-fields, the world over test drilling is recommended and practised by the leading authorities engaged in the delicate work of oil seeking. What is meant by test drilling is the sinking of small diameter-holes to enable the drillers to find out what exists beneath the surface before going to the big expense of boring what is known as large diameter production wells.The drilling of the small diameter well discloses everything to be found in the strata drilled through, and whether there is oil and gas in it or not. The test well is very much less costly than the large diameter production well, and therefore, alone, we felt in the first place that we had a good reason for using the small diameter test bore. Also, in this way, the pressures of oil and gas are revealed without risk, and the drillers then know just what control harness is necessary when the big well is put in.

MAITLAND. As you are all aware, we decided to, at first, drill a test well at Maitland to enable us to determine the geological formation there, and to find out whether oil or indications of it were present or not. Our first test well has now been completed. At three different horizons in it we cut good shows of oil in thin porous beds among impervious strata, together with hardened bitumen, oil residue, in the crevices of the rocks. THUS WE KNOW NOW THERE IS OIL AT MAITLAND, not only in the show-ground bore, but also in the test bore we have just completed within five hundred and fifty yards from it. We have pumped oil on many occasions from the showground bore there for nearly three years, and a test made a week or so ago proved that it is still coming in so fast that there is no diminuation of the supply. These facts enable us to confidently refute the oft repeated false and parrot-like statement that "there is no oil in Australia" -- obviously a false statement made to injure the honest oil seeker. We make this emphatic statement in spite of all that may be said against the oil position at Maitland by Government officials, whose attitude (to use the words of a competent and highly qualified authority) is truthfully described in an excerpt from a recent letter, as follows:--

> "It is a peculiar fact that, despite so much opposition, not one Government Geologist has made a geological survey for oil, not one has had the pluck to express his opinion, based on facts, in writing for the simple reason that they lack the ability to do so. One or two, certainly, have expressed themselves ambiguously on observations of a day or two in the field, but not one has submitted evidence in support of views. Well it is left to us to do this work for Australia, unaided and unappreciated, which, however, may be to our ultimate advantage. Your Company is the only one now operating in Southern Australia, so very much depends upon its work."

We would suggest that the words of Dr. Apley may here be appropriately used, as follows:--

> "There is a principle which is a bar against all information, which is proof against all arguments, and which cannot fail to keep man in everlasting ignorance. This principle is contempt prior to examination."

In view of our great need for oil in this country and the fact that there is plenty of it here, it is certainly a very serious matter to speak falsely against oil seeking here, and which can only be done tothe detriment of Australia and the great Empire to which we belong. At the present time we are said to be spending from fifteen to twenty millions of pounds per annum on petroleum products. The oil seeker

is doing his best to remedy this ruinous outgo of our money that is fast bringing us to the point of bankruptcy. Therefore, do all you possibly can to help and encourage the oil seeker when and wherever you find him intelligently engaged in his great work.

Almost any Australian newspaper you may read relates heart-breaking facts regarding the misery privation and suffering which abounds in many sections of our community -- entirely due to unemployment -- and which conditions we definitely claim would not exist if Australia's undoubted oil resources were developed, as would be the case in any other country but Australia with such indisputable evidenceavailable, of its obvious presence in great abundance. Unfortunately, certain sections of the press and Government Departments, as well as the community, appear most hostile --apparently without the slightly cause -- in their attitude towards the honest oil seeker in this country: and although in effect we really are doing work which Government Departments should themselves be engaged upon, chiefly with the object of relieving distress, as would immediately follow upon the successful completion of such work, and for the purpose of conserving within our country, the millions of pounds which annually leave our shores for foreign lands, and which would undoubtedly make such a tremendous difference to all in Australia, both economically and socially. Unfortunately, they do not extend any help whatever in this direction, but rather seem to take delight in criticising, hindering and ridiculing the work, efforts and honest intentions of those engaged in this great work. However, not any of the opinions of the above sections as applicable, concern us in the slightest -- we have ample evidence in our possession which cannot be disputed by any qualified man living, that Yorke Peninsular, S.A., is a potential oil field of great magnitude, and say definitely that we honestly believe the results of our work there, in the near future, will definitely prove this to the entire satisfaction of all.

OUR NEXT MOVE AT MAITLAND. Having successfully completed the test bore already mentioned, at Maitland, we now definitely know there is oil there, and therefore our next move is to consider the drilling of a large diameter production bore, probably on the site of the test bore. In this connection a start has been made with this object in view. Suitable drilling plant has been enquired for on the one hand, and contractprices have been asked for on the other, some of which have already received. An early start with the drilling of the large diameter producti n well, above mentioned is most probable.

MINLATON. During the past half-year our bore at Minlaton has been advanced to a depth of 1,962 feet. In the course of drilling to this depth indications of oil were continuously present and most favourable in one form and another. At 338 feet petroleum gas was met with and continued until the bore reached its present depth of 1,962 feet. The gas now coming up from the bottom of the well, which is firmly cased to its bottom, is wet and very strong, and explodes when lighted. It condenses when placed in a cold chamber, which shows that it is a wet or petroleum gas. When condensed and thrown on water it shows rainbow colours. At 1,575 feet the drillers reported a fine grained RED sandstone which continued for well over two hundred feet. In reference to RED sediments being associated with oil bearing beds, Professor Emmons, and eminent American Geologist, writes in his latest book -- "Geology fo Petroleum." page 91 -- as follows, namely:--

"In the Appalachian region red sediments are closely associated with many of the oil and gas bearing beds. The Catskill series contains a considerable amount of red shale. Red shales of the Mauch Chunk inclose petroliferous beds. In places the "Clinton" sand of Ohio is red. In Illinois red shales are found in the Chester (Mississippian), which is oil bearing. In the Mid-Continent Oil Field red shales are associated with some of the productive sands."

At about 1,600 feet petroleum wax or dirt was met with the bore and at 1,700 feet oil saturated sands were reported as being brought up in the bailer. For some time we had hoped to be able to report OIL AT MINLATON, to you before this meeting and we firmly believe that we would have done so had it not been for the heartbreaking delays and hindrances we have been subjected.

As you were all advised in our last report, at 1,700 feet Messrs. Price Brothers, who contracted to drill this hole to a depth fo 2,000 feet, lost the string of tools in the well through the breaking of of the steel cable attached to them. This necessitated a sickening delay of five monthes, which was spent by the contractors in recovering these tools, and which they eventually did in the time mentioned. Work was again continued by them, but, we regret to advise you, in a most unwilling spirit, in spite of all the coaxing and encouragement meted out to them by your Directors. At 1,944 feet they deliberately left their contract and removed their plant back to Peterborough, apparently without any sound reason for so doing. Whether this was done through their inability to complete the drilling of the hole to the depth undertaken by them, or for some more serious reason, we do not know and therefore cannot tell you. Legal proceedings are now pending in regard to Messrs. Price Brothers' conduct.
Arrangements were then entered into with Mr. Harold Lee, a competent and thoroughly honest driller, to complete the well to the contract depth. Mr. Lee was anxious and quite willing to do this work for us, but aftererecting his drilling plant on the boresite, it was found that his plant was not capable of drilling to the depth required. To avoid any further delays, and so that the completion of this very valuable well may be accomplished, without further hindrances or humbug your Directors decided to remove our big diamond drilling plant from Maitland and it is now erected at Minlaton and making good progress under our own supervision in the work, the successful results of which will mean so much to all of us. We assure you that all is going on again satisfactorily, and we expect to reach the oil at an early date, when we will promptly report it to you, all being well. At the present depth of the well, 1,962 feet, we are drilling in a fine grained brown sandstone very highly charged with lime.

In reading this report it will be seen that the principal indications of oil at Minlaton are PETROLEUM GAS, A RED SANDSTONE COVER ROCK, OOLITIC LIME AT GREAT DEPTH, SALT GYPSUM, OIL SANDS AND WET GAS, and surely no better indications of oil could be found in an oil well in the whole world.

Although many of doubtless know the value of gas in a bore hole, as an almost invariable indication of oil, in case there should be doubters amongst you, we give two brief expert opinions, by eminent oil geologists in support of what we think about it, viz.:--

On page 97 of his "PRACTICAL OIL GEOLOGY," Dorsey Hager, an eminent American Geologist, in writing of indications of oil, says: "GAS SHOWS ARE FAVOURABLE SIGNS."

On page 18 of a Booklet issued by the Government of New South Wales, the writer of it, Mr. Leo J. Jones, A.S.T.C., Geological Surveyor, says:--

"It is reasonable to expect to find oil within the lateral range of formation containing the gas."

CIRCULAR.

AN AUSTRALIAN OILFIELD.

The above facts are most interesting, especially when it is remembered that the Bibi-Eibat Oilfiels of Baku, Russia, has geological features corresponding, in a measure to those of Yorke Peninsular, South Australia, where THE ADELAIDE OIL EXPLORATION COMPANY, LIMITED, holds extensive areas. AN OIL FIELD WITH EXCELLENT PROSPECTS HAS ALREADY BEEN FOUND THERE -- ON YORKE PENINSULAR, SOUTH AUSTRALIA. KEEP YOUR EYE ON IT.

N.B. -- While it may be difficult, in the absence of anything of the kind in Australia to fully and effectively picture, to Australians generally, sights, scenes, and masses of wealth such as are above briefly described, it will certainly interest great numbers of them to know that it contains immense tracts of rich oil-bearing lands in the same kind of country that the wells above described are situated in, and where geological features calsely resembling those of the Cerro Azul -- Blue Mountain -- region of Mexico are present -- that is, that the geological features of some of our Australian properties are similar to those of the great oil fields of Mexico. The estimated value of the oil from ONE WELL equal to Cerro Azul, No. 4, would probably return £900 per annum on ONE £10 SHARE in the present Capital of the ADELAIDE OIL EXPLORATION COMPANY, LIMITED.

APPENDIX III *.

DETAILED LITHOLOGICAL LOG.....

RAMSAY OIL BORE (R.I.)

MINLATON OIL BORING SYNDICATE.

Section 112. Hd. of Ramsay

16 to 22ft.	Sandy clay with well rounded clear quartz grains - Proportion of Clay is small -
22 to 27ft.	Sandy clay containing pinkish quartz grains which are well rounded -
27 to 32ft.	Fine grained pinkish quartz sand
32 to 35ft.	Fine grained siliceous sand

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35 to 50ft.	Slightly weathered dark grey limestone with a small portion of rounded quartz grains and clay
50 to 60ft.	Dark grey unweathered limestone
60 to 77ft.	Dark grey limestone with certain amount of clay
77 to 90ft.	Dark grey limestone with small proportion of clay
90 to 100ft.	Dark grey argillaceous limestone together a few founded grains of quartz
100 to 110ft.	Same
110 to 120ft.	Sand containing small rounded grains with larger quartz pebbles and also fragments of limestone. The small rounded grains consist of quartz. Quartzite and felspar.
120 to 130ft.	Grey limestone with a few rounded grains of quartz
130 to 140ft.	Grey limestone with a large proportion grains of clear quartz
155 to 160ft.	Light and dark grey limestone
160 to 165ft.	" " " " "
165 to 168ft.	Light grey limestone
168 to 174ft.	Dark grey limestone with angular grains of quartz
174 to 180ft.	Same
180 to 183ft.	"
183 to 205ft.	"
205 to 212ft.	"
212 to 214ft.	Similar limestone as above but no quartz grains. Fragments of quartz probably reached the bottom of the hole from sediments overlaying the limestone and extending from the surface to a depth of 35ft.
214 to 219ft.	Dark grey limestone.
219 to 224ft.	Light grey weathered limestone
224 to 230ft.	Same
230 to 235ft.	Light grey weathered limestone with remains of Archaeocyathinae
235 to 243ft.	Cream calcareous clay with small fragments of limestone

243 to 250ft.	Dark grey limestone with a fair proportion of angular grains of quartz The borehole has apparently passed through an ancient sinkhole.
250 to 253ft.	Light grey limestone
253 to 264ft.	Ferruginous clay with fragments of reddish grey and white (Chalky) limestone
264 to 265ft.	Light grey limestone.
265 to 276ft.	Same
276 to 287ft.	An incoherent cream coloured very fine grained siliceous grit with bands of fine-grained quartzitic phyllite which contains occassional small flakes of mica
287 to 288ft.	Fine aggregate of well rounded ferruginous and all siliceous sands with larger fragments of white chalky limestone, green micaceous schist, and grey limestone
288 to 292ft.	Ferruginous sand with fragments of Chalky limestone. Sandstone and Limestone.
292 to 296ft.	Light brown weathered limestone
296 to 298ft.	Ferruginous sand and small fragments brown limestone
298 to 302ft.	Bluish-grey argillaceous mica schist
302 to 316ft.	Same
316 to 236ft.	Slightly calcareous bluish grey phyllite
326 to 330ft.	Same
340 ft.	"
340 to 350ft.	"
350 to 357ft.	Slightly calcareous bluish grey phyllite
357 to 357ft.	Same
357 to 360ft.	Same
360 to 365ft.	Light grey limestone
365 to 370ft.	Fragments of semi-decomposed and iron-stained sandstone, also of bluish grey phyllite
370 to 371ft.	Light grey limestone (1st gas noticed and taken)
371 to 372ft.	Fine grained quartzite
372 to 375ft.	Purple siliceous slate
375 to 384ft.	Purple siliceous slates
384 to 447ft.	Upper pre-Cambrian limestone with some phyllite calcareous and siliceous slate
447 to 452ft.	Purple calcareous slate

452 to 458ft.	Purple calcareous slate and white limestone
458 to 463ft.	" " "
463 to 470ft.	All the same Purple
470 to 479ft.	Calcareous slate
479 to 484ft.	Same
484 to 488ft.	Purple calcareous slate and white limestone
488 to 492ft.	Same
492 to 496ft.	"
496 to 500ft.	"
500 to 504ft.	Purple calcareous slate
504 to 510ft.	Same
510 to 513ft.	Purple calcareous slate and white limestone
513 to 515ft.	Purple calcareous slate
515 to 517ft.	Purple calcareous slate and white limestone
517 to 522ft.	Purple calcareous slate
522 to 529ft.	Purple and Blue green calcareous slate
529 to 532ft.	" " " " " and white limestone quartz
532 to 534ft.	Light grey and cream coloured limestone with few grains
534 to 538ft.	White limestone
538 to 540ft.	White fine grained chalky limestone
540 to 542ft.	White light brown and pale green limestone
542 to 548ft.	Cream coloured light brown and pale green limestone with a few specks of pyrite
548 to 553ft.	White crystalline limestone (marble)
553 to 560ft.	Same
560 to 564ft.	"
564 to 576ft.	Pink crystalline limestone with large proportion of fine rounded quartz grains
576 to 580ft.	Pink and dark grey crystalline limestone small proportion of sand grains
580 to 585ft.	Pink and grey crystalline limestone with fair proportion of rounded grains of quartz
585 to 590ft.	Pink and grey crystalline limestone with fair proportion of rounded grains of quartz
590 to 598ft.	Light and dark grey crystalline limestone
598 to 605ft.	Same
605 to 610ft.	"

610 to 615ft.	White crystalline limestone
615 to 618ft.	Fine textured white crystalline limestone
618 to 624ft.	" " pinkish white and grey black crystalline limestone
624 to 645ft.	Similar
645 to 650ft.	White and reddish - brown crystalline limestone
650 to 658ft.	Coarse textured light grey and pinkish crystalline limestone
658 to 666ft.	Pink and light grey crystalline limestone
666 to 670ft.	Similar
670 to 678ft.	Pink-white and light grey crystalline limestone
678 to 683ft.	Similar
683 to 688ft.	"
688 to 692ft.	"
692 to 700ft.	"
700 to 708ft.	"
708 to 715ft.	"
715 to 720ft.	Pink, white and light grey crystalline limestone Ferruginous in part
720to 725ft.	Similar
725 to 730ft.	Pink, grey and white crystalline limestone
730 to 735ft.	Same
735 to 740ft.	Reddish brown and grey crystalline limestone
740 to 745ft.	Similar
745 to 754ft.	Pink-white and grey crystalline limestong. Ferruginous in part
754 to 765ft.	Reddish brown, light green and grey crystalline limestone with small ferruginous inclusions
765 to 770ft.	Green grey and white crystalline limestone with inclusions
770 to 775ft.	Dark grey crystalline limestone
775 to 780ft.	Same
780 to 785ft.	Grey crystalline limestone
785 to 790ft.	Same
790 to 795ft.	"
795 to 800ft.	Dark grey crystalline limestone
800 to 807ft.	Similar
807 to 815ft.	Light grey crystalline limestone
815 to 825ft.	" " " "
825 to 840ft.	Similar

840 to 855ft.	Similar
855 to 876ft.	Light grey limestone.
876 to 890ft.	Light grey crystalline limestone
890 to 920ft.	Light grey limestone
920 to 921ft.	Dark grey limestone
921 to 930ft.	Light " "
930 to 950ft.	Dark grey limestone
950 to 955ft.	Cream coloured limestone
955 to 960ft.	Similar
960 to 986ft.	"
986 to 1000ft.	Light grey limestone
1000 to 1020ft.	Similar " "
1020 to 1035ft.	Similar
1035 to 1065ft.	"
1065 to 1080ft.	"
1080 to 1100ft.	Dark grey limestone
1100 to 1120ft.	Similar
1120 to 1130ft.	"
1130 to 1145ft.	"
1145 to 1150ft.	Cream coloured chalky limestone
1150 to 1165ft.	Light grey limestone
1165 to 1180ft.	" " "
1180 to 1187ft.	Light and dark grey limestone
1187 to 1190ft.	" grey limestone
1190 to 1200ft.	Similar
1200 to 1210ft.	Dark grey limestone
1210 to 1220 ft.	" " "
1220 to 1235ft.	Light grey limestone
1235 to 1250ft.	" " "
1250 to 1260ft.	" " "
1260 to 1270ft.	" " "
1270ft. to 1310ft.	" " "
1310 to 1320ft.	" " "
1320 to 1330ft.	" " "
1330 to 1370ft.	" " "

1370 to 1380ft.	Light grey limestone
1380 to 1400ft.	Light and dark grey limestones with crystal and frogments of calcite copper pyrites
1400 to 1410ft.	Light grey limestone
1410 to 1420ft.	Same
1420 to 1430ft.	Light grey limestone
1430 to 1440ft.	" " "
1440 to 1480ft.	No Samples
1480 to 1490ft.	Light grey limestone
1490 to 1500ft.	" " "
1500 to 1510ft.	" " "
1510 to 1520ft.	" " "

Log by L.K. Ward, 1931.

Bore Started