COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Petroleum Search Subsidy Acts

PUBLICATION No. 18

Port Campbell No. 1 and No. 2 Wells

Victoria

OF

FROME-BROKEN HILL COMPANY PROPRIETARY LIMITED

Issued under the Authority of the Hon. David Fairbairn
Minister for National Development
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MINISTER: THE HON. DAVID FAIRBAIRN, D.F.C., M.P.

SECRETARY: SIR HAROLD RAGGATT, C.B.E.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

DIRECTOR: J. M. RAYNER

THIS REPORT WAS PREPARED FOR PUBLICATION IN THE PETROLEUM EXPLORATION BRANCH

ASSISTANT DIRECTOR: M. A. CONDON

Published by the Bureau of Mineral Resources, Geology and Geophysics

Canberra A.C.T.

FOREWORD

In 1959 the Commonwealth Government enacted the Petroleum Search Subsidy Act 1959. This Act enables companies that drill for new stratigraphic information, or carry out geophysical or bore-hole surveys in search of petroleum, to be subsidized for the cost of the operation, provided the operation is approved by the Minister for National Development.

The Bureau of Mineral Resources, Geology and Geophysics is required, on behalf of the Department of National Development, to examine the applications, maintain surveillance of the operations, and in due course publish the results.

Port Campbell No. 1 and No. 2 Wells were drilled in Petroleum Exploration Permit No. 6, south-west Victoria. The No. 1 well was located at latitude 38° 34'57" S., longitude 142° 57'50" E., and Port Campbell No. 2 was sited about 1 3/4 miles south-east of No. 1. The wells were drilled for Frome-Broken Hill Company Proprietary Limited by Oil Drilling and Exploration Limited of Sydney, New South Wales.

This Publication deals with the results of these drilling operations and contains information furnished by Frome-Broken Hill Company Proprietary Limited and edited in the Geological Branch of the Bureau of Mineral Resources. The final report on Port Campbell No. 1 was written by J.S. Bain and A.F. McQueen, and the report on No. 2 Well by R.L. Wood and J.S. Bain, of Frome-Broken Hill Company Proprietary Limited. The methods employed in the drilling operations and the results obtained are presented in detail.

J.M. RAYNER
DIRECTOR

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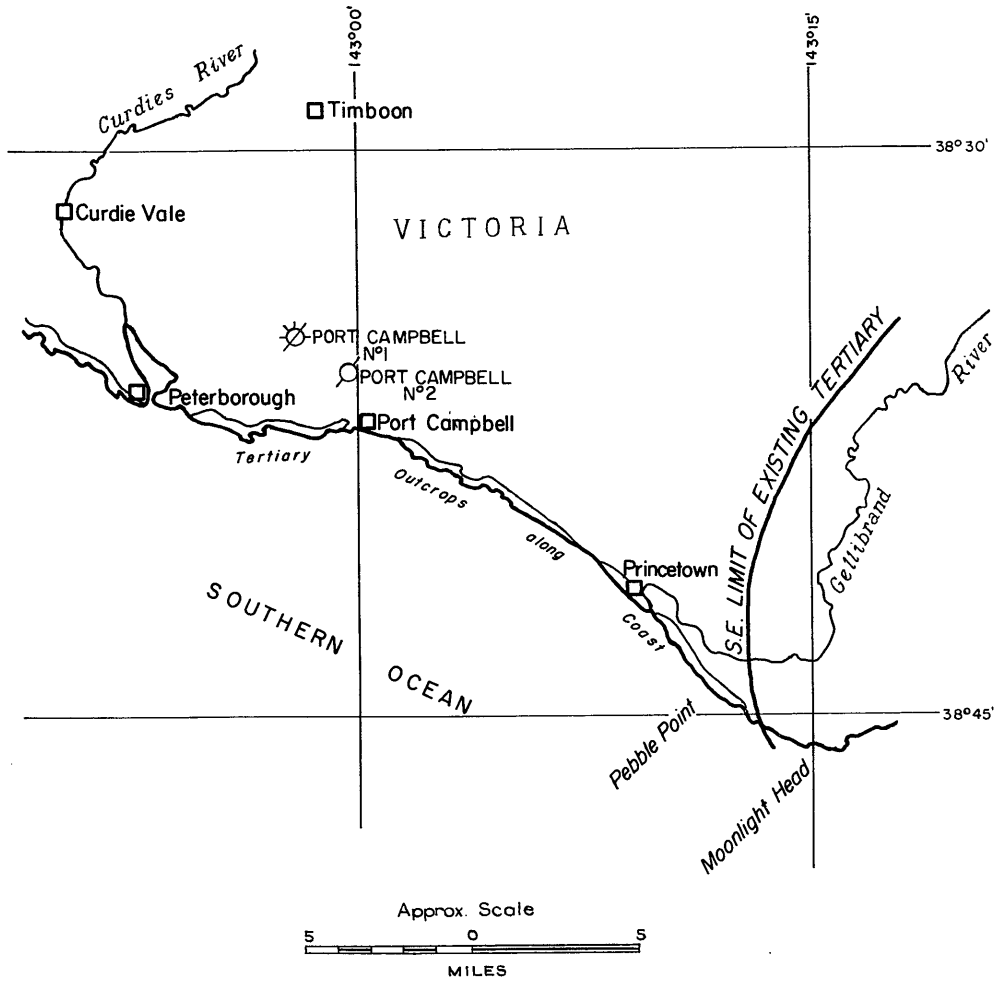

FROME-BROKEN HILL CO. PTY. LTD.

WELL COMPLETION REPORT
PORT CAMPBELL Nº1 & Nº2

By R.L. Wood, J.S. Bain and A.F. Mc Queen

March 1961

V.P. 23 for note re subsidy

SUMMARY

This publication combines the completion reports of two wells drilled at Port Campbell in the Otway Basin, Victoria, by Frome-Broken Hill Company Proprietary Limited in 1959 and 1960. Port Campbell No. 1 was located near the crest of a seismic "high". The seismic reflection survey showed that there was an increase in thickness of section down dip to the south-east; Port Campbell No. 2 Well was sited about 1-3/4 miles south-east of Port Campbell No. 1.

Port Campbell No. 1 Well was spudded in on 9th September, 1959, and reached a total depth of 5965 feet in paralic sediments of Lower Cretaceous age on 9th December, 1959. Miocene and Oligocene marl and calcareous clay were penetrated to 1375 feet, then more than 3000 feet of Lower Tertiary, Eocene and (?)Palaeocene, and 1000 feet of Cretaceous sediments.

The only break evident in the succession in Port Campbell No. 1 was at 5656 feet where a lithological change was noted together with a conspicuous break on the electric log. At this depth the well intersected a porous horizon which produced a flow of petroliferous gas.

Drilling commenced at Port Campbell No. 2 on 12th July, 1960, and was completed on 1st December, 1960, at 8846 feet in sediments of the Otway Group. 1214 feet of Upper Tertiary (Miocene and Oligocene) and approximately 3800 feet of Lower Tertiary (Eocene and Palaeocene) sediments were intersected. Time boundaries are still indefinite but at least 2700 feet of Cretaceous sediments are thought to be present in the well.

Two unconformities were deduced: the upper at 7910 feet, between the Waarre Formation and the Belfast Mudstone, corresponds to the break at 5656 feet in Port Campbell No. 1, but represents a hiatus smaller than that in the earlier well as an extra 770 feet (approximately) of basal Belfast Mudstone and topmost Waarre Formation are present in Port Campbell No. 2.* The lower unconformity separates the Waarre Formation and the Otway Group on a horizon lower than was reached in Port Campbell No. 1, but it was not well defined by the information derived from the one hole.

The petroliferous gas, and a small amount of condensate, produced in Port Campbell No. 1 was a strong but not commercial flow and came from a coarse quartz sandstone between 5656 and 5668 feet. On test, flow rate and pressure decreased rather rapidly and recovery, on standing, was practically imperceptible, indicating that the reservoir is small and not connected with any larger reservoir.

Port Campbell No. 2 did not show any evidence of free gas or oil. The gas obtained from testing was only minor and derived from solution in formation water.

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* Including 200 feet of subsequently recognized and defined Flaxmans Beds.

INTRODUCTION

Port Campbell No. 1 was the first petroleum test well to be drilled in the south-eastern part of the Otway Basin. Indications that facies favourable as a source of oil might exist in the area had been provided by a water bore drilled at Port Fairy. The location of the well was on a seismic "high", a fold with reasonably good east-west relief and good southern closure, which appeared from seismic results to be closed to the north against a fault.

Port Campbell No. 2 was drilled down dip from Port Campbell No. 1 to test a thicker section shown by seismic surveys. It was apparent that there was a marked increase in thickness of sediments down to the top of the Otway Group and more detailed surveys carried out after the completion of the first well also showed that a fault ran between Port Campbell No. 1 and the site chosen for Port Campbell No. 2. This second well was located on the down-thrown side and prospects largely depended on closure or pinchout of the extra sections against the fault.

The reports which follow are arranged in chronological order; important changes resulting from progressive work have been mentioned in footnotes as far as is practicable. Appendix 1 has been incorporated to define new formation names and includes information obtained from subsequent wells; for example, the Flaxmans Beds were not penetrated in Port Campbell No. 1 and were not recognized in Port Campbell No. 2 at the time of drilling. It was not until after the completion of Flaxmans No. 1 Well in 1961 that the unit was recognized as such and named; consequently there is no reference to the Flaxmans Beds in the text of this report. However, footnotes indicate the correct position of the beds on all relevant pages of this publication.

It has not been possible to publish the full background of palaeontological work on these two wells, but comprehensive references to work which has been omitted (or to more up to date work that has replaced it), and which is published elsewhere, have been given.

WELL HISTORY

PORT CAMPBELL NO. 1

General Data

Well name and number:	Port Campbell No. 1
Location:	Latitude 38° 34' 57" S. Longitude 142° 57' 50" E.
Map Reference:	Colac 4-mile Sheet
Name and address of Tenement Holder:	Frome-Broken Hill Company Proprietary Limited, 95 Collins Street, Melbourne, Victoria
Details of Petroleum Tenement:	Petroleum Exploration Permit No. 6, issued by the State of Victoria

District:	South-west Victoria
Total Depth:	5965 feet
Date drilling commenced:	9th September, 1959
Date drilling completed:	9th December, 1959
Date well suspended:	9th February, 1960
Date rig released:	15th February, 1960
Drilling time in days to Total Depth:	92
Elevation (Ground):	337 feet
Elevation (Rotary table):	346.6 feet (datum for depths)
Status:	Shut-in. Casing left full of mud and a plate welded on a blind flange of the top spool, within which the 5-1/2" casing is landed, was inscribed with the well name.

Drilling Data

Name and address of drilling contractor:	Oil Drilling and Exploration Limited, 93 York Street, Sydney, N.S.W.
Drilling Plant:	
Make:	Brewster
Type:	N4
Rated capacity with 4 1/2" drill pipe:	5500 feet
Rated capacity with 3 1/2" drill pipe:	6700 feet
Motor (1):	
Make:	G.M.
Type:	Model 12107 Series 71
B.H.P.:	302
Mast:	
Make:	Lee C. Moore
Type:	126' Cantilever
Rated capacity:	325,000 lb.
Pumps:	
Make:	Oilwell
Type:	214P
Size:	7 1/4" x 14"
Motors:	G.M. Model 12107 Series 71, 302 B.H.P.

Blowout Preventer equipment:		
Make:	Cameron (2)	Cameron
Size:	12"	6"
Series (A.P.I.):	900	900

Hole sizes and depths:

17 1/2" hole to 293 feet.
Drilled 12 1/4" hole to 293 feet;
Reamed with hole opener to 17 1/2" to 293 feet;
Set 13 3/8" surface casing at 291 feet.

12 1/4" hole to 3340 feet.
Drilled 8 3/4" hole to 3340 feet;
Reamed with hole opener to 12 1/4" to 3340 feet;
Set 9 5/8" intermediate casing at 3322 feet.

8 3/4" hole to 5965 feet.

Casing and Liner details:

Size:	13 3/8"
Weight:	48 lb./ft
Grade:	H.40
Range:	2
Setting Depth:	291 feet
Size:	9 5/8"
Weight:	36 lb./ft
Grade:	J.55
Range:	2
Setting Depth:	3322 feet
Size:	5 1/2"
Weight:	613 feet of 20lb./ft; 488 feet of 15.5lb./ft; 4861 feet of 14lb./ft.
Grade:	N.80, J.55, and J.55 respectively
Range:	2
Setting Depth:	5962 feet

Casing and Liner cementing details:

Size:	13 3/8"
Setting Depth:	291 feet
Quantity cement used:	210 sacks
Cemented to:	Surface
Method used:	Circulated to surface using rig pumps.
Size:	9 5/8"
Setting Depth:	3322 feet
Quantity cement used:	1022 sacks
Cemented to:	Surface
Method used:	Circulated to surface using rig pumps. Three centralizers run.

Size:	5 1/2"
Setting Depth:	5962 feet
Quantity cement used:	-
Cemented to:	5575 feet. Later squeezed at 5400, 4950, 4750, 4600, 4150 feet and circulated 3550 to 3000 feet approximately.
Method used:	Abortive circulation attempt by rig pumps. Later squeezed and circulated by HOWCO T.10 pump. Three centralizers run.

Drilling Fluid:

The drilling fluid used was a bentonite-water base, with myrtan and caustic soda added to reduce viscosity, and barytes to increase the weight of the mud. Mud characteristics varied greatly during the drilling of the well. In the earlier stages, while in the marl facies, viscosity reached as high as 150 secs; later, when drilling in the water sands, sand content reached 18% due to ineffectiveness of settling.

To 1500 feet, weight varied from 68 to 76 lb./cu.ft, viscosity 33 to 150 secs, water loss 16 to 22 cc, and wall cake 4/32".

To 3000 feet, viscosity was controlled with myrtan and caustic soda although, as mentioned above, the sand content increased. In general, mud was heavier at 72 to 88 lb./cu.ft, viscosity ranged from 36 to 63 secs, water loss was lower at 6 to 16 cc, and the filter cake was thinner at 2/32" to 3/32".

To 5000 feet, mud was usually about 75 to 81 lb./cu.ft weight, 40 to 80 secs viscosity, 8 to 11 cc water loss, and 3/32" wall cake thickness.

From 5000 feet to T.D., characteristics were better- a fairly steady weight of 76 to 80 lb./cu.ft, viscosity less than 70 secs, water loss less than 10 cc, and wall cake was maintained at 2/32". Sand content was less than 3%.

Sodium bicarbonate was used to treat cement contaminated mud, and rice husks were used in lost circulation zones. C.M.C. was used in the later stages of the hole to decrease water loss.

Water Supply:

During the initial stages of the well, water was pumped to the rig from a small water hole about 3/4 mile away. However, this supply was exhausted about midway through the drilling, necessitating the carting of water by truck from Port Campbell and one other creek source.

Chloride content of this water was approximately 280 ppm.

Perforation and Shooting Record:

Casing Perforation:

For cementing purposes:

5674-5676 feet
5632-5634 feet
5400 feet
4950 feet
4750 feet
4600 feet
4440-4442 feet
4150 feet
3550 feet

For testing:

(i) 5908-5920 feet
5924-5928 feet
(ii) 5756-5766 feet
(iii) 5695-5701 feet
(iv) 5656-5666 feet
and later 5657-5663 feet
(v) 4815-4820 feet
4830-4840 feet
(vi) 4695-4702 feet
(vii) 4498-4515 feet
(viii) 4463-4475 feet

Perforations were made with Lane Wells 4" gun with 24-shot capacity. Length of gun was 10'6" and size of bullet 15/32". Perforation density was four shots per foot, and, as the spacing of shots on the gun was not at this interval, moving of the gun between shots was necessary.

No open hole shooting was undertaken.

Plugging Back and Squeeze Cementation Jobs:

At T.D. 5965 feet:

Squeeze cementing of 5 1/2" casing:

Attempts were made to break circulation behind the 5 1/2" casing at various depths so as to circulate cement.

When circulation was not achieved the perforations were squeezed off. Perforations were made and cemented as follows :

(i) 5400 feet, 15-sack squeeze, final squeeze pressure 4000 p.s.i., held 3000 p.s.i.
(ii) 4950 feet, 15-sack squeeze, final squeeze pressure 3000 p.s.i., held 2000 p.s.i.
(iii) 4750 feet, 15 sack squeeze, final squeeze pressure 3200 p.s.i., held 2000 p.s.i.

(iv) 4600 feet, 15-sack squeeze, final squeeze pressure 4000 p.s.i., held 2400 p.s.i.

(v) 4150 feet, 15-sack squeeze, final squeeze pressure 3000 p.s.i., held 1800 p.s.i.

(vi) 3550 feet, circulated 140 sacks, and 500 p.s.i. pressure left on cement.

In all cases except (vi) pressure was left on the squeeze job for periods of 2 to 12 hours before reverse circulating and coming out of the hole. There was never more than about one barrel of cement circulated out of the hole.

These squeeze jobs were tested on drilling out with 1200 to 1500 p.s.i. pump pressure and found satisfactory at the time. After and during testing:

(i) Set 15-sack plug up from 5930 feet. Top of plug was not felt for.

(ii) Squeezed 15 sacks over 5756-5766 feet at 2000 p.s.i. Tested squeeze with 1500 p.s.i. and was found to be unsatisfactory. Squeezed further 10 sacks at 2600 to 1200 p.s.i. and pressure held for half an hour. Reverse circulated slight cement returns.

(iii) Squeezed 20 sacks over 5695-5701 feet at final squeeze pressure of 2600 p.s.i. Held 2100 p.s.i. for half an hour. Reverse circulated slight cement returns.

(iv) Squeezed 25 sacks over 5656-5666 feet with final squeeze pressure of 2200 p.s.i. Held 1200 p.s.i. dropping to 700 p.s.i. for one hour. Reverse circulated approximately 1 1/2 bbl. cement. Drilled out to 5690 feet, applied pressure to 900 p.s.i. and cement job held satisfactorily.

(v) Squeezed 17 sacks over 5674-5676 feet with final squeeze pressure 2000 p.s.i. Held 1400 p.s.i. for one hour. Reverse circulated slight cement returns.

(vi) Squeezed 15 sacks over 5632-5634 feet, but tubing found to be cemented up after pull out.

(vii) Found leak at 3550 feet at this time, and squeezed 7 sacks with final pressure 2000 p.s.i. Held 1000 p.s.i. pressure for 15 minutes. Reverse circulated, no cement returns. Tested squeeze at 1300 p.s.i. and it held satisfactorily.

(viii) Squeezed further 15 sacks over 5632-5634 feet with 1820 p.s.i. final squeeze pressure and held 1500 p.s.i. pressure. This was then drilled out and retested and found satisfactory.

(ix) Set cement retainer at 5670 feet prior to squeezing below again. However, it was not necessary to run cement to squeeze, as no mud loss or pressure drop was noted in casing below this depth.

(x) Set cement retainer at 5644 feet.

(xi) Set cement retainer at 4810 feet. Squeezed 15 sacks through retainer over 4815-4820 feet and 4830-4840 feet. Held 2200 p.s.i. pressure and circulated slight cement returns.

(xii) Set cement retainer at 4690 feet. Squeezed 15 sacks through retainer over 4696-4702 feet. Held 2000 p.s.i. pressure.

(xiii) Squeezed (bradenhead) 15 sacks over 4440-4442 feet. Final squeeze pressure 2600 p.s.i. Circulated slight cement returns.

(xiv) Set cement retainer at 4485 feet. Squeezed 20 sacks. About one bbl. cement circulated up after cement job.

(xv) Squeezed (bradenhead) 20 sacks over 4463-4475 feet with 2000 p.s.i. pressure. No cement returns on circulation.

Fishing Operations:

At total depth 3738 feet:

On tour change string was pulled off bottom but not rotated and it was found to be stuck when an attempt was made to drill ahead. Backed off above the casing shoe (with aid of string shot) and ran jars without success. Attempted to blow off the bit with 3 1/2 lb. charge detonated above the bit and jarred again without success. Up to this point normal circulation had been maintained at all times, but it ceased after this shot. Backed off above safety joint (overshot not able to go over safety joint) and washed over to top of drill collars. Could not go any farther due to length of washover shoe. A smaller washover shoe was fitted and fish was washed over to full length of washover pipe (283 feet) - approximately 67 feet below the top of the drill collars. Made up and jarred again unsuccessfully, although circulation was restored. Backed off again at drill pipe-drill collar tool joint on third attempt, with the aid of a string shot, and washed over to bit. Ran in with Bowen overshot to pick up fish but grapples slipped on drill collars. Pulled out and found grapples left on fish. Made up again with jars and after short time jarred the fish free. Recovered bit and most of the grapples. Ran Bowen junk basket twice recovering nothing first time and two feet of core and few more bits of grapple the second time. Fish completely recovered.

Total Depth 5965 feet:

While applying pressure to perforations below cement retainer set at 5670 feet the string parted above a weld of a field-made sub from 2 7/8" drill pipe to 2" tubing. Top of fish was 26.75 feet below rotary table. Ran cut-down tapered tap and recovered fish.

Side-tracked Hole:

None.

Logging and Testing

Ditch Cuttings:

Cuttings were taken over a normal shale shaker. Interval sampled was every five feet to 293 feet, every ten feet to 5718 feet, and every five feet to 5965 feet.

Coring:

Original programme outlined cores to be taken at lithological change, significant drilling break, distinctly porous bed, sudden increase in chloride

content as well as all oil and gas shows. In addition, routine stratigraphic cores were to be taken at a maximum interval of 500 feet as required by the Commonwealth Subsidy Agreement. No deviation occurred from the original programme laid down.

Twenty-four cores were cut for a total footage of 296 feet. 165 feet 6 inches were recovered for a total recovery of 56 percent.

Coring equipment used was a conventional Hughes "J" Type core barrel with 8 3/4" Hughes soft and hard formation core heads. Diameter of core recovered was 3 1/2". See Appendix 2 for detailed core descriptions.

Sidewall Sampling:

Sidewall cores were taken at three depths for the following recoveries:

No. 1 -	5400 feet -	Recovered 3 1/2" black, glauconitic, sandy mudstone.
No. 2 -	4700 feet -	Recovered 1" of very fine, clear, loose sand.
No. 3 -	4450 feet -	Recovered 4 1/2" of grey, sandy siltstone.

Tool used was a Howco mechanical sidewall corer with varying length core barrels. Diameter of core was one inch.

Electrical and other logging:

Electric logging was carried out by Oil Drilling and Exploration Limited before the intermediate casing string was run and at three other times during the drilling of the hole. The well was logged to 5934 feet. In the bottom part of the hole, from 4500 to 5934 feet, the logs were run on a scale of 1 inch = 20 feet as well as the normal 1 inch = 50 feet, which was the scale for the other logs. A composite electric log reduced to a scale of 1 inch = 100 feet for comparison with the lithologic log, is available for reference at the Bureau of Mineral Resources, Canberra. Resistivities marked in ohms on the composite log are measured in ohm-metres.

Drilling Time Log:

Time taken, up to one hour, for each ten-foot interval drilled is recorded on the lithologic log. For drilling times of more than one hour, the time is printed in. Coring times are not recorded.

Formation Testing:

For details see Composite Well Log and Appendix 5.

Drill Stem Test No. 1 was carried out in the open hole covering interval 5653-5718 feet using a Johnston open hole packer and test tool assembly. This revealed the presence of petroliferous gas which was later fully tested in Production Test No. 1.

The remainder of the tests, except Production Test No. 1 (a), were carried out through perforations in the 5 1/2" casing using a 5 1/2" Johnston hookwall packer and test tool assembly with pressure bomb. Production Test No. 1 (a) was carried out by landing open ended tubing in the well head and swabbing the tubing until the well came in.

Intervals tested through casing and brief results are as follows :

D.S.T. No. 2. 5908-5920 and 5924-5928 feet - recovered gas-cut salt water.

D.S.T. No. 3. 5756-5766 feet - recovered gas-cut salt water.

D.S.T. No. 4. 5695-5701 feet - recovered gas-cut salt water.

Production Test No. 1.

(a) 5656-5666 feet - recovered petroliferous gas with some condensate and salt water.

(b) 5657-5663 feet - as for (a)

D.S.T. No. 5. 4815-4820 feet and 4830-4840 feet - recovered gas-cut salt water.

D.S.T. No. 6. 4696-4702 feet - recovered gas-cut water.

D.S.T. No. 7. 4498-4515 feet - recovered gas-cut water with considerable clear, fine to medium-grained sand.

D.S.T. No. 8. 4463-4475 feet - recovered gas-cut water with considerable very fine-grained, clear sand.

Deviation Surveys:

Deviation surveys were conducted using the Totco instrument dropped through the drill string. The hole was almost vertical, maximum deviation being 1° at 4170 and 4750 feet. Totco deviations are listed below:

Depth (feet)	Deviation from Vertical (degrees)	
269	1	
500	1/2)	These readings made on
1000	1/2)	Halliburton wire line
1500	1/2)	
1969	0	
2450	0	
3300	0	
3340	1/2	
4170	1	
4360	3/4	
4750	1	
4950	3/4	
5185	3/4	
5550	1/4	
5920	0	

Temperature Survey:

A temperature survey was run on 17th December, 1959, in an attempt to find the height of the cement behind the casing. This was determined at 5575 feet. Bottom hole temperature at 5942 feet was shown as 180° F.

Other well surveys:

None.

GEOLOGY

PORT CAMPBELL NO. 1

Summary of Previous Work

Geological:

Previous geological work in the eastern part of the Otway Basin was carried out by G. Baker (1950, 1953), Reeves and Evans (1949), and J.S. Bain (1958). D.J. Belcher and Associates made a photo-geological interpretation of the area and G.E. Wulff (1958) examined Mesozoic rocks in the Cape Otway area to check structures indicated by this study. Wulff also examined isolated exposures of Tertiary rocks extending westward from Colac, but no deductions about structure could be made as a result of this work.

Sea-cliff sections provide the most useful exposures in the area, as the land surface is mostly covered by recent deposits and basalt. This widespread masking of the Tertiary sediments makes both regional and detailed geological studies difficult.

Baker, on lithological and palaeontological evidence, has divided the Tertiary sequence exposed in cliff sections east of Port Campbell into groups and formations and has measured their thicknesses. Reeves and Evans also measured some of the sections but obtained thicknesses different from those obtained by Baker.

In the younger sediments exposed along the cliffs east and west of Port Campbell, Bain noted gentle folding which was later confirmed by seismic work. Before drilling, it was estimated that the Port Campbell well would intersect about 1500 feet of marls and clays equivalent to the Tertiary Gambier Formation, and 3000+ feet of sands and sandstone equivalent to the Lower Tertiary-Upper Cretaceous Knight Group; both units had been intersected by bores in the western part of the basin. Below the sands and sandstones it was expected that extensions of the Jurassic rocks of the Cape Otway area would be found. One interpretation of the seismic results suggested the presence of an unidentified section between the Tertiary and the Jurassic at Port Campbell, in the place of the small angular unconformity that separates these sequences in the Otway area.

Geophysical:

A seismic reflection survey over part of the eastern margin of the basin was carried out for Frome-Broken Hill Company Pty Ltd during early 1959. This revealed

several reflecting horizons which could be traced over much of the area and which indicated folding and faulting in the sediments. Although this seismic survey was not a detailed one, it indicated the presence of the Port Campbell fold which appeared to be a faulted anticline with north-south trending axis along which were three minor closed structures.

The most southerly of these was selected for the test well and seismic results showed it to have good east-west relief and south closure, and closure to the north against a fault.

Drilling:

Before the drilling of Port Campbell No. 1, no deep drilling had been done in the Port Campbell area. At Timboon, 6-1/2 miles to the north, the Department of Mines of Victoria had drilled a water well to a depth of 2695 feet, and then started another well while drilling was in progress at Port Campbell. Rocks to a depth of 850 feet in the Timboon bore could be correlated with rock units cropping out along the coast; below this depth correlations could not be made with any certainty, but the hole is thought to have stopped in Tertiary rocks. The coarse sand and ligneous clays below 850 feet were believed to be equivalents of the Eocene Knight Group which was intersected in the Portland and Nelson bores in the western part of the basin.

At Port Fairy, 44 miles west along the coast from Port Campbell, a Department of Mines water bore, after penetrating the known arenaceous Lower Tertiary section, intersected 435 feet of black, carbonaceous and micaceous siltstone which was identified as Cretaceous and probably Lower Cretaceous. The distance between Port Campbell and Port Fairy was too great for any confident prediction that this Cretaceous unit might exist at Port Campbell, but the possibility enhanced the prospects of this part of the Otway Basin.

Stratigraphy

The section penetrated by Port Campbell No. 1 can be divided into five fairly distinct lithological units. The two uppermost units can be correlated satisfactorily with the Tertiary succession observed at outcrop along the Cape Otway-Port Campbell coast and are therefore referred to in this report by their existing stratigraphic names.

The three lowermost units have not been seen at outcrop and, for convenience, have been given local names which are considered to be appropriate. These formation names have been approved by the State Committee on Stratigraphic Nomenclature, (see Appendix 1).

The section is generalized as follows:

Surface to 1375 feet	Heytesbury Group (Miocene-Oligocene) Dominantly clayey marl with hard limestone bands becoming more sandy towards the base.
1375 to 4245 feet	Wangerrip Group (Eocene) Dominantly sandstone and siltstone with conglomerate, limestone, dolomite and lignite in places.
4245 to 4930 feet	Paaratte Formation (Eocene-Upper Cretaceous) Transition zone consisting of sandstone, siltstone, mudstone and dolomite.

4930 to 5656 feet	Belfast Mudstone (Upper Cretaceous) Black, glauconitic mudstone.
5656 to 5965 feet+	Waarre Formation (Lower Cretaceous) Sandstone, siltstone and mudstone with pyrite and coal.

The section cut to 1375 feet is a dominantly calcareous facies of Miocene-Oligocene age (Janjukian) and is correlated with Baker's Heytesbury Group. Very little limestone was present in the uppermost part of the hole and it appears that Baker's Port Campbell Limestone is missing.

Below 1375 feet the section is a dominantly sandy-silty facies of Eocene age (Anglesean). The sediments are equivalent, in part at least, to Baker's Wangerrip Group. The bottom of the Tertiary cannot be determined lithologically and it appears that there may be a transition to the Cretaceous, definite evidence of which was first noted in a core at 4754 feet.

Although there has been some controversy on the subject, the weight of palaeontological opinion favours an Upper rather than a Lower Cretaceous age for the Cretaceous sediments above 5656 feet in the well, and, in agreement with the evidence of the electric and lithological logs, suggests that there was no depositional break between the Cretaceous and the lowermost Tertiary.

The most pronounced lithological break in the well, at 5656 feet [1], was thought at first to represent the base of the Cretaceous; below this, the sediments, although not typical of the outcrop, were tentatively correlated with rocks cropping out in the Otway area, which up to that time had been considered as Jurassic. From recent palaeontological work it now appears that some of the sediments in the Otway area are in fact non-marine Lower Cretaceous; Evans (Appendix 3) has found microplankton in cores below 5656 feet which suggest a Lower Cretaceous age, although a marine environment. However, the correlation stands as, lithologically, the sediments below 5656 feet appear to be predominantly of fresh water origin. The marine faunas indicate that they were laid down at least partly in marine conditions with small lenses of marine rocks, as distinct from the marine Upper Cretaceous mudstones above this depth. In the first core cut below 5656 feet (at 5700 feet) a dip of 10^{o} was recorded, whereas no dips, other than those due to cross-bedding, were recorded above 5656 feet. In the next core (5928-5934 feet) no dips were recorded. Because of the general lack of information about dips in the section cut it is not possible to assess the structural significance of the 10^{o} dip recorded at 5700 feet. Regional dip indicated by seismic surveys is of the order of less than two degrees.

Structure

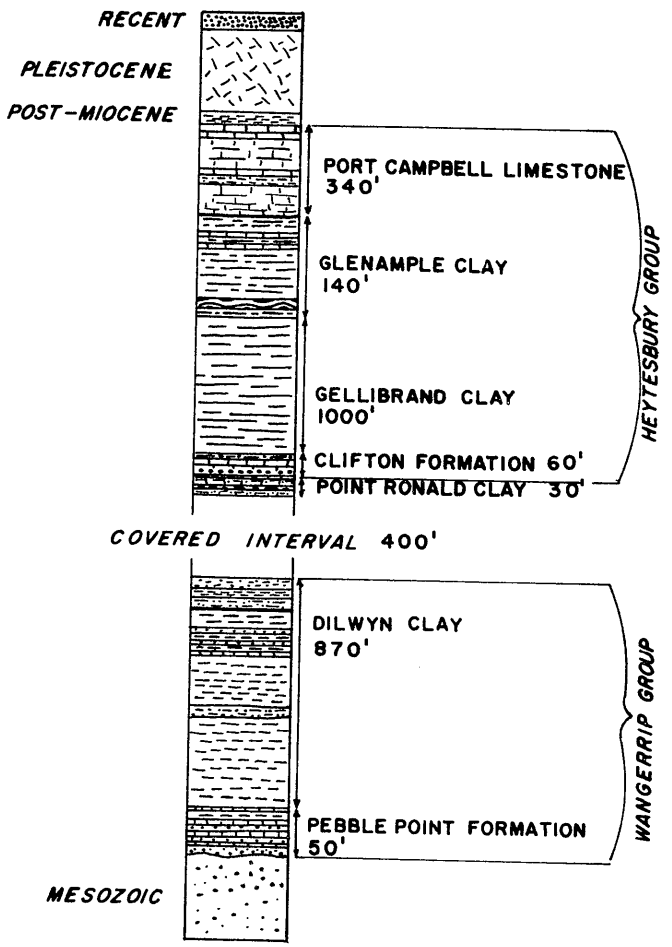
The Port Campbell structure was outlined in a general way by a seismic survey. An anticlinal type fold having a north-south trending arcuate axis exists between Timboon and Port Campbell. Warping and faulting have distorted the fold producing three subsidiary structures separated by east-west trending faults with vertical displacement of between 200 and 500 feet. The most southerly of these three structures is the Port Campbell structure. Seismic contouring indicates closure of about 150 feet at the top of the Cretaceous section,

(1) Footnote by Bureau of Mineral Resources:
The results of Port Campbell No. 2 suggest that this was definitely an unconformity.

Fig. 2

STRATIGRAPHIC COLUMN BEFORE DRILLING

(After Baker, 1953)



Note: Thicknesses are approximate only

WELL COMPLETION REPORT
PORT CAMPBELL NO.1

J.S.BAIN.
MAR. 1960

PE907141

This is an enclosure indicator page.
The enclosure PE907141 is enclosed within the container PE906833 at this location in this document.

The enclosure PE907141 has the following characteristics:

ITEM_BARCODE	= PE907141
CONTAINER_BARCODE	= PE906833
NAME	= Stratigraphic Column (post drill)
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= STRAT_COLUMN
DESCRIPTION	= Stratigraphic Column (post drill), Port Campbell-1
REMARKS	=
DATE_CREATED	= 31/03/60
DATE_RECEIVED	=
W_NO	= W460
WELL_NAME	= PORT CAMPBELL-1
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

PE907140

This is an enclosure indicator page.
The enclosure PE907140 is enclosed within the container PE906833 at this location in this document.

The enclosure PE907140 has the following characteristics:

ITEM_BARCODE	= PE907140
CONTAINER_BARCODE	= PE906833
NAME	= Structure -Top of Jurassic
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= SEISMIC
SUBTYPE	= HRZN_CNTR_MAP
DESCRIPTION	= Seismic Contour Map (Pre-Drill) - Top of Jurassic, Port Campbell-1
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	=
W_NO	= W460
WELL_NAME	= PORT CAMPBELL-1
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

increasing to about 200 feet, one thousand feet deeper. This deeper horizon is probably the gas sand intersected at 5656 feet.

Port Campbell No. 1 Well has not contributed much additional information about the structure of the area. Sediments down to about 3500 feet can be correlated in part with sediments intersected in the Timboon No. 5 bore, and such correlations indicate a regional southerly dip of less than one degree between Timboon and Port Campbell. There is no significant faulting in these upper sediments.

With one exception, cores cut at Port Campbell were either cross-bedded or gave no evidence of dip. At 5705 feet Core No. 23 showed a dip of 10^{o}, and jointing and slickensiding at angles of 51^{o} to 57^{o} to the core axis were noted in some cores cut between 5018 and 5934 feet. These features indicate the possibility that Port Campbell No. 1 approached a fault plane below 5000 feet. Seismic records from adjacent parts of the Port Campbell structure indicate faulting in equivalents of the beds cut at this depth in the Port Campbell well. Regional dips of the order of one or two degrees to the east are also indicated.

Relevance to Occurrence of Petroleum

The Port Campbell No. 1 Well was the first hole in the south coast basin in south-west Victoria to produce a strong flow of petroliferous gas with condensate. All the sands tested produced some gas but, apart from the sandstone at 5656 to 5670 feet, in only minor quantities and apparently dissolved in formation water.

Gas from the sand tested over the interval 5656 to 5666 feet and later 5657 to 5663 feet was accompanied by a small volume of volatile liquid petroleum with specific gravity up to 0.772 at 60^{o}F. Soxhlet extraction tests were carried out on all cores on site (see Appendix 6) and quite a number, even in the marl section, gave a positive cut, but no other indications of oil were noted during drilling of the well.

During the production tests on the gas sand at 5656 to 5666 feet, pressure and rate of flow of gas dropped rapidly and neither showed any significant recovery on shutting the well in. Furthermore, the well started to make salt water in increasing volume as the tests continued. It must be concluded, therefore, that the gas reservoir penetrated by the well is of small dimensions. It is not known, however, whether the sandstone is a relatively small lens or whether it has been truncated by faults which have closed it from communication with some larger reservoir.

Porosity and Permeability of Sediments Penetrated

Porosity and permeability of the sediments cut in the Port Campbell No. 1 Well were estimated in a qualitative way only by the well-site geologist and were described as tight, dense, fairly porous, etc. Measurements of porosity and permeability of selected cores were made by the Bureau of Mineral Resources and these are included in Appendix 2.

Porosity and permeability of the top clayey marl section were very low, as evidenced by the electric log, while the sands and sandstones below this have widely varying porosities.

Below 4250 feet the sands tested in Drill Stem Tests 5, 6, 7 and 8 show good porosity and permeability and some porosity is evident in the cores.

From 4800 to 5656 feet the sediments are all tight mudstones with very little porosity and permeability. At 5656 feet the top of a very porous and permeable sandstone was cut. Below this sandstone the formation was mostly tight.

The usual formulae connecting the recorded self-potential and resistivity with the percentage water saturation of the formation lead to a value of water saturation of approximately 23 percent for the above porous and permeable zone (see Appendix 4).

The maximum water saturation which allows production of oil and gas without water, from a clean sand, is usually quoted as 20 percent. Recovery from this interval was petroliferous gas with some condensate and salt water.

The only other notably permeable zone below 5656 feet depicted by the self-potential log is the interval 5910 to 5919 feet. This zone shows a smaller resistivity, 33 ohm-metres as against 50 ohm-metres, indicating either a higher water saturation or a higher porosity or both. Gas-cut salt water was recovered from this interval.

Contribution to Geological Concepts Resulting from Drilling

Before the drilling of Port Campbell No. 1 there was no subsurface information, other than that from a bore at Timboon, near the eastern end of the Otway Basin. The Mines Department Port Fairy bore, 44 miles along the coast to the west, had shown that marine Cretaceous dark coloured glauconitic mudstones, now known as the Belfast Mudstones, were present in the area, but it was not known whether they would extend to the Port Campbell area. There is no outcrop evidence of these marine Cretaceous rocks anywhere in the basin.

The marls and calcareous clays penetrated down to 1375 feet and the thick underlying sandstones confirmed the already suspected wide distribution of the Tertiary Heytesbury and Wangerrip Groups in this region. The discovery of the black glauconitic mudstones of Cretaceous age in considerable thickness suggests that these sediments also occur over a wide area, though they have been overlapped around the margin of the basin.

The evidence of transition between the Belfast Mudstone and the Wangerrip Group supports the idea of continuous sedimentation in this basin through Cretaceous to Middle Tertiary time. The age of the Otway Group and its relation to the Waarre Formation were not disclosed by Port Campbell No. 1 but Port Campbell No. 2 indicated the existence of an unconformity between these formations.

The Port Campbell No. 1 Well has thus contributed considerably to our knowledge of stratigraphy and geological history of south-west Victoria and the neighbouring part of the Southern Ocean. In the latter respect, especially, a lot remains to be learned, but it would seem that a sedimentary basin of considerable magnitude formed in this region during Upper Mesozoic and Tertiary times. Only the landward margin of this basin is present in Victoria and South Australia where much of the section is non-marine. Marine Cretaceous sediments extend inland quite an appreciable distance in the Port Campbell area but apparently are not present in the Otway region. It is not known yet whether there is any lateral gradation from marine conditions in the Port Campbell area to non-marine in the Otways, but the presence of Lower Tertiary Wangerrip gravels unconformably overlying the Jurassic or Lower Cretaceous sediments on Cape Otway suggests that the earth movements responsible for the Otway uplift took place in late Cretaceous time along with considerable elevation of the northern margin of the basin to expose and subject to erosion a land mass made up largely of quartz sandstone - possibly belonging to the Carbo-Devonian.

WELL HISTORY

PORT CAMPBELL NO. 2

General Data

Well name and number:	Port Campbell No. 2
Location:	Latitude 38° 35' 48" S. Longitude 142° 59' 30" E.
Map Reference:	Colac 4-mile Sheet
Name and address of Tenement Holder:	Frome-Broken Hill Company Proprietary Limited, 95 Collins Street, Melbourne, Victoria
Details of Petroleum Tenement:	Petroleum Exploration Permit No. 6, issued by the State of Victoria
District:	South-west Victoria
Total Depth:	8846 feet
Date drilling commenced:	12th July, 1960
Date drilling completed:	1st December, 1960
Date well suspended:	12th January, 1961
Date rig released:	Rig moved to Port Campbell No. 3 location
Drilling time in days to Total Depth:	143
Elevation (Ground):	266 feet
Elevation (Derrick floor):	281 feet
Elevation (Rotary table):	282 feet (datum for depths)
Elevation (Kelly bushing):	284 feet
Status:	Completed as water bore for State Authorities. 5-1/2" casing recovered to 5650 feet; 9-5/8" casing recovered to 1050 feet. Cement plug at 3050 feet and 9-5/8" casing perforated at 2214-2220 feet and 2810-2816 feet for water production.

Drilling Data

Name and address of drilling contractor:	Oil Drilling and Exploration Limited, 93 York Street, Sydney, N.S.W.
Drilling Plant:	
Make:	National
Type:	55
Rated capacity with 4 1/2" drill pipe:	10,000 feet
Rated capacity with 3 1/2" drill pipe:	14,000 feet
Motors:	
Make:	Caterpillar
Type:	D375
B.H.P:	284
Derrick:	
Make:	Muskogee Standard Derrick
Type:	136' x 30' base
Rated capacity:	800,000 lb.
Pumps:	
Make:	Gardner-Denver
Type:	GR-GXP
Size:	7 3/4" x 16"
Motors:	Caterpillar D375
Blowout Preventer equipment:	
Make:	Cameron (2) QRC
Size:	12"
Series (A.P.I.):	900
Holes sizes and depths:	
Original Hole:	(i) 24" hole to 78 feet 20" conductor pipe set at 78 feet. (ii) 17 1/2" hole to 1182 feet. Drilled 12 1/4" hole to 1176 feet; Reamed with 17 1/2" hole opener to 1182 feet; Set 13 3/8" casing at 1182 feet. (iii) 12 1/4" hole to 5650 feet Drilled 12 1/4" hole to 5650 feet; Set 9 5/8" intermediate string at 5650 feet. (iv) 8 1/2" hole to 8364 feet
Deviated Hole:	(i) 8 3/4" hole from 5650 feet to 8846 feet (T.D.) Set 5 1/2" casing at 8846 feet.

Casing and Liner details:

Size:	13 3/8"
Weight:	48 lb./ft
Grade:	H.40
Range:	2
Setting Depth:	1182 feet
Size:	9 5/8"
Weight:	36 lb./ft
Grade:	J.55
Range:	2
Setting Depth:	5650 feet
Size:	5 1/2"
Weight:	17 lb./ft
Grade:	N.80
Range:	2
Setting Depth:	8846 feet

Casing and Liner cementing details:

Size:	20" conductor
Setting Depth:	78 feet
Quantity cement used:	68 sacks
Cemented to:	Surface
Method used:	Pumped by O.D.E. cementing truck into annulus through 2" line
Size:	13 3/8"
Setting Depth:	1182 feet
Quantity cement used:	778 sacks
Cemented to:	Surface
Method used:	Circulated with plugs by O.D.E. cementing truck
Size:	9 5/8"
Setting Depth:	5650 feet
Quantity cement used:	915 sacks with 112 gallons D4 retarder
Cemented to:	1080 feet with channelling to 1030 feet
Method used:	Circulated with plugs by O.D.E. cementing truck
Size:	5 1/2"
Setting Depth:	8846 feet
Quantity cement used:	550 sacks with 75 gallons D4 retarder
Cemented to:	6615 feet
Method used:	Circulated with plugs by O.D.E. cementing truck

Drilling Fluid:

The well was spudded with a bentonite mud of weight 7.0 to 7.2 lb./gal. and 30 to 50 secs viscosity. To 9 5/8" casing point at 5650 feet mud was conditioned

with water and minor amounts of myrtan and caustic soda to control viscosity. Sand content through the sand section was up to 14%, but was reduced to 5 to 6% by cleaning out the tanks periodically. The sand content decreased to less than 1% during the drilling of the mudstone sections.

After drilling out from the shoe of the 9 5/8" casing, the native mud was treated with bentonite, myrtan, caustic soda and Calgon. On drilling the Belfast Mudstone the hole started to cave badly owing to filtrate invasion. Raising the mud weight to 11.5 to 12 lb./gal. failed to alleviate the problem. Water loss was 6 to 7 cc and, although C.M.C. was added to decrease this, little reduction was effected. This caving hole condition prevented open hole drill stem testing and made coring risky. After becoming stuck at 8364 feet it was decided to change the mud in the hole. The mud was then broken over to a lime-oil emulsion type. At the time of the breakover there were approximately 950 barrels of mud in the system and, after pilot testing, the following mud was planned:

4 1/2 lb./bbl.	Myrtan
2 "	Lime (hydrated)
2 "	Caustic Soda
45% by volume	Water
10% " "	Diesel oil

After normal drilling operations were resumed the average treatments of the mud system each tour were as follows: 140 lb. myrtan, 100 lb. lime, 100 lb. caustic soda and 28 lb. of C.M.C. Over each 24-hour period an average of 350 gallons of diesel oil were added to the system to keep the oil content at 10% by volume.

With these additions, and barytes to increase weight, the mud characteristics were kept within the following limits to total depth:

Weight	:	11.5 to 13.5 lb./gal.
Viscosity (funnel)	:	45 to 68 secs
Viscosity (Stormer)	:	34 to 100 cp at 600 rpm.
Filtrate	:	2.2 to 4 cc
Cake thickness	:	2/32"
pH	:	12.5
Initial and 10 minute gels	:	Zero
Excess lime in the system	:	2 to 3 lb./bbl.

Water Supply:

Water was pumped to the well from Port Campbell Creek and was stored in a 20,000-gallon tank on site. Chloride content of this water was 250 to 300 ppm.

Perforation and Shooting Record:

Casing Perforation: (See Composite Well Log)

For testing:

(i) 8725-8735 feet
(ii) 8586-8592 feet
(iii) 8395-8405 feet
(iv) 8338-8350 feet
(v) 8294-8299 feet
(vi) 8188-8196 feet
and later 8188-8192 feet
" " 8188-8194 feet
" " 8188-8194 feet
(vii) 7910-7918 feet
and later 7910-7916 feet
(viii) 5349-5355 feet
(ix) 2810-2816 feet) Perforation for water production
(x) 2214-2220 feet)

For cementing purposes:

(i) 8214-8216 feet
(ii) 8170-8172 feet

Perforations were made with Schlumberger 4" shaped charge gun at a density of four shots per foot.

No open hole shooting was undertaken.

Plugging Back and Squeeze Cementation Jobs: (See Composite Well Log)

In conjunction with side-tracking in original hole:

(i) 200-sack and 2% calcium chloride plug set from 6500-6399 feet. Dressed off to 6401 feet.
(ii) 485-sack plug set from 6400-5803 feet. Dressed off to 5806 feet.
(iii) 120-sack plug set from 5806-5541 feet. Dressed off to 5635 feet.
(iv) Replugged from 6300-5935 feet with 146 sacks after side-tracking not successful. Dressed off to 5948 feet.

In conjunction with testing:

(i) 20-sack plug set from 8755-8537 feet.
(ii) Set 'K' Retainer at 8386 feet. Attempted squeeze without being able to break down formation.
(iii) Set 'K' Retainer at 8317 feet. Attempted squeeze over 8338-8350 feet perforations without breaking down formation with 450 p.s.i.

(iv) Set 'K' Retainer at 8243 feet. Attempted 6-sack squeeze over 8294-8299 feet without breaking down formation. Left plug from 8317-8243 feet. (Later drilled out).

(v) Set retrievable cementer at 8243 feet. Attempted 25-sack squeeze over 8188-8196 feet perforations after pulling up to 8166 feet. Squeezed 5 1/2 barrels with 4000 p.s.i. Drilled out plug to 8226 feet.

(vi) Set 'K' Retainer at 8205 feet. Attempted squeeze 8214-8216 feet with 15 sacks. Circulating joint leaked cement on top of retainer and squeezed 8188-8194 feet.

(vii) Set 'K' Retainer at 8180 feet. Pressured 8188-8194 feet to 5500 p.s.i. without squeezing any fluid.

(viii) Set 'RT' Cementer at 8165 feet. Pressured perforations 8170-8172 feet without taking fluid at 5500 p.s.i. Ran 'RT' Cementer to 8177 feet. Spotted 10-sack plug from 8177-8162 feet. Checked perforations 8170-8172 feet with 5200 p.s.i. without losing fluid.

(ix) Attempted 18-sack squeeze over 8188-8194 feet perforations with 'RT' Cementer. Squeezed 1/2 barrel and left plug 8196-8121 feet.

(x) 35-sack plug set from 5677-5620 feet.

(xi) 35-sack plug set from 5370-5255 feet.

(xii) 35-sack plug set from 3165-3050 feet.

Fishing Operations:

(i) On bottom at 1182 feet

While installing B.O.P's on 13 3/8" casing head, one 1 3/8" nut was dropped in the hole but was recovered in the cones of a bit when drilling out cement.

(ii) On bottom at 7930 feet

While reaming core hole, circulation was lost and pipe became stuck. After regaining circulation with 2400 to 2600 p.s.i. mud pressure, the string was freed after working for five hours.

(iii) On bottom at 8364 feet

When reaming under-gauge hole pipe became stuck after making a connection although circulation was maintained. A free point indicator showed that the string was free to the bit and, after many operations involving string shots, backing off, working pipe, acidizing and jarring, five drill collars and the bit were left in the hole and by-passed. The top of the fish was at 8154 feet. The hole was plugged back from 7370 feet in four steps to 5541 feet using 1265 sacks of cement.

(iv) After a drill stem test with packer at 4550 feet the packer assembly was backed off at the slips. The fish was recovered with a tapered tap.

Side-tracked Hole:

Following the fishing operations in which a part of the drill string was left in the hole, it was decided to make new hole from below the shoe of the 9 5/8" casing at 5650 feet.

The cement was drilled out from the shoe of the 9 5/8" casing by using 3-6 1/2" drill collars and 8 3/4" bit. The side-tracking programme was based on the assumption that as the original hole had a high deviation, the new hole with controlled low deviation would bypass it. To control the deviation 6 1/2" drill collars were used, 1-7 3/4" drill collar, 1-8 5/8" stabilizer and 1-8 3/4" string reamer. The side-tracking attempt was carried out from the 9 5/8" shoe at 5650 feet, but tools ran back into the old hole at approximately 6300 feet. The side-tracked hole was plugged back and dressed off to 5948 feet.

A knuckle joint was used for the next side-tracking. Drilled rat hole with knuckle joint from 5948 to 6034 feet. After the rat hole had been reamed out, drilled rat hole again from 6034 to 6059 feet+ and this rat hole was reamed out. Drilled ahead with 8 1/2" bit to 6061 feet, and from there knuckle joint rat hole was drilled to 6103 feet. This rat hole was reamed out and drilled to 6122 feet. The Eastman Whipstock was used to drill rat hole from 6122 to 6147 feet and this was reamed out and drilled to 6152 feet. The whipstock was used to drill from 6152 to 6167 feet. The deviation survey showed that the direction of the new hole was 350°, and average deviation was 6° to 7°.

The whipstock was set again and drilled off from 6164 to 6189 feet and the rat hole was reamed out and drilled to 6177 feet. Whipstock was run again and drilled off to 6193 feet. The rat hole was reamed out, and 8 1/2" hole was drilled to 6190 feet. The whipstock was set at 6190 feet with the bit 8 feet above at 6182 feet and rat hole drilled off from whipstock to 6210 feet. The hole was opened up to 8 3/4" and drilled ahead.

Logging and Testing

Ditch Cuttings:

Cuttings were taken over a normal shale shaker. Interval sampled was every ten feet to 7650 feet and thence every five feet to total depth 8846 feet.

Coring:

Original coring programme outlined cores to be taken at lithological change, significant drilling break, distinctly porous bed, sudden increase of chloride content, as well as all oil and gas shows. In addition, routine stratigraphic cores were to be taken at a maximum interval of 500 feet from the depth where the Commonwealth Subsidy Agreement was applicable. No deviation occurred from the original programme laid down.

Eighteen cores were cut for a total footage of 191 feet. Total recovery was 136 feet, or 71%.

Coring equipment used was a conventional Hughes "J" Type core barrel with 7 7/8" and 8 3/4" Hughes hard formation core heads, except for one core (No. 14) for which an 8-11/16" Trifus diamond core head was used.

Diameter of core recovered in all cases was 3 1/2". (See Appendix 2 for detailed core descriptions).

Sidewall Sampling:

No sidewall cores were attempted in Port Campbell No. 2 Well.

Electrical and other logging:

Logging was carried out by Schlumberger Seaco Inc., Schlumberger site engineer being Mr. John White. Logs run were as follows:

Electric Log:

1176- 116 feet	Deviated Hole
2952-1183 feet	7916-5650 feet
4476-2752 feet	8256-7716 feet
5614-4276 feet	8544-8056 feet
7924-5650 feet	8838-8344 feet

Microlog:

1175- 79 feet	Deviated Hole
2940-1183 feet	7915-5652 feet
4476-2741 feet	8254-6200 feet
5606-4256 feet	8542-7780 feet
7921-5648 feet	8836-8342 feet

Laterolog:

5610-1186 feet	Deviated Hole
	7914-5652 feet
	8253-7714 feet
	8542-8049 feet
	8835-8341 feet

Section Gauge:

6402-5650 feet

Temperature Log:

145-5616 feet
5000-8810 feet

Directional Log:

7900-5652 feet	Deviated Hole
6224-5640 feet)	6534-6150 feet
6046-6000 feet)	
6162-5900 feet)	While side-tracking
6211-5900 feet)	

Interval Dipmeter:

5650-7930 feet - selected intervals

Scales of Electric Logs, Micrologs and Laterologs were 1" = 100 feet and 5" = 100 feet, while the other logs were of the scale warranted for their use.

Drilling Time Log:

A Geolograph Continuous Time Depth Recorder was used during the drilling of Port Campbell No. 2, which recorded the time taken for each foot penetrated. A Drilling Time Log was compiled from the Geolograph charts.

Formation Testing:

For details see Appendix 5.

D.S.T. Nos 1 and 2 were carried out with a Johnston 5 3/4" open hole tester assembly.

D.S.T. Nos 3 and 4 were tests of the open hole with Johnston B.O.E.9 casing hookwall type packer set in the 9 5/8" casing.

D.S.T. No. 1.	Attempted test interval 7891 to 7930 feet. The open hole packer failed to seat.
D.S.T. No. 2.	Attempted test interval 7900 to 7930 feet. The open hole packer failed to seat.
D.S.T. No. 3.	Interval 5650 to 5874 feet. Open hole test packer seated in 9 5/8" shoe. Recovered only drilling mud.
D.S.T. No. 4.	Interval 5650 to 5874 feet. Recovered drilling mud and muddy water.

Intervals tested through casing :

D.S.T. Nos 5 to 29 were carried out with a Johnston 5 1/2" B.O.E.5 casing hookwall packer.

D.S.T. No. 5.	8725-8735 feet	Packer failed to hold
D.S.T. No. 6.	8725-8735 feet	Packer failed to hold
D.S.T. No. 7.	8725-8735 feet	Packer failed to hold
D.S.T. No. 8.	8725-8735 feet	Formation considered very tight and impermeable
D.S.T. No. 9.	8586-8592 feet	Recovered gas-cut water
D.S.T. No. 10.	8395-8405 feet	Tool failed to open
D.S.T. No. 11.	8395-8405 feet	Recovered gas-cut water
D.S.T. No. 12.	8338-8350 feet	Recovered gas-cut water
D.S.T. No. 13.	8338-8350 feet	Tool failed to open
D.S.T. No. 14.	8338-8350 feet	Recovered gas-cut water
D.S.T. No. 15.	8294-8299 feet	Packer failed to hold
D.S.T. No. 16.	8294-8299 feet	Recovered mud-contaminated gas-cut water

D.S.T. No. 17.	8294-8299 feet	Packer failed to hold
D.S.T. No. 18.	8294-8299 feet	Small amount of free gas and gas-cut water
D.S.T. No. 19.	8188-8196 feet	Packer failed to hold
D.S.T. No. 20.	8188-8196 feet	Packer failed to hold
D.S.T. No. 21.	8188-8196 feet	Packer failed to hold
D.S.T. No. 22.	8188-8196 feet	Small amount of free gas and gas-cut water
D.S.T. No. 23.	8188-8192 feet	Recovered gas-cut water
D.S.T. No. 24.	8188-8194 feet	Recovered gas-cut muddy water
D.S.T. No. 25.	8188-8194 feet	Recovered brackish dirty water
D.S.T. No. 26.	8188-8194 feet	Recovered water with small amount of dissolved gas
D.S.T. No. 27.	7910-7918 feet	Packer was set too low
D.S.T. No. 28.	7910-7918 feet	Recovered slightly gas-cut water
D.S.T. No. 29.	7910-7918 feet	Slight flow of water

D.S.T. Nos 30, 31 and 32 were carried out with a Johnston B.O.E.9 9 5/8" casing hookwall packer.

D.S.T. No. 30.	5349-5355 feet	On first run packer failed; on second run fluid was lost from the pipe
D.S.T. No. 31.	5349-5355 feet	Recovered gas-cut mud
D.S.T. No. 32.	5349-5355 feet	Recovered water

Deviation Surveys:

Deviation surveys were carried out with the Totco instrument and in conjunction with Schlumberger Deviation Log.

To 5600 feet, deviation was 1 degree or less and rose sharply to 5 degrees at 6190 to 6412 feet and then to more than 7 degrees below 6690 feet. In the deviated hole deviations were irregular ranging from 2 1/4 to 7 degrees.

See Appendix 4 for details of hole deviation.

Temperature Surveys:

Temperature surveys were carried out after cementing both the 9 5/8" and 5 1/2" casing strings to determine the top of the cement. Top of cement behind the 9 5/8" casing was 1036 feet approximately, while top of cement behind the 5 1/2" casing was shown at 6615 feet. Bottom hole temperature at 8838 feet was 188° F.

Other well surveys:

Two well geophone velocity surveys were run in conjunction with Robert H. Ray seismic party operating in the area. The first at depth 8251 feet, and the second at 8338 feet, were both in the deviated hole. Readings were taken at formation breaks and at 500-foot intervals.

GEOLOGY

PORT CAMPBELL NO. 2

Summary of Previous Work

The following paragraphs are concerned with work carried out between the commencement of drilling on Port Campbell No. 1 and the start of drilling on Port Campbell No. 2.

Geological:

Benedek examined Otway Group sediments in the Otway Ranges, but the examination did not add any relevant information. Weegar, and Geotechnics and Resources Inc., made further photogeological interpretations in the Otway Basin.

Geophysical:

A Robert H. Ray contract seismic party continued work in the area and confirmed previous reflection horizons. The survey was fairly detailed and the results made it more apparent that faulting played a major part in the development of the Otway Basin.

Seismic sections showed a much greater thickness of section down to the Otway Group at the No. 2 Well site and stratigraphic pinchout was evident. The structure at this locality was closed against two faults, one trending roughly northeast-southwest and downthrown to the south-east, and the second a northwest-southeast fault downthrown to the southwest. The fault trending north-east runs between Port Campbell No. 1 and the site chosen for Port Campbell No. 2.

Drilling:

Port Campbell No. 1 added significantly to geological knowledge of the south-east Otway Basin, and proved the extension of the Belfast Mudstone along the coast more than 40 miles from its first-known occurrence at Port Fairy. The formation was thicker at Port Campbell (726 feet compared with 435 feet at Port Fairy), but the Victoria Mines Department No. 5 water bore at Timboon, 6-1/2 miles north of Port Campbell, which started drilling while Port Campbell No. 1 was in progress, stopped in Otway Group sediments without having intersected the Belfast Mudstone.

The prospects for Port Campbell No. 2 depended on the occurrence of the porous sandstone which in Port Campbell No. 1 occurred below the Belfast Mudstone and was petroliferous. The fault running between the two well sites was expected to provide the necessary closure, but, in addition, Port Campbell No. 2 was drilled for stratigraphic information on the thicker section revealed by seismic work.

Stratigraphy

Apart from the more disseminated sand in the basal Belfast Mudstone, the lithology of the section cut in Port Campbell No. 2 is very similar to that of Port Campbell No. 1 down to the top of the Waarre Formation which, in Port Campbell No. 2, is slightly different

in parts from its equivalent in No. 1. Part of the Otway Group section was penetrated in the No. 2 Well, whereas it was not reached in the No. 1 Well.

The section can be subdivided as follows :

Surface to 1230 feet	Heytesbury Group (Miocene-Oligocene) Dominantly soft, argillaceous marl with thin limestone bands, and becoming more sandy towards the base.
1230 to 5000 feet	Wangerrip Group (Eocene) Dominantly quartz sandstone and sand with interbedded siltstone and conglomerate, with some coal and dolomite (ankerite) towards the base.
5000 to 5810 feet	Paaratte Formation (Eocene-Upper Cretaceous) Transition zone consisting of siltstone, sandstone and mudstone with minor dolomite (ankerite) and carbonaceous material.
5810 to 7910 feet	Belfast Mudstone (Upper Cretaceous) Dark grey to black, fossiliferous and glauconitic mudstone, slickensided in places, with ankerite in parts, and with some disseminated sand increasing towards the base.
7910 to 8514 feet	Waarre Formation* (Lower Cretaceous) 7910 to 8110 feet - Grey-green sandstone and siltstone and greywacke, conglomeratic in part, with some ankerite and coal, having (?)chloritic matrix and containing weathered feldspar and mica (not seen in No. 1 Well). 8110 to 8514 feet - White to light grey, hard quartz sandstones, conglomeratic in part, and grey to dark grey, carbonaceous siltstones and mudstones with gypsum, mica, pyrite and some ankerite.
8514 to 8846 feet	Otway Group (Lower Cretaceous) Grey-green to green and blue-green feldspathic and micaceous sandstone and sandy mudstone. Chloritic and with abundant dark rock fragments. Top of the Group appears to be weathered.

The highest Cretaceous fossils were found in Core No. 1 at 5340 feet; Taylor recognized five distinct Upper Cretaceous units between this depth and 7910 feet, all of which, except the lowest, were also present in Port Campbell No. 1. This lowest section, the basal Belfast Mudstone, differs slightly from the upper Belfast section in the presence of coarse-grained detrital material.

Examination of a leaf impression from Core No. 18 (8838-8840 feet) by Mary E. White (see Appendix 3) resulted in it being determined as Noeggerathiopsis hislopi (Bunb.). This form is reported to be very common in Australian Permian rocks but has also been recorded from beds of probable Middle Triassic age in India. At the contact of the Belfast

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* The upper 200 feet consist of the Flaxmans Beds (see Appendix 1).

PE907144

This is an enclosure indicator page.
The enclosure PE907144 is enclosed within the container PE906833 at this location in this document.

The enclosure PE907144 has the following characteristics:

ITEM_BARCODE	= PE907144
CONTAINER_BARCODE	= PE906833
NAME	= Cross-Section -Port Campbell Structure
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= CROSS_SECTION
DESCRIPTION	= Geological Cross-Section of Port Campbell Structure
REMARKS	=
DATE_CREATED	= 31/07/61
DATE_RECEIVED	=
W_NO	= W463
WELL_NAME	= PORT CAMPBELL-2
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

PE907143

This is an enclosure indicator page.
The enclosure PE907143 is enclosed within the container PE906833 at this location in this document.

The enclosure PE907143 has the following characteristics:

ITEM_BARCODE	= PE907143
CONTAINER_BARCODE	= PE906833
NAME	= Stratigraphic Column (post drill)
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= STRAT_COLUMN
DESCRIPTION	= Stratigraphic Column (post drill), Port Campbell-2
REMARKS	=
DATE_CREATED	= 31/03/61
DATE_RECEIVED	=
W_NO	= W463
WELL_NAME	= PORT CAMPBELL-2
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

PE907142

This is an enclosure indicator page.
The enclosure PE907142 is enclosed within the container PE906833 at this location in this document.

The enclosure PE907142 has the following characteristics:

ITEM_BARCODE	= PE907142
CONTAINER_BARCODE	= PE906833
NAME	= Structure -Top of Waarre Formation
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= SEISMIC
SUBTYPE	= HRZN_CNTR_MAP
DESCRIPTION	= Seismic Contour Map (Pre-Drill)-Top of Waarre Fm, Port Campbell-2
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	=
W_NO	= W463
WELL_NAME	= PORT CAMPBELL-2
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

Mudstone and Waarre Formation in the No. 2 Well there is a ferruginous siltstone with limonite pellets, pyrite and yellow-brown stained quartz fragments and some chert pebble fragments. Soft, grey clay was also recorded from this apparently oxidised zone. These features possibly indicate an unconformable surface between these two units.

A second unconformity has been postulated at 8514 feet between the Waarre Formation and the Otway Group. The samples at this depth contained unusual soft, brown, calcareous material, apparently weathered ankerite, which is restricted to that depth and may be reworked older sediments. The section of the Waarre Formation from 7910 to 8110 feet, consisting of grey to green sandstones, is not present in Port Campbell No. 1 whereas the section from 8110 to 8514 feet is similar to the Waarre Formation in the No. 1 Well except that the clean, light grey quartz sandstones of No. 2 Well are more siliceous and harder.

A correlation of the formations in the Port Campbell wells is summarized below, the figures in brackets being depths below sea level:

	Port Campbell No. 2	Port Campbell No. 1
Thickness of Heytesbury Group	1214 feet	1365 feet
Top of Wangerrip Group	1230 (-948) feet	1375 (-1028) feet
Thickness of Wangerrip Group	3770 feet	2870 feet
Top of Paaratte Formation	5000 (-4718) feet	4245 (-3898) feet
Thickness of Paaratte Formation	810 feet	685 feet
Top of Belfast Mudstone	5810 (-5528) feet	4930 (-4583) feet
Thickness of Belfast Mudstone	2100 feet	726 feet
Top of Waarre Formation*	7910 (-7628) feet	5656 (-5309) feet
Thickness of Waarre Formation	604 feet	309 feet+
Top of Otway Group	8514 (-8232) feet	-
Thickness of Otway Group	332 feet+	-

Structure

Port Campbell No. 2 was drilled down dip from No. 1 Well; the structure depended on faulting or pinchouts for its closure.

The Schlumberger Interval Dipmeter (Resistivity) was run successfully over three intervals in the hole:

Interval (feet)	Dip (degrees)	Direction (°T)
5658-5681	Not appreciable	-
5764-5787	11	177
5858-5878	9	248

* Now top of Flaxmans Beds (See Appendix 1).

Seismic reflection in the deeper horizons showed the dip to be of the order of 10^{o} towards the south-east, so that the second dip listed is probably a fairly true dip. The deviation of the hole is another feature which has some relation to dip. Deviation was up to 8^{o} in a general north-west direction at 7650 feet in the original hole. As holes generally deviate up dip, the direction of dip would be south-east, as was shown from the seismic work.

Cores Nos 15, 16 and 17, within the Waarre Formation and Otway Group gave evidence of an apparent dip of 15^{o} to 20^{o} but, because of the possibility of cross-bedding and faulting, they are not regarded as reliable. A Schlumberger dipmeter survey on the deeper horizons was not successful.

Relevance to Occurrence of Petroleum

Drill stem tests showed that a small amount of hydrocarbon gas was dissolved in the formation water, but no free gas or oil was apparent in the formations drilled.

Core No. 11 (8339 to 8346 feet), as well as yielding gas, contained a shiny black bituminous material which was considered by Vacuum Oil Company chemists to be of an asphaltic pyrobitumen nature rather than coal or oil shale. Whether this dead oil is a remnant after migration or is indigenous to the rock is not clear.

The gas from this cored interval contained saturated hydrocarbons up to hexane and only very little unsaturated hydrocarbons and hence was similar to that recovered from the Port Campbell No. 1 Well.

The failure of Port Campbell No. 2 to produce hydrocarbons other than gas in solution in saline water suggests that it was located too far down dip on the Port Campbell structure and that the anticipated fault trap does not exist or is too small to include this location. Alternatively, it has been suggested that, since the Belfast Mudstone is the most likely source rock in the section, the absence of free hydrocarbons in the well is due mainly to the occurrence between that formation and Waarre sandstones of a thick section of tight sandstones and mudstones which are not present in Port Campbell No. 1. This is undoubtedly a possibility but, since the water recovered from the Waarre sandstone in Port Campbell No. 2 contained a considerable amount of gas in solution, structural position would also appear to be important.

The No. 2 Well penetrated the full section of Waarre Formation in this locality and showed it to contain a thick section of porous quartz sandstone which, favourably located on a structure, could be a good oil or gas reservoir.

Porosity and Permeability of Sediments Penetrated

Apart from the selected analysed cores, porosity and permeability of the sediments cut in Port Campbell No. 2 were estimated qualitatively by the well-site geologists.

The following are analyses of Cores Nos 6, 7, 10 and 11 from the Waarre Formation:

Core	No. 6	No. 7	No. 10	No. 11
Depth (feet)	7904	7913-7930	8306-8311	8339-8346
Average Effective Porosity	14.6%	13.8%	11%	8.4%
Absolute Permeability				
(i) horizontal	Negligible	0	83 md	19 md
(ii) vertical	"	0	91 md	3 md

Cores Nos 10 and 11 are from the hard, light grey, siliceous sandstones which appeared to be the best reservoir rocks in the Waarre section. As can be seen from the analyses, the porosities are fair and permeabilities are low with the exception of No. 10 which is only fair. This is in marked contrast to the gas sand at 5665 feet in Port Campbell No. 1 which had a porosity of 26.5% and permeabilities of 2985 md horizontal and 1695 md vertical.

Log interpretations on other sands not analysed showed only low to medium porosities and the S.P. log gave little evidence of good permeability through the Waarre section. Drill stem testing of these sands substantiated this.

The Otway Group sediments were in general tight as evidenced by the amount of matrix and results of drill stem testing.

Contribution to Geological Concepts Resulting from Drilling

Port Campbell No. 2 showed the Wangerrip Group and the Belfast Mudstone to be much thicker at that locality than at Port Campbell No. 1. In addition to a general thinning of section between Port Campbell No. 2 and No. 1 Wells the lower part of the Belfast Mudstone cut in Port Campbell No. 2 is absent from Port Campbell No. 1 as also is the 200-foot section of greenish-grey silty sandstone and mudstone (the Flaxmans Beds, see Appendix 1) lying between the Belfast Mudstone and the typical quartz sandstone of the Waarre Formation.

These thickness changes are consistent with the seismic reflection survey results which indicate that Port Campbell No. 2 lies down dip on the Port Campbell structure and is separated from Port Campbell No. 1 by a large fault trending north-east downthrown to the south-east. The seismic data also suggest that the thickness changes take place mainly across the fault which apparently was active during deposition of the Belfast-Wangerrip sediments.

The Port Campbell structure was obviously growing during Cretaceous and Lower Tertiary time. It is not clear at present whether the absence of section in the Port Campbell No. 1 area was due wholly to erosion during periods of emergence above sea level or partly to non-deposition. Indications of weathering at the top of the Waarre Formation (actually, the top of the Flaxmans Beds), in Port Campbell No. 2 favour erosion as a contributory cause at least. Possibly both erosion and non-deposition played a part.

The lowest 350 feet penetrated in Port Campbell No. 2, greenish feldspathic sandstones and sandy mudstones, are correlated with the Otway Group on lithological resemblance although they contain rather more quartz. The top of this section has a weathered appearance which, together with the sharp lithologic change from the overlying Waarre Formation, suggests the possibility of an unconformity. So far there is no information to indicate whether this also is associated with local structural "highs" or whether it is of regional importance.

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APPENDIX 1

DEFINITIONS OF NEW FORMATION NAMES

The following new formation names have arisen from wells drilled by Frome-Broken Hill Company Proprietary Limited in the eastern part of the Otway Basin between 9th September, 1959, and 9th November, 1961. The names have been approved by the State Committee on Stratigraphic Nomenclature.

Paaratte Formation

Type Section: Port Campbell No. 1 Well (Lat. 38° 35' S; Long. 142° 58' E.)

Drilled Thickness: 685 feet

The name is taken from the Parish of Paaratte, County of Heytesbury, in which the Port Campbell Nos 1 and 2 wells were drilled. It is applied to a section of sediments which are transitional between the Belfast Mudstone and the Wangerrip Group (Baker).

The lithology is very fine to coarse quartz sandstone interbedded with grey to dark micaceous and carbonaceous siltstones and mudstones. Pyrite and glauconite are present in places. Some of the sandstones are slightly calcareous and ankerite is common. The formation is fossiliferous and of Upper Cretaceous age. Fossils include foraminifera, mollusc casts, plant and spore microfossils. This formation has been cut in Port Campbell Nos 1, 2 and 3, and Flaxmans No. 1 wells.

Drilled intervals range from 317 to 810 feet.

The Paaratte Formation underlies the Wangerrip Group and overlies the Belfast Mudstone without unconformity.

Name first published: Aust. Oil and Gas J., 1961, 8 (2).

Belfast Mudstone

Type Section: Port Campbell No. 1 Well.

Drilled Thickness: 726 feet

This formation has been named from the Parish of Belfast. The formation was first recorded from the Belfast No. 4 water bore drilled by the Victorian Department of Mines at Port Fairy in 1959 (Kenley).

Equivalent sediments are present in the four Frome wells in the eastern part of the basin and their lithology, age and relationships are given for this area.

The lithology is medium to dark grey, dense siltstone and mudstone, usually micaceous and glauconitic. The unit is very fossiliferous and the fossils include foraminifera, gastropods, ammonites, pelecypods, plant and spore microfossils. In one well, Port Campbell No. 2, the formation becomes sandy towards the base. Ankerite and pyrite are common.

The age of the Belfast Mudstone is not yet defined, different authors assigning ages from Middle Albian to Upper Campanian. It is generally regarded, however, as being Upper Cretaceous.

Drilled intervals range from 378 to 2100 feet.

The Belfast Mudstone underlies the Paaratte Formation in all wells with apparent conformity and overlies the Flaxmans Beds in the Port Campbell No. 2 and Flaxmans No. 1 wells and the Waarre Formation in the Port Campbell No. 1 and No. 3 wells.

The relationship to the Flaxmans Beds is apparently conformable in the Flaxmans No. 1 Well, although there may be an unconformity at the contact in Port Campbell No. 2. The relationship to underlying Waarre Formation at Port Campbell No. 1 and No. 3 wells is unconformable.

Name first published: Aust. Oil and Gas J., 1961, 8 (2).

Flaxmans Beds

7910-7110

Type Section: Port Campbell No. 2 Well (Lat. 38° 36' S; Long. 142° 59' E.)

Drilled Thickness: 200 feet

These beds are named after the Flaxmans No. 1 Well which is located to the east of Flaxmans Hill, a triangulation point in the Parish of Nirranda at latitude 38° 33'S, and longitude 142° 46' E. The beds occur in the Port Campbell No. 2 and the Flaxmans No. 1 wells, but are absent from the Port Campbell No. 1 and No. 3 wells. The beds are regarded as transitional between the Waarre Formation and Belfast Mudstone. The lithology is brown and green to greenish-grey sandy siltstones and chloritic greywackes, very limonitic in places. The matrix is chiefly chlorite and feldspar is prominent. Quartz grains are clear, poorly sorted and subordinate in the rock.

No macrofossils have been found but spore and microplankton determinations indicate a Middle Cretaceous (Albian/Turonian) age.

Drilled intervals range from 200 to 386 feet.

In Flaxmans No. 1 Well the Flaxmans Beds underlie the Belfast Mudstone with apparent conformity but, at Port Campbell No. 2, there is some evidence for an unconformity. In both wells the beds conformably overlie the Waarre Formation.

Name first published: Unpublished.

Waarre Formation

Type Section: Port Campbell No. 2 Well.

Drilled Thickness: 404 feet

Named after the Parish of Waarre, near the Port Campbell wells in the County of Heytesbury.

This formation consists dominantly of clean, light grey, fine to very coarse-grained, very porous quartz sandstones with minor interbedded grey to dark grey carbonaceous and micaceous siltstones and mudstones. The sandstones are calcareous in parts and become dirtier with an increasing amount of feldspar, chlorite and dark rock grains at depth and as the Otway Group is approached. A small amount of ankerite and glauconite is present. The age is Lower Cretaceous. The formation occurs in all four Frome wells with drilled intervals ranging from 202 to 454 feet. Fossils consist of sparse foraminifera, plant and spore microfossils.

The Waarre Formation unconformably underlies the Belfast Mudstone at the Port Campbell No. 1 and No. 3 wells and conformably underlies the Flaxmans Beds in Port Campbell No. 2 and Flaxmans No. 1 wells. Port Campbell No. 1 did not penetrate the full Waarre section.

Name first published: Aust. Oil and Gas J., 1961, 8 (2).

Representative samples of the above formations are deposited in the Victorian Department of Mines Core Library, Port Melbourne, and with the Geological Branch, Bureau of Mineral Resources, Canberra.

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APPENDIX 2

LITHOLOGICAL DESCRIPTIONS AND ANALYSES OF CORES

PORT CAMPBELL NO. 1 AND NO. 2 WELLS

CONTENTS

DETAILED LITHOLOGICAL DESCRIPTION

PORT CAMPBELL NO. 1.

Heytesbury Group

Surface to 1050 feet	Dominantly soft, grey, clayey, extremely fossiliferous marl with minor amounts of white limestone and a little sand near the top.
1050-1150 feet	Sand, brown and clear, medium to coarse-grained, comes into the section with clayey marls as above; a hard fossiliferous sandy limestone band is present at 1057-1067 feet.
1150-1375 feet	Brown, calcareous, silty clays with minor loose fine to coarse sand and some limestone and marl. Samples very fossiliferous. From 1280-1375 feet samples are very glauconitic.

Wangerrip Group

1375-2557 feet	Sand and sandy siltstone; dirty, white and some clear, fine to coarse subangular to subrounded, probably in a brown silty clay matrix which washes away. Hard calcareous sandstone 1457-1493 feet. Gravel and very coarse sand bands 1570-1580, 1640-1670, 1770-1790 and 2110-2120 feet. Some white, clayey limestone; hard, compact, slightly glauconitic 1710 to 1735 feet. All this interval contains pyrite and is sparsely fossiliferous to approximately 1520 feet. Below 1520 feet no fossils have been found.
2557-3290 feet	Sand, gravel and conglomerate; white, clear, light brown, loose, fine to very coarse, subangular to rounded. Pyrite present. Gravel, pebble conglomerate 2690-2700, 2730-2790, 2840-2850, 2915-2916, 3020-3090, 3200-3210, and 3230-3240 feet. Pebbles and granules in the conglomerates were made up of white and clear quartz, green chert, red mudstone and black-green pebbles of (?) metamorphic origin. Pebbles are usually rounded to well rounded. Matrix is silty in places and in others the granules and pebbles are cemented by pyrite, but mostly there is no matrix at all. These beds appear to be the fresh water aquifers.
3290-3720 feet	Sandy siltstone and sand, probably with a silty clay matrix washed out, light brown to grey, very fine to medium-grained with a few coarse bands, grains subangular to subrounded. Pyrite, mica and carbonaceous matter present. Carbonaceous material is probably present in stringers through the sandy siltstone as cores show evidence of lamination. Formation generally fairly tight. Cross-bedding is present in some of the cores. No fossils noted.
3720-4002 feet	Sandy siltstone; usually very fine to medium-grained, light grey,

3720-4002 feet (Cont'd)	dark grey and brown and some black subangular to subrounded, harder than interval 3290-3720 feet, and with some coal and carbonaceous matter. Coal decreasing from 3900-4002 feet and some mica in the sediments. Dolomitic matrix in intervals 3720-3730, 3910-3930, and 3940-3950 feet.
4002-4245 feet	Sandstone; grey, white, compact, fairly hard, fine to medium-grained, calcareous, with minor black siltstone. Brown, very hard dolomite 4190-4200 feet. Slight porosity.

Paaratte Formation

4245-4450 feet	Sandy siltstone and interbedded sandstone, light brown to black, very fine to fine-grained, subangular to subrounded, well sorted in places. In places grades into a claystone. Slightly glauconitic in Core No. 15 (4284-4293 feet) and a few forams in cuttings at 4284 feet (? contaminated). Dolomite 4320-4340 feet.
4450-4460 feet	Mudstone, orange-brown, tight, compact, slightly glauconitic, some forams. (?)Marker bed. Note: This lithology was not confirmed by the sidewall core taken at 4450 feet.
4460-4697 feet	Silty sandstone and sandy siltstone, grading to mudstone in places. Brown and black, very fine to medium-grained, tight. Little glauconite, some mica and pyrite. Dolomite 4480-4490 feet; massive nodules in Core No. 16 (4518-4536 feet), 4610-4620 feet, and 4670-4680 feet. Few broken shell fragments but generally sparse fossils.
4697-4710 feet	Sandstone; light brown to grey, slightly calcareous, very fine to medium-grained, subangular to subrounded. Also loose sand, clear white and light brown, slightly glauconitic.
4710-4830 feet	Mudstone; silty in places, black, tight, with little carbonaceous material, some glauconite and little pyrite, fossiliferous. Minor brown, very hard dolomite, 4710-4730, 4750-4760, 4780-4790, and 4810-4820 feet. Minor amount of loose fine to medium-grained sand, subrounded at 4820-4830 feet.
4830-4910 feet	Sandstone; light grey, brown and few white patches, calcareous, very fine to fine-grained - in places siltstone - compact, subangular to rounded, slightly glauconitic and micaceous. Little pyrite, fossiliferous. Brown, very hard dolomitic fragments in most of the interval.
4910-4930 feet	Dolomite and some dolomitic sandstone; brown, very hard, tight, compact. Minor sandstone as for 4830-4910 feet, and some black, compact mudstone, slightly glauconitic.

Belfast Mudstone

4930-5005 feet	Mudstone; black, compact, fairly hard, slightly glauconitic and micaceous. Minor loose sand and sandstone, white and clear, very fine to medium-grained, subangular to subrounded. Minor dolomite in this interval with approximately 40 percent at 4980-4990 feet.
5005-5060 feet	Mudstone; very glauconitic, dark grey to green to black, sandy in patches (5031-5040 feet), fairly tight, fossiliferous. Evidence of gas in cores from 5018 to 5031 feet. Very minor brown dolomite.
5060-5090 feet	Mudstone as for 5005-5060 feet, but not quite so glauconitic.
5090-5587 feet	Mudstone; black, very glauconitic, compact, dense, some fossils, with very minor sand patches. Very fine to medium-grained. Little pyrite and few shell remains. Little dolomite at 5390-5400, 5440-5470, and 5480-5500 feet.
5587-5656 feet	Mudstone; black, very glauconitic as for 5090-5587 feet and minor sandstone-siltstone, light brown to brown, hard, calcareous in parts and some calcite, slightly glauconitic, mainly fine to medium-grained.

Waarre Formation

5656-5670 feet	Sandstone, light grey to white, clean, very porous and permeable, friable; top six inches pebble conglomerate. Pyrite and coal lenses present. Slightly calcareous in parts.
5670-5965 feet	Mudstone-siltstone; black, carbonaceous, glauconitic in places with sandstones, light grey, fine to medium-grained, subangular to subrounded, fairly porous and permeable, abundant pyrite and coal in parts. Laminated with white sandstone in parts. Dip in Core No. 23 (5700-5718 feet) 10^{o}.
	Brown hard dolomite 5860-5865 feet. Evidence of gas cutting in cores. Some jointing and slickensiding. Sandstone has a feldspathic or slightly calcareous matrix in parts.

DETAILED LITHOLOGICAL DESCRIPTION

PORT CAMPBELL NO. 2

Heytesbury Group

Surface to 880 feet	Marl; light grey to grey, soft, highly fossiliferous.
880- 920 feet	Sand; orange-brown, medium to coarse-grained, rounded to subrounded, highly polished, oxidised, limonite-stained quartz grains. Grey, soft, sticky, fossiliferous marl and cream to yellow skeletal limestone with limonite and fossil fragments.

920- 940 feet	Limestone; sandy, yellow to brown, crystalline with very fine to fine rounded limonite pellets and sand grains.
940-1230 feet	Marl; grey to brown, soft, sticky, fossiliferous, glauconitic. Shell fragments, Turritella, Bryozoa.

Wangerrip Group

1230-1450 feet	Sand; yellow to brown, iron coated, subrounded to angular with polished quartz grains. Interbedded with marl, sandy limestone and siltstone.
1450-2850 feet	Sand; white, clear to yellow stained quartz, fine to very coarse, subrounded to rounded, polished, interbedded with hard pyritic sandstone bands and soft silty brown mudstones.
2850-3274 feet	Sand; yellow to brown, iron stained, polished, fine to very coarse to granule, angular to subrounded with hard pyritic sandstone bands. Interbedded with siltstone, grey to greenish-grey to brown, sandy, limonitic, glauconitic, pyritic, micaceous.
3274-3570 feet	Sand to pebble conglomerate; light grey to clear to yellow stained, angular to subrounded fragments of quartz, chert and igneous rock.
3570-3590 feet	Sand as above interbedded with black slightly pyritic coal.
3590-4290 feet	Sand; white to clear, medium to coarse, subrounded to angular, pyritic. Interbedded with siltstone, grey, soft, finely micaceous, glauconitic with streaks of black carbonaceous material and bands of soft, slightly pyritic coal.
4290-5000 feet	Sand to sandstone; light grey, fine to coarse-grained, angular, slightly calcareous and dolomitic, interbedded with siltstone to silty mudstone, dark brown to black, slightly micaceous, very fine textured, pyritic with streaks of coal.

Paaratte Formation

5000-5260 feet	Sand to sandstone; white to clear to iron stained, medium to very coarse-grained, angular to rounded quartz grains, some polished with bands of calcareous, dolomitic, glauconitic and pyritic sandstones interbedded with silty mudstones, black, finely micaceous.
5260-5810 feet	Siltstone to silty mudstone; grey to dark grey, micaceous, pyritic, slightly glauconitic with bands of hard, tight, sandy, dolomitic mudstones, carbonaceous in parts.

Belfast Mudstone

5810-7910 feet	Mudstone; dark grey to black, very fine-textured, slightly micaceous, pyritic, glauconitic sands in parts with bands of ankerite. Fossiliferous, slickensided, fractures with calcite fillings.

Waarre Formation*

7910-8110 feet	Sandstone, argillaceous to greywacke, greenish-grey, well sorted, fine to medium-grained, subrounded to rounded quartz grains and subrounded to angular green clay fragments in a grey silt matrix. Sandstone contains many dark minerals, biotite. Interbedded with siltstone, dark grey to greenish-grey, composed from mostly the same minerals as sandstone above.
8110-8143 feet	Conglomeratic sandstone and siltstone; grey, dark grey to greenish-grey. Glauconitic, pyritic, with ankerite bands.
8143-8188 feet	Siltstone to mudstone, dark grey, carbonaceous, micaceous, pyritic with nodules of resin, with thin band of coal and sandstone.
8188-8514 feet	Sandstone; white, fine to very coarse-grained, subangular to subrounded, well sorted to poorly sorted, non-calcareous in a white quartz silt and gypsum matrix, pyritic. Interbedded with dark grey micaceous, pyritic, carbonaceous siltstone to mudstone.

Otway Group

8514-8846 feet	Sandstone, light grey to greenish-grey, fine to medium-grained, subangular to subrounded, slightly calcareous, tight, argillaceous, pyritic, chloritic, biotitic, feldspathic. Interbedded siltstone to silty mudstone, dark grey, greenish-grey, carbonaceous, pyritic, chloritic, feldspathic.

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* The upper 200 feet consist of the Flaxmans Beds (see Appendix 1).

CORE DESCRIPTIONS

PORT CAMPBELL NO. 1

Core No. 1

Depth Cored: 421-439 feet

Total Recovery: 15 feet

15 feet of light to dark grey clayey marl. Extremely fossiliferous, very soft, puggy and compact. Uniform lithology and no dip.
Density at bottom of core: 1.94
Soxhlet: No cut

Core No. 2

Depth Cored: 900-918 feet

Total Recovery: 9 feet

Nine feet of light and dark grey marl, soft, compact, extremely fossiliferous, puggy. Uniform lithology and no dip. A few pieces of clear white siltstone and white opaque slightly crystalline limestone through core.
Density at 902 feet: 1.29
Soxhlet: Very faint cut and faint fluorescence

Core No. 3

Depth Cored: 1067-1077 feet

Total Recovery: 10 feet

Top six inches - very dense, hard, heavy, compact, limonitic limestone. Calcareous matrix, fossiliferous. Sand grains clear and brown (Fe stained), fine to very coarse-grained and few granules, subrounded, slightly frosted.
Density: 2.66

Eight feet of marl, light brown to green, very glauconitic, soft, micaceous, very fossiliferous, ovoid limonite pellets.
Density: 1.94

Bottom 1 1/2 feet - dark brown to black, dense soft marl with many fossils and much glauconite.
Density: 2.08. No dip.
Soxhlet: Slight cut with blue fluorescence

Core No. 4

Depth Cored: 1457-1475 feet

Total Recovery: 2 feet

Two feet of brown, hard, compact, calcareous, gritty, tight sandstone. Sand is clear and brown (Fe stained), medium to grit size, subrounded and some grains polished in a calcareous matrix; a few glauconite pellets and some limonite; also some stringers of black clay (?carbonaceous) through it.
Density at 1458 feet: 2.55. No dip.
Soxhlet: Slight cut with greenish fluorescence

Core No. 5

Depth Cored: 1475-1493 feet

Total Recovery: 6 feet

Top 2 feet 6 inches of hard compact calcareous sandstone. Quartz is clear and brown (Fe stained) fine to very coarse-grained, frosted, subrounded, in calcareous matrix, limonite and glauconite pellets. Few sparse fossils.
Density at 1476 feet: 2.59

Remainder of core (3 feet 6 inches) very friable quartz sand, clear brown, very fine to very coarse, polished grains, subangular to subrounded, poorly sorted, very porous, (?)ligneous. Probably fresh water sand.
Soxhlet: No cut

Core No. 6

Depth Cored: 1969-1987 feet

Total Recovery: 9 feet

Nine feet of soft brown to black, slightly loose, dirty sandy siltstone, (?)ligneous. Sand is fine to coarse-grained and few grit and gravel fragments. Pyrite present. Bottom two inches as above except it is hard and tight sandy siltstone. No dip in core.
Soxhlet: No cut
Salinity of interstitial water less than 10 ppm. NaCl.

Core No. 7

Depth Cored: 2450-2466 feet

Total Recovery: 16 feet

16 feet of dark brown to black dirty sandy siltstone, soft, compact and fairly tight with some white and clear very fine to fine subangular to subrounded well sorted sand stringers. Ligneous. Much pyrite and a few glauconite pellets. In a few places the sand increased up to coarse grain-size.
Density: 2.19. No dip.

When core is broken and washed up and the matrix washed out only the sand remains.
Soxhlet: No cut
Salinity of interstitial water less than 10 ppm. NaCl.
Extract with distilled water showed pH = 4.2

Core No. 8

Depth Cored: 2915-2933 feet

Total Recovery: 7 feet

Top one foot - pebble conglomerate. White and light brown, rounded to well rounded quartz pebbles in black (?)carbonaceous matrix. Pyrite. Rest of core is very loose sand, clear white and grey, coarse to very coarse, subangular to subrounded with few scattered quartz pebbles, very porous and permeable and without fine matrix. Some pyrite. Fresh water sand.

Bottom one inch grades into a pebble conglomerate as for the top foot. No dip in core.
Soxhlet: No cut

Core No. 9

Depth Cored: 3148-3167 feet

Total Recovery: 4 feet

Main part of core except for four inches is loose, coarse to very coarse, and in some places up to pebble size, very porous quartz sand. Quartz is white and clear. Some grains dark grey and black (?metamorphic origin), subangular to subrounded and poorly sorted. Fresh water sand. Three inches of dark brown to black (?carbonaceous) silty mudstone, soft, tight, puggy at 3150 feet, and one inch of this silty mudstone at bottom of core.
Density: 2.25 on this bottom inch
Soxhlet: No cut and no fluorescence
Salinity of interstitial water less than 10 ppm. NaCl.

Core No. 10

Depth Cored: 3333-3340 feet

Total Recovery: 5 feet

Top 3 feet 6 inches, green, dark brown to black, sandy siltstone (?glauconitic), soft, compact, sand grains are clear subangular to subrounded, medium to very coarse and some granules. Six inches of hard, fine, brown sandstone with siliceous matrix.

Bottom one foot, thin bedded, laminated bands of black (carbonaceous) and white siltstone. Cross-bedded and micaceous.
Soxhlet: Very slight cut and brownish-green fluorescence

Core No. 11

Depth Cored: 3600-3618 feet

Total Recovery: 9 feet

Top one foot very finely laminated bands of white and black sandy siltstone-mudstone. Sand is white and dirty, fine to medium-grained, subangular and loose, without matrix, and in parts grades into black shale. Micaceous, and evidence of cross-bedding.

Rest of core (eight feet), very slightly greenish to light grey fine sandstone. Sand is white, few green grains, fairly clean, fine to medium, subangular to subrounded, slightly more compact than top foot with some black carbonaceous and micaceous stringers through it.
Density at 3609 feet: 2.21
Dip of 10^{o} - probably cross-bedded dip
Soxhlet: No cut
Salinity of interstitial water less than 10 ppm. NaCl.

Junk Basket Core:

Interval: 3738-3740 feet Recovery: Nil

Interval: 3740-3742 feet Recovery: 2 feet

Two feet of light to dark grey and in places black siltstone. Compact, tight, moderately hard, laminated in places, very pyritic and micaceous; cross-bedded.

Core No. 12

Depth Cored: 3995-3997 feet

Total Recovery: Nil

Core No. 13

Depth Cored: 3997-4009 feet

Total Recovery: 12 feet

Top two feet, dark grey to black, and white to grey, laminated, interbedded sandy siltstone, tight, compact, and cross-bedded. Sand fragments up to very coarse and subangular to subrounded. Mica and pyrite present and black material is carbonaceous.

Four inches of hard, slightly crystalline, grey to black laminated, compact siltstone with a dolomitic matrix. Little slickensided in parts.

Eight inches of light grey, fine to very fine-grained, compact sandstone (as for bottom of this core).

Two feet of cross-bedded, black and light grey, laminated, micaceous sandy siltstone as for top two feet.

Bottom seven feet, light grey-white, very fine to fine, massive, compact sandstone, tight, and with a few black, thin, cross-bedded siltstone bands at base. Mica and pyrite (like bottom of Core No. 11).
Density: 2.12
Soxhlet: 4005 feet - no cut

Core No. 14

Depth Cored: 4280-4283 feet

Total Recovery: 1 foot

Three inches of finely laminated, grey and black, cross-bedded fine sandstone - siltstone. Pyrite and mica present.

Two inches of fine, hard, compact sandstone (like bottom of Core No. 13), tight, slightly calcareous, little carbonaceous matter and few green specks (?glauconite). Nodular weathering. Pyrite and mica.

Two inches of massive pyrite with a few fragments of fine grain sandstone through it.

Rest of core dark brown to black silty mudstone, compact, puggy and micaceous.
Soxhlet: 4282 feet - no cut

Core No. 15

Depth Cored: 4284-4293 feet

Total Recovery: 7 feet

Seven feet of black and white to grey, intermixed sandy siltstone grading into mudstone in places. Compact, tight, puggy, with

Core No. 15 (Cont'd)

pyrite and mica (biotite - muscovite). Few glauconite fragments. Cross-bedding and general jumbled appearance of core. Few black carbonaceous specks. The white to grey siltstone is usually interbedded with very fine to fine-grained, subangular to subrounded sandstone. Piece of brown, conchoidal fractured mineral piece which fluoresces, (?amber).
Density: 2.28
Forams from cuttings at 4284 feet (?contamination)
Soxhlet: 4291 feet - no cut

Core No. 16

Depth Cored: 4518-4536 feet

Total Recovery: 4 feet

One foot of black (carbonaceous) and white to light grey, interbedded, very fine sandstone and siltstone. Compact, tough, tight, micaceous, and a little pyrite. General mixing of bedding. Few small brown hard dolomite nodules.

1 foot 6 inches of grey to white and some light brown, very fine to fine sandstone, compact, with a few thin bands of carbonaceous material. Mica and some pyrite. Hard brown dolomite nodules at base.
Dip of 6°, (?cross-bedded).
Density: 2.20. (?)Fossil fish scale.

Remainder of core is black and white-grey, interbedded and cross-bedded siltstone and very fine to fine sandstone with brown, hard dolomite nodules and some mica, (as for Core No. 15).
Soxhlet: 4520 feet - no cut

Core No. 17

Depth Cored: 4754-4764 feet

Total Recovery: 8 feet

Eight feet of black fossiliferous mudstone, massive, tight and compact with few thin streaks of cross-bedded, white to grey silty bands at top. Few thin streaks of pyrite and some glauconite fragments, also fluorescent mineral (?amber). No obvious bedding.
Density: 2.40 Age: Cretaceous
Soxhlet: 4757 feet - Slight but distinct cut yellow (?)waxy oil - just prior to evaporation, solution in petroleum ether had distinct bluish bloom, green fluorescence.

Core No. 18

Depth Cored: 4862-4869 feet

Total Recovery: 6 feet

Dark grey to black, with few white patches, very fine to fine, calcareous sandstone. Fossiliferous, hard, compact, massive and

Core No. 18 (Cont'd)

tight. Few medium quartz grains. No bedding. Quartz is white and clear, subangular to subrounded in calcareous matrix. Black colour due to carbonaceous material and black mudstone fragments with some glauconite and a little pyrite.
Density: 2.47
Soxhlet: 4868 feet - slight cut as for Core No. 17

Core No. 19

Depth Cored: 5018-5026 feet

Total Recovery: 5 feet

Five feet of dark grey to black, sandy in patches, very glauconitic mudstone. Fairly tight, compact and massive. Very fossiliferous with pyrite stringers through it and a few black carbonaceous fragments. Sand is clear and white, fine to coarse, subrounded to rounded, poorly sorted and is in small patches. Last foot is more sandy than top four feet and is slightly gas-cut. A little brown, very hard glauconitic dolomite at base. Jointing at bottom of core (51°) with some slickensiding.
No dip. Density: 2.40
Soxhlet: 5021 feet - slight cut, greasy oil residue - greenish fluorescence.

Core No. 20

Depth Cored: 5026-5031 feet

Total Recovery: 5 feet

Dark green to black, sandy in patches, very glauconitic mudstone, hard, compact, fossiliferous, massive, fairly tight, (as for Core No. 19). Slight gas-cutting in top 1'6" and second bottom foot. Pyrite stringers.
No dip. Density: 2.41

One inch of very fine to fine, hard, calcareous sandstone, tight, compact, without porosity, and 1/2" of black and white, cross-bedded sandstone and mudstone of density 2.47 at base of core. Few brown, very hard dolomite fragments through core.

Core No. 21

Depth Cored: 5223-5233 feet

Total Recovery: 8 feet

Eight feet of black and dark green, very glauconitic sandy mudstone. Tight, dense and sandy in only a few patches. No apparent macro-fossils. Some dolomite fragments. Few mica flakes and pyrite

Core No. 21 (Cont'd)

stringers. Sand is loose and coarse to granule grain size. Quartz grains scattered through the core. No bedding. Jointing and slickensiding along plane at 54° to 57° to axis of core.
Density. 2.40
Soxhlet: 5227 feet - slight greasy cut - pale greenish fluorescence.

Core No. 22

Depth Cored: 5660-5670 feet

Total Recovery: 3 feet 6 inches

Top six inches, pebble conglomerate, light grey to white and clear subangular to rounded quartz pebbles and granules in loose matrix. Friable, very porous and permeable. Pyrite and some coal stringers. Few calcareous and (?)feldspathic cemented fragments.

Three feet of light grey and white, medium to very coarse-grained sandstone. Subangular to subrounded, fairly well sorted and friable. Very porous and permeable. A little pyrite and a few coal bands.
Density: 2.20
Note: Pinkish colour observed on standing due to mud penetration (Myrtan).
Soxhlet: 5661 feet - slight cut, greasy appearance, pale greenish fluorescence.

Depth (feet)	Porosity (%)	Permeability (md)
5660-5662	24.0	169 Horizontal
		660 Vertical
5663-5665	26.5	2985 Horizontal
		1695 Vertical

Core No. 23

Depth Cored: 5700-5718 feet

Total Recovery: 8 feet

Top 1'6", light grey to white, medium to granule (few pebbles) sandstone. Subangular to subrounded, very porous and permeable. Calcareous and feldspathic matrix in parts. Pyrite and coal present.

6'3" of hard, black, tight, dense, compact mudstone with lenses of white and light grey siltstone with medium-grained sandstone in parts. Dip 10°. Much pyrite and coal fragments. Gas cut.
Density: 2.46

Bottom three inches, sandstone as for top 1'6".

Core No. 23 (Cont'd)

Soxhlet: 5705 feet - slight but better than average cut - very pale yellow waxy residue - pale blue fluorescence.

Depth (feet)	Porosity (%)	Permeability (md)
5700-5702	14.8	5.0 Horizontal
		2.75 Vertical
5702-5704	12.5	Nil Horizontal
		Nil Vertical
5706-5708	8.6	Nil Horizontal
		Nil Vertical

Core No. 24

Depth Cored: 5928-5934 feet

Total Recovery: 6 feet

Top inch, black, glauconitic, dense, tight, compact mudstone (?shell fossil fragment). Rest of core is black, dense, tight, compact, hard mudstone with much coal and pyrite. Gas-cut and evidence of jointing and slickensiding.
Density: 2.43

Sidewall Cores:

No. 1 Depth: 5400 feet Recovery: 3 1/2 inches

Black, glauconitic, sandy mudstone, tight, dense, compact. Sand is light grey and white and fine-grained. Slightly gas-cut.

No. 2 Depth: 4700 feet Recovery: 1 inch

Sand-sandstone, clear, white and dark grey, loose, very fine to fine (few medium fragments), well sorted, clean. Few glauconitic and brown dolomitic fragments. One shell fragment.

No. 3 Depth: 4450 feet Recovery: 4 1/2 inches

Grey to dark grey sandy siltstone, micaceous, soft, slightly carbonaceous, small patches of white, very fine to fine sandstone also in core.

CORE DESCRIPTIONS

PORT CAMPBELL NO. 2

Core No. 1

Depth Cored: 5340-5343 feet

Total Recovery: 1 foot 8 inches

Top 1 1/2", siltstone to very fine sandstone, grey coloured quartz, mica, carbonaceous material. Medium hard, compact, unsorted, argillaceous matrix.

Core No. 1 (Cont'd)

1'6 1/2", siltstone to very fine sandstone, grey to dark grey coloured. Quartz, angular, subrounded grains, slightly glauconitic, micaceous in dark grey argillaceous matrix. Unsorted, medium hard, compact carbonaceous material, plant remains (?) replaced by pyrite. Finely pyritic, small quartz pebbles, dolomitic concretions. Bottom 5 1/2", coarser grained and more unsorted.
Density: 2.39

Core No. 2

Depth Cored: 5355-5361 feet

Total Recovery: 3 inches

Sandstone, grey coloured, made up of white, clear, light grey, fine to very coarse, angular to rounded, poorly sorted sand grains. Black carbonaceous patches and pyrite, clayey matrix very slightly calcareous. Few glauconite grains.
Density: 2.35 No fluorescence. Acetone test negative.

Core No. 3

Depth Cored: 5910-5919 feet

Total Recovery: 7 feet

Mudstone to siltstone, dark grey, micaceous, glauconitic, sandy. Small pockets of highly glauconitic sands. Thin bands of brown dolomite. Pyritic, very fine pyrite crystals partly replace plant remains. Fossiliferous with pearly shell fragments. Biotite and muscovite mica, compact.
Density: 2.5 Acetone test: Very weak
Ultra Violet: Negative on core, slight fluorescence on acetone solution, and pale yellow on Soxhlet solution.
Soxhlet: Slightly greasy cut.

Core No. 4

Depth Cored: 7403-7409 feet

Total Recovery: 5 feet

Top one foot, ankerite, brown to dark brown, very hard, dense, heavy, very glauconitic. Very shattered in places and replaced with calcite. Bottom four feet, mudstone, black, compact, very glauconitic, very shattered and slickensided with calcite along the planes. Fossiliferous, shark tooth and few shell fragments.
Density: 2.53
Soxhlet: Greasy cut, pale yellow fluorescence.

Core No. 5

Depth Cored: 7885-7897 feet

Total Recovery: 5 feet

Top 4", dolomite; brown, very hard, dense, very slightly glauconitic.

4'8", dark grey to black, sandy, limonitic and pyritic mudstone. Dense with a little glauconite, limonite is light brown, very fine-texture and probable oxidized glauconite. Minor slickensiding with calcite. The sand is white to brown, fine to coarse with a few granules, rounded and very rounded.
Density: 2.64 Acetone Test: Negative, no fluorescence.
Soxhlet: Slightly greasy cut and pale yellow fluorescence.

Core No. 6

Depth Cored: 7904-7913 feet

Total Recovery: 9 feet
Dark green clayey sandstone. Clear, white to light brown, fine to granule, angular to rounded and some well rounded grains. Very poorly sorted in a clayey matrix. Green colour is due to green clay and claystone fragments. Weathered feldspar(?). Matrix is argillaceous and is probably feldspathic. Few pieces are very lightly carbonaceous and few fragments of mica and coal particles. Also black siltstone matrix in parts.
Density: 2.65 Acetone Test: Negative
Porosity: 14.6% Permeability: O+ md
Water Content: 2.3% by weight
" " 15.8% by porosity
Soluble Hydrocarbons: 0.36% by weight
" " 2.70% by porosity
Chloride content of water: 590 ppm. Trace of carbonate.

Core No. 7

Depth Cored: 7913-7930 feet

Total Recovery: 17 feet

Top eight feet, greywacke; greenish-grey, well sorted, fine to medium-grained. Subrounded to rounded quartz grains. Subrounded to angular pale green to deep green clay (?) fragments. Grey siltstone matrix. Dark minerals, red and pink grains of chert. Biotite, occasional coarse quartz grains, small lenses of siltstone. Very slightly calcareous. Plant remains, very well preserved fossiliferous wood partly carbonized, poorly pyritized.

Core No. 7 (Cont'd)

Bottom nine feet, greywacke as above; finer grained with increasing amount of siltstone, angular, coarse quartz grains. Pyrite nodules and pyritic cementation in parts.
Density: 2.63 Acetone Test: Negative
Slight fluorescence on acetone solution.

Average effective porosity:	13.8%
Absolute permeability, Horizontal:	0
" " Vertical:	0
Residual water content by weight:	3.15%
" " " in percent of porosity as above:	23% ≡ 52% of pore space
Residual (non-gaseous) hydrocarbon content by weight:	0.35% ≡ 6% of pore space
Residual (non-gaseous) hydrocarbon content in percent of porosity as above:	2.5%
Fluorescence of the hydrocarbon extract as above:	Yellowish-white

Core No. 8

Depth Cored: 8096-8110 feet

Total Recovery: 10 feet

Conglomeratic, argillaceous siltstone with very fine to fine sandstone stringers, grading into a conglomeratic sandstone in the bottom five feet. Siltstone is grey, dark grey to greenish-grey, hard, dense and compact, not very well sorted. Conglomeratic fragments are nearly all quartz, white, clear to light brown, ranging up to pebble size, mainly rounded to well rounded. Green flakes appear to be mainly green clay fragments (chlorite?) but glauconite could be present. Trace of pyrite, mica, calcite, and dolomite concretions are also present in the core.
Density: 2.65 Density of dolomite: 2.87
No bedding, no oil and gas, and no fluorescence.
Soxhlet: Slight greasy cut with pale yellow fluorescence.

Core No. 9

Depth Cored: 8174-8188 feet

Total Recovery: 8 feet

Top 2", dolomite, brown, glauconitic, crystalline, fractured with calcite filling. Probable cave-in from higher beds.

Core No. 9 (Cont'd)

7'8", mudstone to siltstone, dark grey, micaceous (muscovite), with carbonaceous material, containing pyrite nodules and resin. Laminated with white, fine to medium-grained quartz sandstone, well sorted, subrounded. The amount of sandstone increases towards bottom, and is interbedded, interlensed and slightly cross-bedded.

Bottom 2", sandstone, white quartz, fine to medium, well sorted, subrounded, non-calcareous, with dark grey mudstone pellets. Density: 2.53 Acetone Test: Slightly positive; slight fluorescence.
Soxhlet: Slight greasy cut with yellow fluorescence.

Core No. 10

Depth Cored: 8306-8311 feet

Total Recovery: 3 feet

Top foot in barrel not counted in recovery. Several cobbles well rounded glauconitic mudstone and dolomite caved from above.

Core: Sandstone, white to light grey, fine to mainly coarse, mostly angular to subangular, slightly porous, carbonaceous, slightly pyritic. Hard quartz sandstone with quartz siltstone matrix. Poorly sorted.
Density: 2.48 Acetone and Soxhlet: Negative

Average effective porosity:	11%
Absolute permeability, Horizontal:	83 md
" " Vertical:	91 md
Residual water content:	2.4% by weight; 21.82% of porosity
Residual (non-gaseous) hydrocarbon content:	0.79% by weight; 7.2% of porosity
Salinity (NaCl content of the water):	120 ppm.
Fluorescence of hydrocarbon extract:	Bright milky white

Core No. 11

Depth Cored: 8339-8346 feet

Total Recovery: 6 feet

Siliceous, quartzitic sandstone, light grey, medium to very coarse-grained, subangular to subrounded. Hard, very slightly porous in parts. Granules and pebbles of quartz. Fractures are filled with

Core No. 11 (Cont'd)

carbonaceous material and pyrite. Pyrite occurs as nodules and crystals. Also finely disseminated and as lumps or nodules is a solid black bituminous material with conchoidal fracture, that cuts and fluoresces only after treatment with toluene. Fluorescence is yellow. There is an apparent lineation of black material in fractures 27^{o}-30^{o}.

Density: 2.51 Acetone Test: Negative.

Soxhlet: Good film with yellow fluorescence. Toluene treated core fluoresces in parts yellow.

Average effective porosity:	8.4%
Absolute permeability, Horizontal:	19 md
" " Vertical:	3 md
Residual water content:	2.3% by weight; 27.3% of porosity
Residual (non-gaseous) hydrocarbon content:	0.23% by weight; 2.7% of porosity
Fluorescence of hydrocarbon extract:	Bluish-white

The gas from the core contained saturated hydrocarbons up to hexane at least. A small amount of unsaturated hydrocarbons was also present. Methane amounted to about 0.2% of the gas collected.

Core No. 12

(Deviated Hole)

Depth Cored: 7093-7103 feet

Total Recovery: 10 feet

Top 6'9", mudstone, dark grey to dark brown, very fine-textured, slightly carbonaceous, finely micaceous, pyritic, (small nodules) non-glauconitic. Very brittle, hard, compact. Core snaps and pops as it dries, breaking into curved sharp shards. Minor micro faults with slickensides.

6" ankerite concretions, brown to dark brown, very finely crystalline, hard, tight, dense, with calcite fillings in tiny fractures.

2' mudstone as above with 1" ankerite concretion.

6" ankerite concretion as above.

3" mudstone as above but completely shattered and slickensided. Core has fracture lineation or bedding (?) of 11^{o} apparent. If bedding with 4^{o} Totco added, would give 15^{o} dip.

Density: Mudstone 2.50, Ankerite 3.52

Acetone Test: Negative

Core No. 13 (Deviated Hole)

Depth Cored: 7683-7694 feet

Total Recovery: 10 feet

Top 1", ankerite, brown to dark brown, very hard, dense, with calcite in fractures, glauconitic. Probably cavings.

Rest of core is sandy mudstone grading into clayey sandstone in places. Dark grey, black, hard, dense, micaceous. Sand is clear white, very fine to very coarse in spots, mainly fine to medium, poorly sorted and set in a black clayey matrix. Also green mineral is prevalent throughout the core. Pyrite concretions and carbonaceous matter are also present. Six feet from the top of core is a 1" coal band, with pyrite inclusions and pyrite-filled veins within the coal. Three or four sandy ankerite concretions through core. Evidence of slickensiding mainly in bottom three feet with some calcite.
Density: 2.72 Acetone Test: Negative

Core No. 14

Depth Cored: 8313-8319 feet

Total Recovery: 4 feet

Sandstone; white, light grey, discoloured to a dirty brown, colour due to myrtan and diesel oil penetration. Medium to granule, and pebble conglomerate in places. Angular to rounded, not very well sorted, medium porosity but not very high permeability. Very hard, dense, carbonaceous material and pyrite scattered through core. Also some coal fragments and pyrite nodules. In parts siliceous cement.
Density: 2.48 Acetone Test: Negative
Soxhlet: Yellow cut, fluorescence with toluene

Core No. 15

Depth Cored: 8409-8418 feet

Total Recovery: 8 feet

Top 5', mudstone, dark grey to black to dark brown. Very fine texture, slightly micaceous (muscovite), very slightly sandy in streaks. Carbonaceous material (plant remains) and pyrite nodules. Core contains several slickensided zones, but not badly fractured. Thin edges of fragments are dark brown in colour. Not glauconitic.

2'10", mudstone as above, but very highly pyritic sandy streaks and pyrite nodules.

Core No. 15 (Cont'd)

Bottom 2", sandstone, light grey, very coarse to granule, sub-rounded to subangular, hard, tight, pyritic quartz sandstone. Pyrite is cementing agent.
Density: 2.6 Apparent dip of sandstone streaks: 16°

Core No. 16

Depth Cored: 8556-8570 feet

Total Recovery: 8 feet

Silty mudstone, grey to dark grey to greenish-grey, very fine sandstone in a few parts.

Dense, tight with very fine texture, with pyrite and a few coal fragments, traces of amber.
Apparent dip: 18° to 22°
Density: 2.60

Core No. 17

Depth Cored: 8605-8624 feet

Total Recovery: 8 feet

Four inches on top are ankerite cavings.

Top three feet, light grey to greenish-grey sandstone of white and light grey quartz grains. Fine to very coarse, with granules mainly subangular to subrounded, poorly sorted, friable.

Abundant grey subangular to subrounded rock fragments, with angular matrix, with abundant chlorite and pyrite, biotite, muscovite. Also stringers of black carbonaceous material and silty mudstone. Medium porous.

Bottom five feet, light grey to greenish-grey sandstone with abundant black siltstone with carbonaceous lenses and stringers. Constituents the same as for top three feet but sandstone is very much harder and lighter, better sorted and not friable. Lenses and stringers through core are contorted. Suggestion of dip is approximately 15°.
Density: Top of core is 2.37, bottom of core 2.54.

Core No. 18

Depth Cored: 8826-8846 feet

Total Recovery: 16 feet

Mudstone, light green to bluish-green, very micaceous (biotite), slightly carbonaceous, chloritic, silty, with tiny red rock fragments.
Density: 2.50

POROSITY AND PERMEABILITY DETERMINATIONS

PORT CAMPBELL NO. 1 AND NO 2 WELLS

by

Bureau of Mineral Resources

Port Campbell No. 1

Core No.	Depth (feet)	Porosity (% by vol.)	Permeability Millidarcys	
			Horizontal	Vertical
4	1458	8	3	0
5	1476	12	7	0
5	1478	37	729	694
11	3602-3604	25	65	85
13	4001-4003	31	98	95
13	4003-4005	33	231	130
18	4862-4864	21	10	4
20	5026-5028	20	22	0
22	5660-5662	24	169	660
22	5663-5665	26.5	2985	1695
23	5700-5702	14.8	5	2.75
23	5702-5704	12.5	0	0
23	5706-5708	8.6	0	0

Port Campbell No. 2

6	7904	14.6	0	0
7	7913-7930	13.8	0	0
10	8306-8311	11.0	83	91
11	8339-8346	8.4	19	3

APPENDIX 3

PALAEONTOLOGICAL REPORTS

PORT CAMPBELL NO. 1 AND NO. 2 WELLS

CONTENTS

NOTES ON CRETACEOUS MACROFOSSILS FROM PORT CAMPBELL NO. 1

by

P.R. Kenley*

INTRODUCTION

Marine Cretaceous macrofossils were first recognized in Victoria in sediments from the Belfast No. 4 Bore at Port Fairy and were reviewed briefly by the writer in June, 1959 (Kenley, 1959).

In November, 1959, similar macrofossils were recognized in cores submitted from Port Campbell No. 1. Forms recognized are listed below.

SAMPLES

Cores Examined

The cores supplied came from intervals in the depth range 3740 to 4762 feet. An additional sample which had previously been examined by the State Laboratories for gaseous hydrocarbons came from 5021 feet.

Lithology

The black siltstones represented in the core from 4754-4762 feet are lithologically similar to those encountered at 4550-4985 feet in the Belfast No. 4 Bore, Port Fairy. The sample from 5021 feet contains disseminated quartz sand, but is otherwise indistinguishable from the other siltstones.

Macrofauna

4754-4756 feet

Pisces:	Small fish scales and bones
Incertae sedis:	Organic fragment indet.

4756-4758 feet

Pelecypoda:	One small sp. indet.
Gastropoda:	Merelina sp. (identical with the Port Fairy species) Two other spp. indet.
Annelida:	Rotularia sp. (identical with the Port Fairy species referred to "Tubulostium")

* Geological Survey of Victoria.

4758-4760 feet

Pelecypoda:	One small sp. indet.
Ammonoidea:	Fragment of a somewhat crushed small compressed ammonite with weakly keeled venter. Test thin and apparently lacking strong ornament.
Pisces:	Fish scales and bones

4760-4762 feet

Pelecypoda:	Two small sp. indet.
Annelida:	Rotularia sp. (as above)
Incertae sedis:	Tubular organisms indet. (2 pieces) Fragments indet.

5021 feet

Foraminifera:	One miliolid foraminifer
Ammonoidea:	Small Ammonite fragment indet., showing septal sutures

REMARKS

The most common fossils in the Belfast No. 4 Bore Cretaceous sediments in order of relative abundance are:

(i) Fish scales and bones
(ii) Plani-spirally coiled annelid tubes - Rotularia sp.
(iii) Small rissoid gastropods - Merelina sp.
(iv) Small ringiculid gastropods - Eriptycha sp.
(v) Ammonites - Crushed and fragmentary tests of several genera.

Of these organisms, forms identical with the first three occur in the Port Campbell No. 1 Well. In addition, the ammonite fragments, although not identifiable, appear to be referable to genera occurring at Port Fairy.

CONCLUSIONS

The siltstones and sandy siltstones represented by the cores from 4754-4762 feet and 5021 feet in the Port Campbell No. 1 Well are directly correlatable, both on lithological and faunistic grounds, with the Cretaceous (?early Upper Cretaceous) sediments from 4550-4985 feet in the Belfast No. 4 Bore at Port Fairy.

REFERENCE

KENLEY, P.R., 1959 : The occurrence of marine Cretaceous sediments in the Belfast No. 4 Bore, Port Fairy. Min. geol. J. Vic., 6 (3).

PLANT FOSSILS IN CORE NO. 18, PORT CAMPBELL NO. 2 WELL

by

Mary E. White*.

Core No. 18 from a depth of 8838 to 8840 feet in Port Campbell No. 2 contains one leaf impression. Repeated splitting of the core failed to reveal any other fossils.

The impression appears to be part of a lamina of Noeggerathiopsis hislopi (Bunb). Although the leaf is imcomplete, its elongated form, the number of veins per cm and its general appearance leave little doubt as to its identity(2).

Noeggerathiopsis hislopi is a predominantly Permian form. It is of common occurrence in Australia in Permian horizons. It is probable that it is an unimportant member of early Mesozoic floras, as there is no evidence of its abrupt extinction at the end of the Permian era. In India it has been recorded with Glossopteris browniana, Pterophyllum and Taeniopteris in Parsora beds of probable Middle Triassic age. (Lele, 1955).

REFERENCES

LELE, K.M., 1955 : Plant fossils from Parsora in the South Rewa-Gondwana Basin, India. Palaeobotanist, 4, 23-33.

MEDWELL, L.M., 1954 : A review and revision of the flora of the Victorian Lower Jurassic. Proc. Roy. Soc. Vic., 65 (2), 63-111.

A PALYNOLOGICAL REPORT ON PORT CAMPBELL NO. 1 AND NO. 2 WELLS, VICTORIA

by

P.R. Evans*

INTRODUCTION

An examination of samples, prepared from main cores and certain cuttings from Port Campbell No. 1 and No. 2 Wells, Victoria, has suggested a provisional means of correlating a portion of the Cretaceous sections of the wells. It is considered that part of the Lower Cretaceous (Albian) and probably the whole of the Upper Cretaceous is represented in the combined well sections and that portions of these sections are equivalent to a part at least of the outcropping Otway Group.

Palynological observations were made on the Cretaceous sequence while No. 1 Well was being drilled; the results obtained are incorporated in this report, augmented by

* Bureau of Mineral Resources.

(2) Footnote by Bureau of Mineral Resources:
J. Douglas of the Geological Survey of Victoria, considers that the nature of the species makes confusion with typical Mesozoic species of similar form quite possible.

those from additional observations which were necessary for the clarification of problems raised at the time. Since the No. 1 Well was drilled, Cookson and Eisenack (1960) have published descriptions of microplankton from the Upper Cretaceous of the Carnarvon Basin, Western Australia, of which several species are common to the Victorian beds. Their paper has made it possible for a more refined definition of the age of the Victorian strata to be attempted. Samples from No. 2 Well and its side-tracked hole have been examined to check the sequence of species determined in the first well. Not all cores from the highest Cretaceous section of the second well were available to the Bureau of Mineral Resources so this check has not been complete, but the comparison suggests that the combined series of samples provides a picture of the local palynological variations. The sampling method used does not provide a complete correlation scheme, but it is adequate at this stage for correlations of regional significance.

At the time of writing, no details of the distribution of other faunas in the well are available so that no overall assessment of the palaeontological information from these stratigraphic holes is possible here. It is understood that the Victorian Mines Department is conducting an analysis of the same well sections in relation to others in the Otway Basin.

RESULTS AND CORRELATIONS BETWEEN WELLS

The occurrence of non-mineralized micro-organisms in both wells is shown in the chart which accompanies this report. (See Fig. 8). The fossils are arranged in stratigraphic order of appearance; a check list of these species, in alphabetical order, is given in Appendix B. Numbers which follow specific names in the text correspond to the numbers which have been allocated to those species on the chart. Many of the species which have been recorded are new and of little value at present for stratigraphic purposes and will remain so until described. The presence of new species is recorded chiefly to assist illustration of the degree of change in assemblage composition through the section. Those species which have been described already from the Mesozoic of Australia seem to provide adequate evidence for the present stratigraphic deductions.

The lithological columns in the chart and their division into formations are those of Wood, Bain and McQueen, but the ages to which these formations are allocated are based solely on palynological evidence. In many respects the use in palynology of European stage names in the Mesozoic of Australia implies a degree of accuracy which is not fully justified by the present state of knowledge. Nevertheless, in absence of a local zonal scheme, these names, in the sense customarily followed in Australia, are all that are available for the present purposes. It will be noted that, while the microspores show a steady change throughout the sequence, the microplankton occur more or less in distinct bands. A tentative age may be assigned to these bands, but the intervening strata remain undated; more information about the distribution of microplankton in reference sections of appropriate age is required.

The ages noted on the chart are based on the occurrence of species, particularly of microplankton, which either were found associated with foraminifera in Western Australia (Cookson & Eisenack, 1960) or have been observed in the Great Artesian Basin (Evans, 1961). Unfortunately, only microspores from the Lower Cretaceous and Tertiary of Australia have been described so far: the Upper Cretaceous spore and pollen assemblages of Australia are virtually unknown. Several forms appear to be conspecific with pollens described by Couper (1960) from the Upper Cretaceous of New Zealand.

The palynological results compare favourably with the lithological correlations, particularly in the top of the Waarre Formation, but the lack of samples from higher levels in No. 2 Well and the fact that No. 1 Well did not penetrate the lowest Waarre Formation and "Otway Group"(*) prevent any other correlations at this stage.

AGE DETERMINATIONS

The section under consideration ranges from the Lower Cretaceous (probably Albian) to the (?) Tertiary and includes a large section of the Upper Cretaceous. The boundaries defined herein must still be regarded as tentative.

The lowest strata which have yielded microfossils are in the "Otway Group" in No. 2 Well and they were cut in Cores 16 and 17 (8556-8624 feet). Samples from the core below this level were barren of micro-organisms. Rare microplankton and a variety of spores were located in Cores 16 and 17, while Dr Crespin (pers. comm.) records the presence of glauconite and some arenaceous foraminifera in Core No. 16. Both the microflora and microfauna are typically Lower Cretaceous. The microplankton are not sufficient to define where in the Lower Cretaceous the samples should be placed, but the presence of Balmeisporites holodictyus (44) suggests that nothing older than the Albian is present.

The beds cut in No. 2 Well by Cores 9, 14, 11, 15(ø) (8174-8418 feet) are undated since all the samples from these cores were barren, but Cores 5-8 (7885-8110 feet) yielded abundant microplankton, similar to those of the Waarre Formation of No. 1 Well. The horizon where Odontochitina operculata (3) and Deflandrea acuminata (17) occur together, compares closely with the Cenomanian section of the Gearle Siltstone of the Carnarvon Basin (Cookson & Eisenack, 1958). For the present, the underlying beds, which contain only O. operculata (of the two key species), are regarded as Albian in age. The microspores are in accordance with this sequence: Trilobosporites trioreticulatus (61) is typical of an upper portion of the marine beds and the overlying freshwater beds (Winton Formation) of the Great Artesian Basin where it occurs also with Cingulatisporites euskirchensoides (62) and Leptolepidites verrucatus (69). Although these latter species are known to have long ranges, their locality frequency (Couper, 1958) is very high at this level in the Cretaceous.

A succeeding division, probably extending from the Cenomanian to (?) Lower Turonian, fills in the space between the Cenomanian of the top of the Waarre Formation and the base of the Belfast Mudstone on the one hand and the succeeding (?) Turonian of the top half of the Belfast Mudstone on the other. Within this intermediate zone only one possibly distinctive species, Balmeisporites glenelgensis (87), has been located. Cookson and Dettmann (1958a) considered the possibility of an Upper Cretaceous age for this species, so that its association with the angiospermous Proteacidites sp. nov. 1 (86), above beds which are no older than the Cenomanian, would support this view. Angiosperm pollens are known from the Great Artesian Basin Winton Formation, but none compares with the triporate types of Port Campbell, which develop into a major component of the higher Cretaceous beds. Nevertheless,

(*) "Otway Group" is used in the sense employed by the company in reference to the subsurface sections. This may not be exactly the same as Otway Group of outcrop and more work will be required to reconcile the two.

(ø) The cores are arranged in stratigraphic order. Their numerical sequence was governed by the need to cut a side-track hole during drilling.

B. glenelgensis is present at a very high level in the Winton. Another fact worthy of comment is the occurrence of Cicatricosisporites australiensis (48) at the same level as B. glenelgensis, an association noted by Cookson and Dettmann (1958a) in the Nelson bore of Western Victoria. Although C. australiensis would seem to be a typical and very widespread microfossil in Lower Cretaceous sediments in Australia, its range, therefore, continues into the Upper Cretaceous.

Within the upper half of the Belfast Mudstone and the lower quarter of the Paaratte Formation (No. 1 Well, 4758-5231 feet), an assemblage is present typified by Odontochitina porifera (29) and Deflandrea cretacea (28). Subdivision of this section may be possible if the upper portion, with Nelsoniella aceras (35), Gymnodinium nelsonense (32) and Amphidiadema denticulata (33) is separated. These species have been described from Turonian, Santonian and (?) Campanian of Western Australia (Cookson & Eisenack, 1960). Although different opinions occur over the relative parts of the Turonian or Santonian, which may be present in that area (cf. Belford, 1958), the position of these microplankton, relative to the other assemblages in the Port Campbell wells, is identical to their arrangement so far established in the Carnarvon Basin, and some note can be made of their role as markers of a level approximately in the middle of the Upper Cretaceous. The associated spores are of little stratigraphic value at present, except for the fact that a greater variety of angiosperm pollens are present at this level than in lower strata.

Above this section age determinations are in doubt so that the position of the Cretaceous - Tertiary boundary cannot be determined readily. Nelsoniella tuberculata (40) and Xenikoon australis (41) were described initially from Upper Cretaceous sediments but the presence of e.g. Dacrydiumites mawsonii (122) in the same cores (No. 1 Well, Cores 14/15, 4280-4293 feet) suggests that Tertiary beds cannot be far from this horizon. For the present, the microplankton are regarded as the main markers and it is suggested on this basis that sediments at 4518 feet in No. 1 Well are still Cretaceous in age.

In summary, therefore, the following ages may be assigned to the formations of the Port Campbell wells on the basis of their micro-organic content:

Wangerrip Group	Tertiary
Paaratte Formation	Upper Cretaceous
Belfast Mudstone	Upper Cretaceous
Waarre Formation	Lower-Upper Cretaceous (Albian-Cenomanian)
"Otway Group"	Lower Cretaceous

There is no palynological evidence available to suggest a break in this sequence except perhaps between the Waarre Formation and the Belfast Mudstone in No. 1 Well. Marine influences were repeatedly, if not continuously, present during Cretaceous times.

REGIONAL CORRELATIONS

Comparisons have been made already in this report between the Cretaceous beds of Port Campbell and the Carnarvon and Great Artesian Basins. It is natural that a comparison should be attempted with the Cretaceous of the outcropping Otway Group to the east (Cookson & Dettmann, 1958a, 1958b) and with the subsurface Cretaceous of the bore at Nelson in the extreme west of Victoria (Baker & Cookson, 1955). The appearance of a microspore and

microplankton association (B. glenelgensis, C. australiensis, O. porifera) in the Upper Cretaceous of the Nelson bore has been mentioned already. It is likely, when the Belfast No. 4 Bore is taken into account (Kenley, 1959), that a widespread development of Upper Cretaceous rocks underlies the Teritary of the western half of the Otway Basin.

No mention has yet been made of the possible presence of Upper Cretaceous strata in the Otway Group to the east of Port Campbell. Cookson and Dettmann examined a sample from near the Mesozoic - Palaeocene unconformity at the mouth of the Gellibrand River, the assemblage from which (1958b, p.120) can be no younger than those of the Waarre Formation or the very base of the Belfast Mudstone (in No. 2 Well only). Not one of the samples examined by Cookson and Dettmann from the Otway Group yielded microplankton and, although those authors considered nothing to be younger than the Albian, the microplankton - microspore association of Port Campbell suggests that it could be difficult, on the microspore species lists available, to distinguish Albian from Cenomanian samples. However, allowing for the possibility of Cenomanian being present in the Otway Group, at least at Gellibrand, it appears that the remainder of the Upper Cretaceous is missing in outcrop. From another viewpoint, the Cenomanian part of the Waarre Formation may not have an equivalent at outcrop, but it is almost certain that the major portion of the formation could be equivalent to part of the outcrop sequence. A difference between bore and outcrop lies in the presence of microplankton in the subsurface section, reflecting the existence of a different facies at Port Campbell to that at Otway during Lower Cretaceous time. The (?) marine facies even existed, at least briefly, in the basal Otway Group of Port Campbell. However, only seven localities from the Otway Group were sampled by Cookson and Dettmann and detailed work might prove the extension of marine influences to certain levels of the outcrop section.

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APPENDIX A

REGISTERED SAMPLE NUMBERS

Samples, which have been examined from the Port Campbell No. 1 and No. 2 Wells, have been recorded in the Bureau of Mineral Resources palynological collection under the following numbers:

Port Campbell No. 1

MFP. 1186	Core 14	4280-4281 feet (mudstone)
MFP. 1187	" 14	" " " (sandstone)
MFP. 1188	" 15	4290-4291 "
MFP. 1189	" 16	4518-4520 "
MFP. 450	" 17	4758-4760 "
MFP. 473	" 18	4862-4864 "
MFP. 474	" 19	5020-5025 "
MFP. 475	" 20	5028-5030 "
MFP. 476	" 21	5223-5231 "
MFP. 652	Cuttings	5300-5310 "
MFP. 653	"	5400-5410 "
MFP. 654	"	5500-5510 "
MFP. 643	"	5600-5610 "
MFP. 644	"	5610-5620 "
MFP. 645	"	5640-5650 "
MFP. 646	"	5650-5660 "
MFP. 455	Core 22	5660-5662 "
MFP. 477	" 22	5660-5665 "
MFP. 647	Cuttings	5660-5670 "
MFP. 648	"	5670-5675 "
MFP. 641	"	5675-5680 "
MFP. 650	"	5680-5690 "
MFP. 651	"	5690-5700 "
MFP. 454	Core 23	5700-5708 "
MFP. 456	" 24	5932-5934 "
MFP. 610	Cuttings	5960-5965 "

Port Campbell No. 2 (including side-track hole)

MFP. 1031	Core 12	7097-7099 feet (deviated hole)
MFP. 1032	" 13	7691-7693 " (" ")
MFP. 872	" 5	7887-7890 "
MFP. 873	" 6	7906-7908 "
MFP. 874	" 7	7927-7930 "
MFP. 875	" 8	8100-8102 "
MFP. 876	" 9	8174-8176 "
MFP. 1149	" 14	8313-8315 "
MFP. 1148	" 11	8339-8341 "
MFP. 1121	" 15	8413-8415 "
MFP. 1122	" 16	8560-8562 "
MFP. 1123	" 17	8609-8611 "
MFP. 1124	" 18	8830-8832 "
MFP. 1054	" 18	8826-8846 "

APPENDIX B

SPECIES CHECK LIST

Species	Chart No.
Microplankton	
Amphidiadema denticulata	33
Ascodinium parvum	9
Baltisphaeridium sp. nov. 2	16
Baltisphaeridium sp. nov. 4	7
Baltisphaeridium sp.	2
cf. Baltisphaeridium sp. 11	13
aff. Chlamydophorella nyei	22
Cyclonephelium distinctum	18
Cyclonephelium sp. nov. 1	23
Deflandrea acuminata	17
Deflandrea cretacea	28
Deflandrea sp. nov. 1	31
Deflandrea sp. nov. 2	27
Deflandrea sp. nov. 5	37
Gymnodinium nelsonense	32
Gymnodinium westralium	36
Hystrichodinium cf. oligacanthum	24
Hystrichosphaera aff. bulloidea	20
Hystrichosphaera cf. ramosa	19
Hystrichosphaera sp. nov. 5	38
Hystrichosphaera sp.	21
Hystrichosphaeridium cf. arundum	6
Hystrichosphaeridium complex	1
Hystrichosphaeridium cf. heteracanthum	10
Hystrichosphaeridium pulcherrimum	8
Hystrichosphaeridium cf. recurvatum	12
Hystrichosphaeridium striatoconus	26
Hystrichosphaeridium sp. nov. 2	30
Hystrichosphaeridium sp. nov. 18	14
Leiosphaeridia sp.	34
Micrhystridium sp. nov. 1	39
Nelsoniella aceras	35
Nelsoniella tuberculata	40
Odontochitina cribropoda	4
Odontochitina operculata	3
Odontochitina porifera	29
Palaeohystrichophora infusorioides	11
Pterospermopsis cf. australiensis	25
Pyritosphaera sp.	15
Veryhachium sp. nov.	5
Xenikoon australis	41

Species	Chart No.
Microspores	
Alsophilidites sp.	64
Appendicisporites sp.	54
aff. Appendicisporites sp.	123
Araucariacites australis	67
Baculatisporites comaumensis	57
Baculatisporites sp. 1	73
Baculatisporites sp. 2	109
Balmeisporites glenelgensis	87
Balmeisporites holodictyus	44
Casuarinidites cf. cainozoicus	88
Cicatricosisporites australiensis	48
Cingulatisporites euskirchensoides	62
Concavisporites sp.	89
Cyathidites australis	45
Cyathidites cf. minor	43
Cyclogranisporites sp.	84
Dacrydiumites florinii	120
Dacrydiumites mawsonii	122
Dictyototriletes sp. nov.	110
aff. Dictyototriletes	72
aff. Dysoxylum sp.	104
Ginkocycadophytes cf. nitidus	75
Gleicheniidites circinidites	51
Gleicheniidites sp. nov. 1	59
Gleicheniidites sp. nov. 2	99
Granulatisporites sp. nov.	65
Granulatisporites sp.	90
Inaperturopollenites sp. nov. 1	50
Inaperturopollenites sp. nov. 2	70
Leiotriletes sp. 1	47
Leiotriletes sp. 2	78
Leptolepidites verrucatus	69
Liliacidites variegatus	113
Lunatisporites limpidus (Permian remanie)	112
Lycopodiumsporites sp.	52
aff. Lygodioisporites	111
Microcachryidites antarcticus	46
Murornati gen. et sp. nov. 1	91
Murornati gen. et sp. nov. 2	92
Murornati gen. et sp. nov. 3	119
Myrtaceidites parvus anesus	82
Neoraistrickia sp.	79
Nothofagus cf. diminuta	121
aff. Parsonidites	106
Perinotrileti gen. et sp. nov.	55
Podocarpidites ellipticus	58
Podocarpidites micropterus	81

PE907145

This is an enclosure indicator page.
The enclosure PE907145 is enclosed within the container PE906833 at this location in this document.

The enclosure PE907145 has the following characteristics:

ITEM_BARCODE	= PE907145
CONTAINER_BARCODE	= PE906833
NAME	= Microfossil Distribution Chart
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= DIAGRAM
DESCRIPTION	= Microfossil Distribution Chart, Port Campbell-1 and -2
REMARKS	=
DATE_CREATED	= 30/04/61
DATE_RECEIVED	=
W_NO	= W463
WELL_NAME	= PORT CAMPBELL-2
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

Species	Chart No.
Microspores (Cont'd)	
Podocarpidites sp. 1	68
Podocarpidites sp. 2	53
Podocarpidites sp. 4	108
Podocarpidites sp. 5	85
Podocarpidites sp. 6	71
Podocarpidites sp. 7	80
Polypodiaceaeidites sp. nov.	49
Polypodiites arcus	63
Polypodiites sp. nov.	95
Polyporate gen. et sp. indet.	107
Proteacidites anananthoides	115
Proteacidites sp. nov. 1	86
Proteacidites sp. nov. 2	97
Rugulatisporites sp. nov. 1	42
Rugulatisporites sp. nov. 2	60
Sphagnumsporites australiensis	56
Sphagnumsporites aff. tenuis	100
Sphagnumsporites sp. 1	77
Sphagnumsporites sp. 2	101
Stephanocolpate gen. et sp. indet.	105
Styxisporites sp. nov.	93
Tricolpites cf. lilliei	76
Tricolpites pachyexinus	118
Tricolpites sp. nov. 1	83
Tricolpites sp. nov. 2	94
Tricolpites sp. nov. 3	96
Tricolpites sp. nov. 4	114
Tricolporopollenites sp. nov. 1	102
Tricolporopollenites sp. nov. 2	103
Trilobosporites trioreticulatus	61
Triorites edwardsi	116
Triorites minor	117
Triorites sp.	98
Zonati sp.	66
Zonotriletes gen. et sp. nov.	74

APPENDIX 4

WELL LOGGING

PORT CAMPBELL NO. 1 AND NO. 2 WELLS

CONTENTS

ELECTRIC LOGS

PORT CAMPBELL NO. 1

Wireline logging in this well was carried out by Geological Investigations Pty Ltd, a subsidiary of Oil Drilling and Exploration Ltd, the drilling contractors. The results are shown on the Composite Log; some comments in connection with this are mentioned below:

(i) On the composite log only the SP and the 16" Normal curves are shown. Although the 64" Normal and the 18' Lateral curves were recorded, the 64" log apparently suffered from a faulty relay switch or leakage in the cable giving a repetition of the 16" log. The reading of the Lateral log appears to be also faulty and is believed by our advisers to have no significance.

(ii) It is obvious that at points along the 16" Normal the curve is shown extending below the zero as marked on the heading of the log. This cannot be reconciled, as no electrical or mechanical zeros were recorded by the operator on the original logs, the zero as shown by the scale bar in the heading being the only scale on the originals.

(iii) At join of Runs Nos 2 and 3, 3 and 4, the resistivity values of the 16" curve do not match up. This fact can probably be explained under (ii) above, as it is obvious that the resistivity of the mudstone section wherein the joins lie would not vary as much as is evident on successive runs, there being no mud invasion into this section. Later wells show the resistivity of the Belfast Mudstone to be of the order of 3 to 4 ohms.

ELECTRICAL PROPERTIES OF THE PRODUCING ZONES AT PORT CAMPBELL NO. 1

by

F. Jewell*

At depths between 3300 and 3700 feet in Port Campbell No. 1, the self-potential log does not indicate permeable zones very clearly because of the freshness of the formation water. Below 3700 feet however the formation water becomes more saline and the self-potential log indicates several zones which are obviously permeable and contain water more saline than the drilling fluid. These zones are at:

4005-4015 feet	4197-4203 feet
4047-4050 feet	5656-5668 feet
4059-4070 feet	5910-5919 feet
4110-4117 feet	

Probably many of the resistivity peaks correspond to sandstone in which mud invasion or shale content has reduced the self-potential value.

Consider the gas-producing bed at 5656-5668 feet; if it is accepted that the value of mud resistivity Rm = 1.09 ohm-metres at 72°F (quoted in the log), then

---

* Bureau of Mineral Resources.

$$\text{Self-potential (in mV)} = 71 \log_{10} \frac{0.75Rm}{Rw}$$

where Rw is the resistivity of formation water.

$$\text{i.e.} \qquad 36 = 71 \log_{10} \frac{0.82}{Rw}$$

$$\text{whence} \qquad Rw = 0.25 \text{ ohm-metres.}$$

The porosity of the bed is not known, but if a reasonable value of P = 0.3 is assumed, the formation factor F would be given by

$$F = P^{-1.8}$$

$$= 8.8$$

The resistivity R of the water-saturated formation, which is given by R = F.Rw, would then be equal to 2.2 ohm-metres. In actual fact, however, the formation resistivity R is approximately 50 ohm-metres. Presumably therefore the bed is only partially saturated and gas or oil takes up the remaining pore-space. The degree of saturation S is given by

$$S = \sqrt{\frac{F.Rw}{R}} \quad \text{(approximately)}$$

$$= \sqrt{\frac{2.2}{50}}$$

$$= 0.21$$

If instead of 0.3 a value of 0.25 had been assumed for the porosity P, the formation factor F would be 12, and the saturation would be 0.27.

The maximum water saturation which allows production of oil or gas without water is usually quoted as approximately 0.3 except where the formation permeability is low, as in silty sand; under these conditions a higher water saturation is tolerable. Judging by the appearance of the self-potential log for the zone in question, it is unlikely that the sand is silty.

Consider now the gas-producing bed at 5910-5919 feet; as the formation resistivity here is only about 33 ohm-metres the water saturation is probably much greater than at the previous zone. If the recorded self-potential (20 mV) is taken as the true value, the resistivity of the formation water is only 0.43 ohm-metres. This corresponds to a formation factor F = 18 and a water saturation S = 0.48. This zone did in fact produce salt water, whereas the 5656-5668 foot zone produced gas.

ELECTRIC LOGS

PORT CAMPBELL NO. 2

INTERPRETATION OF LOGS RUN 3RD NOVEMBER, 1960

by

J.A.W. White*

Casing Shoe: 5650 feet

Total Depth: 7940 feet

A. Logs Run

Electric Log Run-6 Depth Scales 5" and 1"
Microlog Run-6 Depth Scales 5" and 1"
Laterolog Run-2 Depth Scales 5" and 1"

B. Mud Properties

(i) Measured
Rm = 0.51 at 92°F
Rmf = 0.41 at 53°F
Rmc = 1.34 at 53°F

(ii) Computed
Rm at BHT = 0.27 at 172°F
Rmf at BHT = 0.138 at 172°F
Rmc at BHT = 0.43 at 172°F

(iii) Mud Log
Rm = 0.36 at 6200' (163°F)

Note: This is an upper limit of Rm

C. Interpretation

No permeable beds of any consequence are found in this section of the hole. Immediately below the casing shoe there is some sand development down to about 5814 feet but although it is shown on the SP curve there is not enough permeability for a mud cake to form as shown by the Microlog. The increase in resistivity is caused by the increase of sand or silt content.

5875 feet A highly resistive bed 2'6" thick appears at this point. From the log it may be either a dolomitic band or a dense impermeable sand streak.

6190-6210 feet The whipstock set at this depth is clearly shown by its effect on the Micro-caliper curve and on the two Micro-resistivity curves. Above this depth, the average hole size is around 13 inches whilst below it, it is only 10 inches, reflecting the smaller amount of caving with the lime/caustic/diesel mud. It is interesting to note that the 'shale' resistivity as shown by the Electric log and the Laterolog (and also the Run-5, Electric log) are all reading the same, namely 2.4 ohms approximately.

6770 feet At this point there is a slight increase in the 'shale' resistivity and at the same time there is a distinct change in the appearance of the Microlog. There may be a slight change in facies at this point.

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* Schlumberger Seaco, Inc.

7676 feet Below this depth the formations become more silty, although there is still no permeability development at all. The degree of 'siltiness' can be seen from the resistivity reading of the Laterolog.

7911 feet This is the top of a 'sand' which has just marginal permeability - it is probably of the order of 1 millidarcy as it is just sufficient to produce a deflection of the SP curve but there is no evidence of any mudcake opposite this section. Unfortunately, due to cavings at the bottom of the hole, only the top few feet of this sand could be logged, but, on the evidence of the topmost section, it must be considered tight.

ELECTRIC LOGS

PORT CAMPBELL NO. 2

INTERPRETATION OF LOGS RUN 11TH NOVEMBER, 1960

by

J.A.W. White*

Casing Shoe: 5650 feet

Total Depth: 8264 feet

A. Logs Run

Electric Log	Run-7 Depth Scales 5" and 1"
Microlog	Run-7 Depth Scales 5" and 1"
Laterolog	Run-3 Depth Scales 5" and 1"

B. Mud Properties

(i) Measured

Rm = 0.51 at 83°F
Rmf = 0.34 at 65°F
Rmc = 2.00 at 65°F

(ii) Computed

Rm at BHT = 0.24 at 180°F
Rmf at BHT = 0.13 at 180°F
Rmc at BHT = 0.70 at 180°F

(iii) Mud Log

Rm = 0.32 at 6200' (163°F)

C. Interpretation

7911-7956 feet The top of this sand, which had just been reached at the time of the last survey (3.11.1960) has already been interpreted and the present logs show that there is little change in the lower part of the sand. It is tight.

8128-8188 feet This section shows a lot of variation in resistivity both on the Laterolog and on the Microlog. This variation is apparently due to a change in the rock type and is not related to a change in the interstitial fluids as this section is quite tight with no permeability or porosity.

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* Schlumberger Seaco, Inc.

8188-8214 feet Taking the sand at 8192 feet as representative of the rest of the bed, it is found by using charts A-8, A-10, A-12, C-4, C-12, and D-16 that the porosity is 13% and Sw is 35%. This assumes a residual oil saturation of 10% and an invasion of 3d.

8214-8219 feet Hard and impermeable.

8219-8249 feet There is a permeability barrier at 8226 feet and again at 8239 feet. There is some variation throughout this sand body and three points representative of the part of the sand in which they occur have been chosen. At 8222 feet the porosity is 12% and Sw is 30%, at 8232 feet porosity is 15% and Sw 32%, and at 8244 feet porosity is 16% and Sw 29%.

8252 feet This is the top of another sand which is porous, but at the time of logging, the hole had penetrated only two feet into it and this is not sufficient for quantitative interpretation.

DEVIATION SURVEYS

PORT CAMPBELL NO. 2

Totco Readings

Depth (feet)	Deviation (degrees)
100	1/8
195	0
430	3/4
740	1/8
950	1/8
1165	1/2
1700	1/8
2925	1/4
3154	1/2
3264	3/4
3500	1/2
3890	3/4
4190	3/4
4379	3/4
4748	3/4
4960	1/2
5245	1
5600	1
6190	5
6412	5
6690	7 1/2
6832	8
6855	8
7025	7 3/4
7225	8
7403	7 3/4
7491	8
7615	8
7719	8 1/2
7800	7 1/2
8095	6 1/2
8170	6 1/2
8284	6 1/2

Depth (feet)	Deviation (degrees)
Deviated Hole	
5739	1 1/2 - 2
5762	1 1/2
5835	1 3/4
5896	1 3/4
5995	2
6105	3 - 3 1/2
6142	3
6190	4
6220	4
6292	5
5927	1 1/2 - 2
5988	2
6034	3 - 3 1/4
6140	2 1/4
6185	4
6190	3
6195	6 3/4
6210	2 3/4
6232	3
6300	2 3/4
6490	3
6760	2 1/4
6830	3
7090	4
7360	5 1/2
7540	6
7683	7
7830	6 1/2
7938	6 3/4
8110	6 1/2
8140	6
8197	5 3/4
8245	6
8375	6
8721	3 - 3 1/4

DEVIATION SURVEYS

PORT CAMPBELL NO. 2

Schlumberger Readings

Date	Depth (feet)	Deviation (degrees) (minutes)	Azimuth (degrees)	Date	Depth (feet)	Deviation (degrees) (minutes)	Azimuth (degrees)
27. 8.60	5658	1.45	306	12.10.60	6044	1.30	251
	5681	1.45	316		6046	2.00	266
	5764	1.45	315	14.10.60	6000	1.15	321
	5787	1.45	308		6050	1.30	321
	5858	2.00	313		6100	3.00	336
	5878	2.00	311		6120	3.00	331
	6250	4.00	321		6130	2.45	326
	6450	5.30	316		6140	4.00	336
	6650	6.15	321		6150	4.30	326
	6850	7.00	321		6160	4.00	328
	7050	7.00	316		6162	3.30	334
	7250	7.15	315	16.10.60	6100	3.00	331
	7450	7.45	309		6150	4.30	336
	7650	8.00	303		6180	2.45	024
	7900	7.00	311		6190	5.00	011
7.10.60	5640	1.15	Cased		6200	6.30	002
	5700	1.00	311		6210	8.00	003
	5750	0.45	330		6211	8.00	001
	5800	1.00	328	21.10.60	6150	5.00	339
	5850	1.00	301		6200	2.30	009
	5900	1.15	311		6250	2.00	039
	5950	1.30	328		6300	2.00	029
	6000	1.30	329		6350	2.00	023
	6050	1.45	331		6400	2.00	006
	6100	2.00	326		6450	2.15	016
	6150	3.30	326		6500	2.30	354
	6200	3.15	326		6534	2.30	356
	6224	4.30	324				
12.10.60	6000	1.15	316				
	6030	2.30	329				
	6042	1.30	256				

APPENDIX 5

RESERVOIR ENGINEERING

PORT CAMPBELL NO. 1 and NO. 2 WELLS

CONTENTS

FORMATION TESTS

PORT CAMPBELL NO. 1

Open Hole Tests

D.S.T. No. 1. Interval 5653 - 5718 feet

1/4" choke in Johnston packer. No water cushion. 2" Cameron valve choked back used as wellhead choke. Immediate strong blow of gas increasing in pressure to 1600 p.s.i.g. and steady until tool closed after 1 hour 20 minutes. Recovered 900 feet gas-cut mud.

I.M.P. - 3020 p.s.i. F.M.P. - 2910 p.s.i.

I.F.P. - 2320 p.s.i. F.F.P. - 2310 p.s.i.

S.I.P. - Not taken

Drill Stem Tests through Casing Perforations

D.S.T. No. 2. Intervals 5908 - 5920 feet, and 5924 - 5928 feet

Johnston packer set at 5890 feet; 1/4" choke in tool. No water cushion. Adjustable choke on wellhead wide open. Light flow of air (?gas) - maximum reading of 3" of Hg through 1/8" orifice plate. Test open for 1 hour 40 minutes. Recovered 5460 feet of gas-cut salt water with gas-cut mud in first stand.

I.M.P. - 3100 p.s.i. F.M.P. - 2900 p.s.i.

I.F.P. - 1500 p.s.i. F.F.P. - 2175 p.s.i.

S.I.P. - Not taken

Salinity of water: 8600 mgm Cl/litre (on site)
13,700 ppm. NaCl (Lab.)

D.S.T. No. 3. Interval 5756 - 5766 feet

Packer set at 5744 feet. No bottom choke. No water cushion. Adjustable wellhead choke wide open. Very slight flow of air and gas ceased after 10 minutes. Test open for 1 hour and shut in for 1 hour 10 minutes. Recovered 5314 feet of gas-cut mud and salt water.

Salinity of water: 7000 mgm Cl/litre (on site)
12,700 ppm. NaCl (Lab.)

I.M.P. - 2990 p.s.i. F.M.P. - 2880 p.s.i.

I.F.P. - 2050 p.s.i. F.F.P. - 2125 p.s.i.

S.I.P. - 2125 p.s.i.

D.S.T. No. 4. Interval 5695 - 5701 feet

Packer set at 5681 feet with 5/16" bottom choke. No water cushion. Adjustable wellhead choke wide open. Slight flow of gas diminishing to nothing after 30 minutes.

Well open for 1 hour 15 minutes.

Recovered 270 feet gas-cut mud and 5050 feet of gas-cut dirty salt water with much colloidal material.

Salinity of water: First salt water sample = 5360 mgm Cl/litre (on site)

Sample just above packer = 8300 mgm Cl/litre (on site)

I.M.P. - 3050 p.s.i. F.M.P. - 2900 p.s.i.

I.F.P. - 1175 p.s.i. F.F.P. - 2105 p.s.i.

S.I.P. - Not taken

Production Test No. 1(a) Interval 5656 - 5666 feet

Tubing landed at 5649 feet. Mud displaced with water and rocking commenced. No result. Swabbed well and after 17 swabs (approx. 47.7 bbl. of water) well came in. Wellhead nippled up and started producing through 24/64" top choke (on adjustable choke) while well cleaning itself up. Small amount of condensate and salt water also noted. Pressures dropped slowly on the tubing head and casing head until well shut in. Pressures recorded are listed below.

Readings from midnight Saturday, 2.1.1960, until 11 a.m. Sunday, 3.1.1960, when well was shut in. Choke: 24/64"

Time	Tubing Head Pressure (p.s.i.)	Casing Head Pressure (p.s.i.)
12.00	1825	1825
12.30 a.m.	1825	1825
1.00	1800	1800
1.30	1800	1800
2.00	1800	1800
2.30	1800	1800
3.00	1800	1800
3.30	1775	1775
4.00	1775	1775
4.30	1775	1775

Time	Tubing Head Pressure (p.s.i.)	Casing Head Pressure (p.s.i.)
5.00	1775	1775
5.30	1750	1750
6.00	1750	1750
6.30	1725	1725
7.00	1675	1725
7.30	1700	1725
8.00	1600	1725
8.30	1600	1725
9.00	1600	1725
9.30	1600	1725
10.00	1575	1750
10.30	1550	1750
11.00	1550	1750

Flow reading taken through 2" orifice plate at 9.30 a.m. Sunday, assuming specific gravity of gas at 0.6, = 4,200,000 cu.ft/24 hours. Well was kept shut in until 5.00 p.m. (6 hours). Readings during shut-in period are recorded below:

Time	Tubing Head Pressure (p.s.i.)	Casing Head Pressure (p.s.i.)
11.00 a.m.	1550	1750
11.30	1700	1700
12.00	1750	1675
12.30 p.m.	1775	1650
1.00	1775	1625
1.30	1760	1600
2.00	1760	1590
2.30	1760	1555
3.00	1760	1530
3.30	1760	1500
4.00	1760	1500
4.30	1760	1490
5.00	1760	1450

Well was then opened at 5.00 p.m. on 16/64" choke; salt water was coming in, so after half an hour shut the choke down to 12/64". This choke size also produced large amounts of water and approximately 500 gallons flowed in two hours. Choke opened to 16/64" at 7.40 p.m. and well flowed on this choke. Pressure at midnight Sunday, 3rd January, 1960, was 1525 p.s.i. on tubing and 1725 p.s.i. on casing. Gas burning well.

Readings of pressure after well opened were as follows:

Choke Size (in.)	Time	Tubing Head Pressure (p.s.i.)	Casing Head Pressure (p.s.i.)
16/64	5.30 p.m.	1375	1600
12/64	6.00	1275	1600
"	6.30	1300	1625
"	7.00	1325	1650
"	7.30	1425	1675
16/64	8.00	1475	1700
"	8.30	1500	1725
"	9.00	1550	1725
"	9.30	1500	1725
"	10.00	1525	1725
"	10.30	1550	1725
"	11.00	1550	1725
"	11.30	1550	1725
"	12.00	1525	1725

Well was kept flowing through 16/64" top choke until shut in at 12.40 a.m. on 7.1.1960. Periodic flow readings were taken through the Orifice Tester using a 1 1/2" orifice plate. Readings were also noted of the time taken to flow 500 gallons (approx.) from the liquid knockout tank. When it appeared that the fluid might kill the gas the well was shut in. Fluid in the storage tank consisted of salt water, (chloride content determined on site = 7920 to 10,480 mgm/litre) and a film of light brown condensate becoming darker and a little heavier before well was shut in. Intermixed with this brown (?)hydrocarbon was a brown frothy mud substance which separated out on top of the tank and which could be fine particles and colloids of the drilling mud which had penetrated into the formation during its original drilling.

Initially the tank was filling at a rate of approximately 100 gallons an hour until the evening tour on 5.1.1960, when rate had increased to 100 gallons in 40 minutes. This rate further increased until during the evening tour on 6.1.1960, fluid was being collected at the rate of 100 gallons per 20 minutes. At this point it was decided to shut the well in.

In general, pressures taken half hourly throughout the test on both the tubing head and casing head decreased slowly with minor variations, the former decreasing somewhat faster than the latter, such that from 12.30 a.m. on 4.1.1960, when tubing showed a pressure of

1525 p.s.i. and casing 1700 p.s.i., they had decreased to 1075 p.s.i. and 1500 p.s.i. respectively just before the well was shut in. Tubing pressure had been as low as 950 p.s.i. at 7.30 p.m. on 6.1.1960.

Flow readings taken at various times and, with their respective pressures, are shown below, all through 16/64" top choke.

Time and Date	Flow Readings (Mcf/D)	Tubing Pressure (p.s.i.)	Casing Pressure (p.s.i.)
11.30 a.m. 4.1.60	1674	1450	1675
8.00 p.m. "	2227	1425	1625
8.00 a.m. 5.1.60	2077	1375	1575
3.15 p.m. "	1858	1320	1550
8.30 p.m. "	2479	1290	1550
6.45 a.m. 6.1.60	2721	1250	1500
2.45 p.m. "	2060	1180	1500
8.25 p.m. "	1446	1050	1500

Before each of these readings was taken, the top choke was opened to 17/64" for 1 minute and then shut back again to clear it, as it had been noticed that brown muddy material had probably choked the flow a little on a previous reading. However, the flow was usually steady by the time the reading was taken (usually 20 minutes before temperature constant) and it may be that the increase of the flow noted at 8.30 p.m. on 5.1.1960, and at 6.45 a.m. on 6.1.1960, if not natural, was due to the adjustable choke being a fraction out on resetting to 16/64". After the well was shut in at 12.40 a.m. on 7.1.1960, tubing pressure built up from 1075 p.s.i. to a maximum and steady pressure of 1525 p.s.i. by 7.30 a.m., while the casing pressure initially went up from 1475 p.s.i. to 1500 p.s.i. at 2 a.m., then decreased slowly until constant at 1325 p.s.i. until day tour on 8.1.1960, when it was at 1300 p.s.i. It did not fall any further until well was killed. This pattern of pressure variation is similar to that noted when the well was shut in previously.

The well was left shut in until killed with mud at 6.00 a.m. on 9.1.1960.

Pressure readings were as follows:

Pressure Recording from 12.30 a.m. 4.1.1960 to 6.00 a.m. 9.1.1960

Time	Tubing Pressure (p.s.i.)	Casing Pressure (p.s.i.)
	4.1.1960	
12.30 a.m.	1525	1700
1.00	"	"
1.30	"	"
2.00	"	"
2.30	1500	"
3.00	"	"
3.30	"	"
4.00	"	"
4.30	"	"
5.00	"	"
5.30	"	"
6.00	1475	"
6.30	1450	"
7.00	"	"
7.30	"	"
8.00	"	1675
8.30	"	"
9.00	"	"
9.30	"	"
10.00	"	"
10.30	"	"
11.00	"	"
11.30	"	"
12.00	"	"
12.30 p.m.	"	"
1.00	"	1670
1.30	"	1660
2.00	"	1650
2.30	"	"
3.00	1400	"
3.30	"	"
4.00	"	"
4.30	"	"
5.00	1450	1625
5.30	1425	1650
6.00	1400	"
6.30	"	"
7.00	1350	"
7.30	1425	"
8.00	"	1625
8.30	"	"
9.00 p.m.	1450	1625
9.30	1425	"
10.00	1375	"
10.30	1425	"
11.00	"	"
11.30	"	"
12.00	"	"
	5.1.1960	
12.30 a.m.	1425	1700
1.00	1400	"
1.30	"	"
2.00	"	"
2.30	1375	"
3.00	"	1675
3.30	"	"
4.00	"	"
4.30	1350	"
5.00	"	1600
5.30	"	"
6.00	"	"
6.30	"	"
7.00	1325	1575
7.30	1350	"
8.00	1325	"
8.30	"	"
9.00	"	"
9.30	"	"
10.00	1310	"
10.30	"	"
11.00	1325	"
11.30	1310	"
12.00	1300	"
12.30 p.m.	1315	"
1.00	"	"
1.30	"	"
2.00	1300	"
2.30	"	"
3.00	1320	1550
3.30	1275	"
4.00	1300	"
4.30	"	"

Time	Tubing Pressure (p.s.i.)	Casing Pressure (p.s.i.)
	5.1.1960	
5.00 p.m.	1300	1550
5.30	"	"
6.00	"	"
6.30	"	"
7.00	1290	"
7.30	"	"
8.00	"	"
8.30	"	"
9.00	1275	"
9.30	"	"
10.00	"	"
10.30	"	"
11.00	"	"
11.30	"	"
12.00	"	"
	6.1.1960	
12.30 a.m.	1250	1525
1.00	"	"
1.30	"	1500
2.00	"	"
2.30	"	1525
3.00	1225	"
3.30	"	"
4.00	1230	"
4.30	"	1500
5.00	"	"
5.30	"	"
6.00	1225	"
6.30	1250	"
7.00	"	"
7.30	1225	"
8.00	"	"
8.30	1235	"
9.00	1230	"
9.30	1225	"
10.00	1230	"
10.30	1225	"
11.00	"	"
11.30	"	"
12.00	"	"
12.30 p.m.	1200	"
1.00 p.m.	1200	1500
1.30	"	"
2.00	"	"
2.30	1180	"
3.00	"	"
3.30	1175	"
4.00	1190	"
4.30	1550	"
5.00	1125	"
5.30	1110	"
6.00	1125	"
6.30	1125	"
7.00	1000	"
7.30	950	"
8.00	1050	"
8.30	"	"
9.00	1100	"
9.30	1075	"
10.00	990	"
10.30	1125	"
11.00	1100	"
11.30	1075	"
12.00	"	"
	7.1.1960	
12.30 a.m.	1075	1475
	WELL SHUT IN	
1.00 a.m.	1250	1500
1.30	1300	"
2.00	1350	"
2.30	1400	1475
3.00	1450	1450
3.30	1475	1425
4.00	1500	1400
4.30	"	"
5.00	"	"
5.30	"	1375
6.00	"	"
6.30	"	1350
7.00	"	1325
7.30	1525	1300
8.00	"	"

From this time until the well was killed on 9.1.1960, pressure hardly varied. Tubing pressure remained between 1500 - 1530 p.s.i. while casing pressure remained between 1300 - 1325 p.s.i.

Production Test No. 1(b)* Interval 5657 - 5663 feet

A hookwall packer with a slotted bail below was run on 2" tubing to a depth of 5638 feet. The mud in the tubing was displaced with water, the packer set, and the well swabbed from 3000 feet. The well started to flow at 9.15 a.m. on 19.1.1960. Placed well on 5/16" choke to clean up well. Wellhead pressure at 9.30 a.m. was 1025 p.s.i.g. and increased to 1325 p.s.i.g. at 12.00 noon. Pressure decreased to 1175 p.s.i.g. at 4.00 p.m. Well making small amount of drilling mud and clear condensate of 62° A.P.I. gravity. No water being produced. Placed well on 1/2" choke for one hour during which time the pressure decreased to 825 p.s.i.g. and then increased to 860 p.s.i.g. Changed choke back to 5/16" and flowed until 1.00 a.m. Flowing pressure on 5/16" choke was 1280 p.s.i.g. Shut well in for build-up previous to running a bottom-hole static pressure. After a shut-in time of 24 hours, ran Amerada gauge and maximum recording thermometer to 5630 feet. Made stops at 0, 1500, 3000, 4500, 5000, 5500, 5600 and 5630 feet. Gradient showed liquid at 5600 feet. Pressure at 5630 feet was 1710 p.s.i.g. Extrapolations to 5660 feet gave sand static pressure of 1722 p.s.i.g. Wellhead static pressure by Amerada gauge was 1421 p.s.i.g. Wellhead static pressure by test gauge 1420 p.s.i.g. Bottom-hole temperature 157° F. Connected up testing equipment as follows: Wellhead consisted of a tee on tubing with two 2" valves and a positive choke body on the wing and two 2" valves running above. A calibrated test gauge was placed upstream of the choke to take wellhead pressures. From the choke, the flow-line entered a liquid knock-out from which liquid could be drained into a 500-gallon tank and measured. Gas passed from the top of the liquid knock-out into a line and then through a 4" meter run and was flared through a vertical riser. Back pressure was held in the meter run with an adjustable choke. Gas was metered with a dryflow orifice meter with a 0-100 inch differential and 1000 p.s.i. static element. Pressures were taken on the meter run with a calibrated test gauge and temperatures read from an ordinary thermometer in a thermometer well on the meter run. The well was opened on a 5/16" choke at 8.00 p.m. on 20.1.1960, and flowed on this choke for 18 hours during which time the wellhead pressure gradually declined to 1260 p.s.i.g. at 75° F. The metered rate was 2510 Mcf/D. Total gas produced was 1885 Mcf. Clear condensate produced was 9.75 barrels or 0.224 gallon per thousand cubic feet. A.P.I. gravity 65.3° at 60° F. No water produced.

Changed choke to 1/2" and flowed for 6.5 hours during which time the wellhead pressure gradually decreased to 870 p.s.i.g. at 85° F. The metered rate was 4360 Mcf/D. Total gas produced on this rate 1185 Mcf. Clear condensate produced was 6 barrels or 0.212 GPMcf. No water produced. Changed choke to 1/4" and flowed for 11 hours during which time the wellhead pressure gradually decreased to 1265 p.s.i.g. at 65° F. Metered rate was 1360 Mcf/D. Total gas produced on this rate 623 Mcf. Clear condensate produced was 3 barrels or 0.202 GPMcf. A.P.I. Gravity 64.8° at 60° F. No water produced. Changed choke to 1/8" and flowed for 5 hours during which time the wellhead pressure remained steady at 1300 p.s.i.g. at 68° F. Metered rate was 615 Mcf/D, total gas produced being 128 Mcf. Well was shut in from 2.00 p.m. until 5.45 p.m. to extend flare line and change choke and meter run plate. Opened well on 5/16" choke at 5.45 p.m. on 22.1.1960. At 5.00 p.m. on 23.1.1960, the wellhead pressure had decreased to 1075 p.s.i. at 78° F. The metered rate was 2200 Mcf/D.

Well started making salt water at 12.00 noon on 23.1.1960. Salinity of water 5041 mgm Cl/litre. Water rate 0.306 GPMcf. Clear condensate rate 0.115 GPMcf. A.P.I. gravity 65.2° at 60° F. Continued to flow on 5/16" choke until 10.00 a.m. on 24.1.1960, at which time wellhead pressure had decreased to 1010 p.s.i.g. at 80° F. Metered rate was 2020 Mcf/D. Gas produced on this rate 4220 Mcf. Clear condensate rate 0.134 GPMcf. Water rate 0.268 GPMcf. Salinity of water at 10.00 a.m. 7694 mgm Cl/litre.

* By A.P. Hansen, Petroleum Engineer, S.V.O.C.

Changed choke to 1/2" to make sure well was not loading up and would be clean for bottom hole pressure survey. Flowed well for 5 hours during which time wellhead pressure steadily dropped to 660 p.s.i.g. at 76°F. Metered rate 3260 Mcf/D. Gas produced 680 Mcf. Clear condensate produced 1.5 barrels or 0.0925 GPMcf. A.P.I. Gravity 62.7° at 60°F. Water produced 9.5 barrels or 0.585 GPMcf. Salinity 8520 mgm Cl/litre.

Well shut in at 3.00 p.m. on 24.1.1960 for build-up prior to taking bottom-hole static pressure survey. Total gas produced since last pressure survey was 8131 Mcf. Total condensate produced 34 barrels; total water produced 17.5 barrels. When the previous 5/16" choke was pulled it was a yellow-green colour which indicated that the water being produced is coming from below at 5695 to 5701 feet. Fluorescein dye of this colour had previously been squeezed in the water sand at that depth ahead of the cement squeeze job.

After a shut-in time of 19 hours an Amerada gauge and maximum thermometer were run to 5630 feet. Stops were made at 0, 1500, 3000, 4500, 5000, 5250, 5500, 5600 and 5630 feet. The top shut-in pressure was 1115 p.s.i.g. which agreed with the test gauge on wellhead. The static pressure at 5630 feet was 1355 p.s.i.g. The gradient showed no liquid in the tubing. Extrapolated to 5660 feet, the sand face static pressure was 1357 p.s.i.g. The bottom hole temperature was 158°F. With the production of 8131 Mcf of gas the reservoir pressure was decreased 365 p.s.i. This is a decrease of 44.8 p.s.i. per MMcf which is indicative of a very small gas reservoir or possibly a small gas cap of an oil reservoir. The well was again flowed in an effort to obtain four nearly stable rates to calculate an absolute open flow potential. Opened on 1/2" choke for one hour, the wellhead pressure declined to 560 p.s.i.g. and then increased to 590 p.s.i.g. at 78°F. A longer period of flow may have seen a slightly greater rise. Metered rate was 3090 Mcf/D. Clear condensate rate 0.0597 GPMcf. A.P.I. Gravity 61° at 60°F. Water rate 0.362 GPMcf. Salinity 7684 mgm Cl/litre. Changed choke to 5/16" and flowed for 2 1/4 hours during which time the wellhead pressure steadily dropped to 918 p.s.i.g. at 82°F. The metered rate was 1860 Mcf/D.

Changed choke to 1/4" and flowed for one hour during which time the wellhead pressure declined to 975 p.s.i.g. at 81°F. Metered rate was 1132 Mcf/D.

Changed choke to 1/8" and flowed for three hours during which time the wellhead pressure decreased to 1015 p.s.i.g. at 73°F. Metered rate was 0.241 Mcf/D. This rate was slightly low due to the small volume passing through a too large orifice plate and thereby being metered near the minimum range of the differential meter. The above four flow rates were used to calculate a four point "Back Pressure Test". These calculations are attached along with a "back pressure curve", (see Figures 9, 10). As can be seen on the curve, the points do not line up properly. This is due to the inability of the well to stabilize on a rate. Rate number one would probably have come more in line given a little more time. Rate number four is probably a little low and should be more in line. Regardless of the fact that a smooth curve was not obtained, the "absolute open flow" of 4150 Mcf/D is close to the well's true "absolute flow" since the slope of the curve would be less than 1.0 and would have to be drawn with a slope of 1.0 through the highest rate of flow anyway.

The rate of flow taken earlier in the tests could not be used because the shut-in pressure of the well was pulled down too much between the rates taken.

D.S.T. No. 5 Intervals 4815 - 4820 feet, and 4830 - 4840 feet

After setting a Baker Model 'K' cast iron cement retainer as a bridge plug at 5644 feet, the intervals 4815 - 4820 and 4830 - 4840 feet were perforated with 59 shots on

Fig. 9

New Well X
Workover
Re-Test
Reclassified
Oil to Gas

BACK PRESSURE TEST

Field _____ Reservoir _____ County _____
Well Owner *Frome-Broken Hill Co. Pty. Ltd.* Lease _____ Well No. *Park Campbell No 1*
Section _____ Block _____ Survey _____ Location _____
Date of Test *25/1/60* Acres _____ Pipe Line Conn _____
Gravity (Raw Gas) *0.770* Avg. Shut-In Temp *65°F* Bottom Hole Temp *158°F* @ *5660*
Size CSG *5½"* Wt./Ft. *14#* *20#* Lbs. I. D. CSG _____ Set at *5962*
Size TBG *2⅜"* Wt./Ft. *4.7* Lbs. I. D. TBG *1.995* Set at *5638*
Prod. Section From *5657 - 5663* Avg. Prod. Length. (L) *5660*
Elevation *347 K.B* Date of Completion _____ Producing through Tubing *×* Casing _____

FIELD DATA

Run No.	Time of Run Min	Choke Size	Coefficient	Choke Press. PSIA	Choke Temp. °F	Wellhead Prcss P_w PSIA	Wellhead Flow Temp. °F	P_w^2 (Thousands)
Shut-In		*9 hours*				*1130*	*65*	*1277*
1		¼				*605*	*78*	*366*
2		7/16				*933*	*82*	*870*
3		½				*990*	*81*	*980*
4		⅝				*1030*	*73*	*1061*
5								

VOLUME CALCULATIONS

Run No.	Size Line Fig. - Top	Size Orifice	Meter Coeff. 24 Hrs.	Static $\sqrt{P_m}$	Diff. $\sqrt{h_w}$	Flow Temp. °F	Temp. Factor F_{tf}	Gravity Factor F_g	Compress Factor F_{pv}	Volume MCF / Day
1	4	*2.5"*	*43543.2*	*16.9*	*4.62*	*68°*	*.9924*	*.8827*	*1.040*	*3090*
2	4	*2.5*	*43543.2*	*13.05*	*3.65*	*61*	*.9990*	"	*1.027*	*1,860*
3	4	*2.0*	*25922.4*	*10.50*	*4.70*	*69*	*.9915*	"	*1.011*	*1,132*
4	4	*2.0*	*25922.4*	*7.55*	*1.4*	*70*	*.9905*	"	*1.005*	*241*
5										

S.P.G. of gas = 0.77

PRESSURE CALCULATIONS

Gas Liquid Hydrocarbon Ratio *470* MCF per Bbl.
Gravity of Liquid Hydrocarbons *61* Deg A.P.I.
Gas produced into pipe line during test _____ MCF

$(D_{eff})^{8/3} = 6.310$ $\sqrt{T_f} = \sqrt{573} = 23.94$

$C = \frac{1118 \times (D_{eff})^{8/3}}{\sqrt{T_f}} = \frac{1118\ (6.310)}{23.94} = 296$

$\sqrt{GL} = \sqrt{(.77)(5660)} = 66.0$ $\frac{\sqrt{GL}}{C} = \frac{66.0}{296} = 0.223$

$G_{mix} = .77$ $\theta = 45°$ $N = 1000$

Run No.	R	R^2 (Thousands)	P_t	P_w/P_t	F	K	$S = \frac{1}{2}$	E^{KS}	$\frac{P_f}{P_s}$ ★ a	$\frac{P_f^2}{P_s^2}$ a	$P_f^2 - P_s^2$
Shut-In						*.143*	*1.316*	*1.2075*	*1372*	*1882*	
1	*690.0*	*476*	*917.5*	*.660*	*.897*	*.1265*	*1.228*	*1.1685*	*708*	*501*	*1381*
2	*415.0*	*172*	*1021.0*	*.914*	*.958*	*.1350*	*1.270*	*1.1870*	*1107*	*1225*	*657*
3	*252.5*	*64*	*1022.0*	*.968*	*.984*	*.1388*	*1.277*	*1.1938*	*1182*	*1397*	*485*
4	*53.7*	*3*	*1032.0*	*.995*	*.997*	*.1413*	*1.286*	*1.1995*	*1237*	*1530*	*352*
5											

Absolute Open Flow *4,150* MCF/Day

★ *Ps is the sand face pressure.*

Run & Calculated by A.P. Hansen

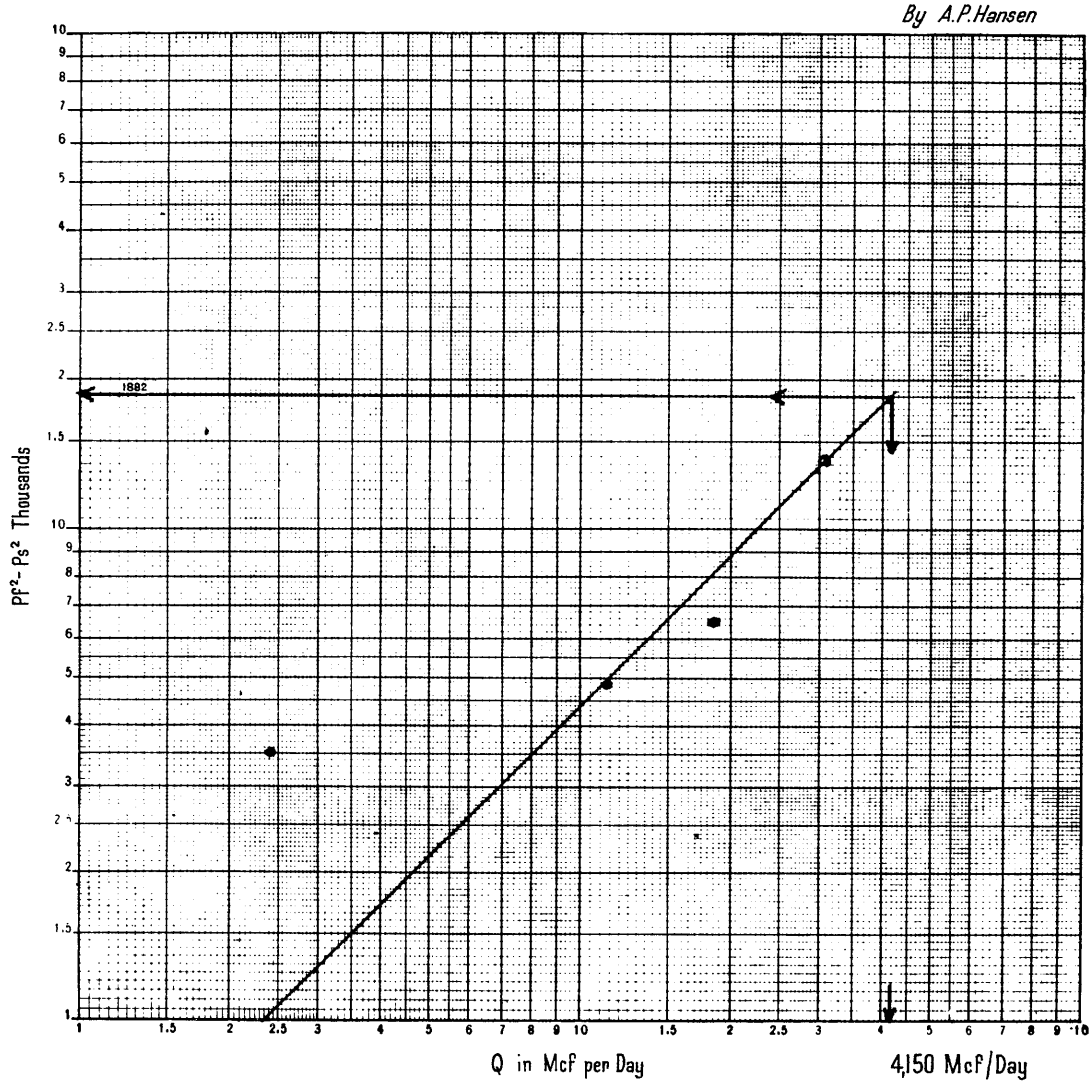
Fig. 10

BACK PRESSURE CURVE

Port Campbell #1

FROME-BROKEN HILL CO. PTY LTD.
Absolute open flow 4150 Mcf/Day
25-1-1960

By A.P.Hansen



31.1.1960. Went in hole with Johnston tester and set packer at 4814 feet. Opened tool at 9.55 a.m. Received very slight blow which diminished to nil after 3 1/4 hours. Closed tool and pulled out of hole. Recovered 2880 feet of water diluted gas-cut mud and 720 feet of gas-cut salt water. Salinity of water 4934 mgm Cl/litre.

I.M.P. - 2600 p.s.i.g. F.M.P. - 2500 p.s.i.g.

I.F.P. - 700 p.s.i.g. F.F.P. and Static Pressure - 1850 p.s.i.g.

On pulling the test tool out of the hole one slip was missing from the 5 1/2" packer.

Ran Baker Model 'K' cast iron cement retainer and set at 4810 feet. Squeeze cemented perforation with 15 sacks. Squeeze pressure 2200 p.s.i. Backed off to retainer and circulated while waiting on another packer to arrive since no slips were available to repair packer.

D.S.T. No. 6 Interval 4696 - 4702 feet

On 2.2.1960, pulled out of hole and perforated interval 4696 to 4702 feet with 24 shots. A 5 3/4" packer arrived instead of a 5 1/2" as ordered. Since the I.D. of the 5 1/2" 14-pound casing was large enough, the 5 3/4" packer was run but it held up at 2122 feet. Pulled out of hole and found 'J' slot pin sheared off. While repairing packer ran bit and scraper to 4700 feet to check for obstructions. While running scraper, drilling line fouled and had to be replaced. On 4.2.1960, ran 5 3/4" packer to 2122 feet where it stood up. Marks on packer indicated a joint of 20-pound casing at 2122 feet. Removed one slip from 5 3/4" packer and had it cut down to fit 5 1/2" packer. Ran Johnston Tester and set at 4690 feet. Opened tool at 11.20 a.m. Received very slight blow. Shut well in at 3.30 a.m. on 5.2.1960, for build-up. No top pressure received. Closed tool and unseated packer at 4.30 a.m. Recovered 180 feet of water diluted, slightly gas-cut mud and 270 feet of slightly gas-cut water. Water salinity 1065 mgm Cl/litre, pH 11.

I.M.P. - 2500 p.s.i.g. F.M.P. - 2450 p.s.i.g.

I.F.P. - 0 p.s.i.g.

F.F.P. - too low to read on chart

S.I.P. - too low to read on chart

Ran Baker Model 'K' cast iron cement retainer and set at 4690 feet. Squeezed perforations with 15 sacks of cement. Pulled out of hole and perforated shale interval at 4440 - 4442 feet with 7 shots. Went in hole with open-end drill pipe and bradenhead; squeezed interval 4440 - 4442 feet with 15 sacks.

D.S.T. No. 7. Interval 4498 - 4515 feet

On 6.2.1960, laid down tubing while waiting on cement. Went in hole with bit and cleaned out small amount of cement. Attempted to perforate interval 4498 - 4515 feet. Perforating gun would not fire. On 7.2. 1960, located and repaired short circuit after 14 hours. Perforated interval 4498 - 4515 feet with 59 shots. Went in hole with Johnston Tester and set at 4487 feet. Opened tool at 6.45 p.m. Received fair blow immediately. Left tool open

for 1 3/4 hours. Blow had become nil. Shut in for 30 minutes. Opened top bleed valve and received slight blow of gas which burned with good flame. Top pressure too low to register on gauge. Closed tool and unseated packer. Recovered 270 feet of gas-cut mud and 3690 feet of gas-cut water. Gas had a sharp smell. Water salinity 1136 mgm Cl/litre. A considerable amount of medium grain sand was present in the liquid. Last 90 feet of string filled with medium grain, well sorted sand.

I.M.P. - 2325 p.s.i.g.	F.M.P. - 2175 p.s.i.g.
I.F.P. - 1600 p.s.i.g.	F.F.P. - 1750 p.s.i.g.
Shut-in Bottom Hole Pressure	1750 p.s.i.g.

On 8.2.1960, ran Baker Model 'K' cast iron cement retainer and set at 4485 feet. Squeezed perforations with 20 sacks of cement at pressure 2100 p.s.i.

D.S.T. No. 8. Interval 4463 - 4475 feet

Pulled out of hole and perforated interval 4463 - 4475 feet with 44 shots. Ran Johnston Tester and set at 4456 feet. Opened tool at 8.00 p.m. Received fair blow which diminished to nil after one hour. Shut in for 30 minutes. No top shut-in pressure registered. Recovered 210 feet of slightly gas-cut mud and 3600 feet of slightly gas-cut water. Salinity of water 994 mgm Cl/litre. Considerable amount of very fine grain sand in liquid.

I.M.P. - 2130 p.s.i.g.	F.M.P. - 2050 p.s.i.g.
I.F.P. - 1300 p.s.i.g.	F.F.P. - 1735 p.s.i.g.
Shut-in Bottom Hole Pressure	1735 p.s.i.g.

All of the four preceding tests were taken with no bottom choke in tool and with no water cushion in string. A sample of the water from each test was obtained. None of the tests indicated any liquid hydrocarbons. The first interval tested produced salt water and the last three intervals produced fresh water.

On 9.2.1960, squeezed interval 4463-4475 feet with 20 sacks of cement at pressure 2000 p.s.i.g. Laid down all drill pipe and tubing. Well left in suspended status as follows: All perforations in the hole were squeeze cemented except interval 5657 - 5663 feet which had a bridging plug above and below. Casing left full of mud with a blind flange bolted to the top of the casing head. The following inscription was welded on the blind flange "FROME-BROKEN HILL PTY LTD, PORT CAMPBELL NO. 1".

FORMATION TESTS

PORT CAMPBELL NO. 2

Open Hole Tests

D.S.T. No. 1. Interval 7891 - 7930 feet

Test failed. Packer failed to hold.

D.S.T. No. 2. Interval 7900 - 7930 feet

Test failed. Packer failed to hold.

D.S.T. No. 3. Interval 5650 - 5874 feet

Casing hookwall packer set at 5630 feet in 9 5/8" casing. 1/2" choke in tool. No water cushion. Open for 45 minutes. Initial slight blow decreasing to steady, surging in 10 minutes and further decreased to weak for rest of flowing period. Shut in for 35 minutes. Recovered 1295 feet drilling mud, salinity 1300 ppm. chlorides.

I.H.P. - 4070 p.s.i.	F.H.P. - 4020 p.s.i.
I.F.P. - 560 p.s.i.	F.F.P. - 900 p.s.i.
I.S.I.P. - -	F.S.I.P. - 1800 p.s.i.

D.S.T. No. 4. Interval 5650 - 5874 feet

Casing hookwall as for D.S.T. No. 3. 1/2" choke in tool. No water cushion. First test failed. Second test at 5645 feet - open 45 minutes - received fair blow decreasing through remainder of flowing period. Shut in for 35 minutes. Recovered 1020 feet drilling mud and 370 feet muddy water. Salinity of water 4300 ppm. chlorides. Resistivity 0.80 at 52°F.

I.H.P. - 4080 p.s.i.	F.H.P. - 3960 p.s.i.
I.F.P. - 600 p.s.i.	F.F.P. - 1000 p.s.i.

S.I.P.'s not shown on chart (tool failed to close).

Drill Stem Tests through Casing Perforations

D.S.T. No. 5. Interval 8725 - 8735 feet

Test failed. Packer rubbers torn off and packer failed to seat.

D.S.T. No. 6. Interval 8725 - 8735 feet

Test failed; same reason as for D.S.T. No. 5.

D.S.T. No. 7. Interval 8725 - 8735 feet

Test failed as for D.S.T.'s Nos 5 and 6.

D.S.T. No. 8. Interval 8725 - 8735 feet

Packer set at 8689 feet. 1/4" choke in tool. Test appeared to be open for 12 minutes before seat failed, but no flowing pressures recorded on the chart.

D.S.T. No. 9. Interval 8586 - 8592 feet

Packer set at 8577 feet. 1/4" choke in tool. No water cushion. Open for 68 minutes. Slight blow increasing until 45 minutes, then decreased to nil at 68 minutes. Shut in 45 minutes. Recovered 270 feet mud and 180 feet muddy water and 3070 feet gas-cut water, and 180 feet mud. Salinity of water 8500 ppm. chlorides. Resistivity 0.4 ohm at 80°F.

I.H.P. - 4700 p.s.i. F.H.P. - 4500 p.s.i.

I.F.P. - 200 p.s.i. F.F.P. - 1400 p.s.i.

No S.I.P.'s recorded.

D.S.T. No. 10. Interval 8395 - 8405 feet

Test failed as disc did not break after three bars had been dropped.

D.S.T. No. 11. Interval 8395 - 8405 feet

Packer set at 8372 feet. Open 87 minutes. Received fair blow decreasing throughout flowing period. Shut in for 33 minutes. Recovered 90 feet mud, 7050 feet gas-cut water and 1230 feet gas-cut mud. Salinity of water 7600 ppm. chlorides.

I.H.P. - 4500 p.s.i. F.H.P. - 4420 p.s.i.

I.F.P. - 250 p.s.i. F.F.P. - 3330 p.s.i.

I.S.I.P. - 3510 p.s.i. F.S.I.P. - 3510 p.s.i.

D.S.T. No. 12. Interval 8338 - 8350 feet

Packer set at 8328 feet. Open 78 minutes. Received good blow after 2 minutes which decreased to slight at end of flowing period. Shut in for 42 minutes. Recovered 180 feet gas-cut mud and 7308 feet gas-cut water and 840 feet gas-cut mud. Salinity of water 7500 to 8000 ppm. chlorides.

I.H.P. - 4400 p.s.i. F.H.P. - 4370 p.s.i.

I.F.P. - 200 p.s.i. F.F.P. - 3380 p.s.i.

I.S.I.P. - 3670 p.s.i. F.S.I.P. - 3640 p.s.i.

D.S.T. No. 13. Interval 8338 - 8350 feet

Test failed as disc did not break. Leak in tubing gave 120 feet drilling mud.

D.S.T. No. 14. Interval 8338 - 8350 feet

Packer set at 8333 feet. Open for 120 minutes. Received good blow decreasing to nothing by end of flowing period. Shut in for 34 minutes. Swabbed 60 barrels gas-cut water. Salinity 8000 ppm. chlorides. Recovered 31 barrels gas-cut water, same salinity from string.

I.H.P. - 4225 p.s.i. F.H.P. - 4275 p.s.i.

I.F.P. - 700 p.s.i. F.F.P. - 3300 p.s.i.

No S.I.P.'s recorded.

D.S.T. No. 15. Interval 8294 - 8299 feet

Test failed. Rubbers on packer failed after 15 minutes and recovered only drilling mud.

D.S.T. No. 16. Interval 8294 - 8299 feet

Packer set at 8282 feet. Open for 99 minutes. Received very faint blow in 2 minutes increasing for 30 minutes and then decreased to nothing by end of flow period. Shut in for 18 minutes. Swabbed 60 barrels gas-cut muddy water. Salinity 7940 ppm. chlorides. Recovered 30 barrels gas-cut muddy water. Salinity 7800 ppm. chlorides. Small leak in rubber seal above packer allowed the mud to contaminate the water.

I.H.P. - 4100 p.s.i. F.H.P. - 4100 p.s.i.

I.F.P. - 500 p.s.i. F.F.P. - 3650 p.s.i.

I.S.I.P. - 3700 p.s.i. F.S.I.P. - 3700 p.s.i.

D.S.T. No. 17. Interval 8294 - 8299 feet

Test failed. Rubbers on packer failed and recovered only drilling mud.

D.S.T. No. 18. Interval 8294 - 8299 feet

Packer set at 8282 feet. Open for 86 minutes. Received good blow - strong in 20 minutes - gas to surface in 25 minutes. Blow decreased to nothing by end of flow period. Swabbed 40 barrels gas-cut water. Salinity 8000 ppm. chlorides. Shut in for 45 minutes. Recovered 32 barrels gas-cut water, salinity 8000 ppm. chlorides.

I.H.P. - 3840 p.s.i. F.H.P. - 3840 p.s.i.

I.F.P. - 460 p.s.i. F.F.P. - 3430 p.s.i.

I.S.I.P. - 3410 p.s.i. F.S.I.P. - 3450 p.s.i.

D.S.T. No. 19. Interval 8188 - 8196 feet

Test failed. Rubbers on packer failed after 16 minutes and recovered only drilling mud.

D.S.T. Nos 20 and 21. Interval 8188 - 8196 feet

Rubbers on packer failed after 10 minutes and 3 minutes respectively.

D.S.T. No. 22. Interval 8188 - 8196 feet

Packer set at 8151 feet. Open for 158 minutes. Received good blow. Gas to surface after 33 minutes. Blow dead by 113 minutes. Swabbed 40 barrels gas-cut water. Salinity 8300 ppm. chlorides. Shut in for 60 minutes. Recovered 28.5 barrels gas-cut water and 3 barrels gas-cut muddy water.

I.H.P. - 3780 p.s.i.	F.H.P. - 3780 p.s.i.
I.F.P. - 200 p.s.i.	F.F.P. - 3330 p.s.i.
I.S.I.P. - 2280 p.s.i.	F.S.I.P. - 3250 p.s.i.

D.S.T. No. 23. Interval 8188 - 8192 feet

Packer set at 8170 feet. Open for 210 minutes. Received slight blow decreasing after 40 minutes. Slight increase after 60 minutes and then died before swabbing. Swabbed 14 barrels gas-cut water. Shut in for 30 minutes. Recovered 18.5 barrels gas-cut water from string. Salinity 8500 ppm. chlorides.

I.H.P. - 3700 p.s.i.	F.H.P. - 3680 p.s.i.
I.F.P. - 450 p.s.i.	F.F.P. - 1590 p.s.i.
I.S.I.P. - -	F.S.I.P. - 2030 p.s.i.

D.S.T. No. 24. Interval 8188 - 8194 feet

Packer set at 8164 feet. Open for 37 minutes. Received fair blow decreasing through flow period. Shut in for 38 minutes. Swabbed one barrel gas-cut muddy water and recovered 21.5 barrels gas-cut muddy water from string. Salinity 8500 ppm. chlorides.

I.H.P. - 3670 p.s.i.	F.H.P. - 3650 p.s.i.
I.F.P. - -	F.F.P. - 870 p.s.i.

No S.I.P.'s recorded.

D.S.T. No. 25. Interval 8188 - 8194 feet

Packer set at 8107 feet. Open for 63 minutes. Fair blow decreasing through flowing period. Shut in for 12 minutes. Swabbed two barrels of mud and recovered 21 barrels of gas-cut water. Salinity 9000 to 9200 ppm. chlorides from string.

No pressures recorded as clock had stopped.

D.S.T. No. 26. Interval 8188 - 8194 feet

Packer set at 8133 feet. Open for 330 minutes. Slight blow - ceased after 30 minutes. Swabbed one barrel of water and recovered 1810 feet of water from the string. Salinity 9230 ppm. chlorides. Bottom 900 feet contained small amount of dissolved gas.

No flowing pressures recorded on chart.

Only 3500 p.s.i. - hydrostatic pressure.

D.S.T. No. 27. Interval 7910 - 7918 feet

Test failed. Packer set below perforations.

D.S.T. No. 28. Interval 7910 - 7918 feet

Packer set at 7896 feet. Open for 90 minutes. Received very faint blow - died after 7 minutes. Recovered 750 feet of slightly gas-cut water, salinity 1050 ppm. chlorides.

I.H.P. - 3250 p.s.i.	F.H.P. - 3310 p.s.i.
I.F.P. - -	F.F.P. - 190 p.s.i.

D.S.T. No. 29. Interval 7910 - 7918 feet

Packer set at 7894 feet. Open for 167 minutes. Slight blow ceased after 25 minutes. Swabbed without recovery. Recovered 480 feet of water from string. Salinity 900 to 1000 ppm. chlorides.

No pressures recorded on chart.

D.S.T. No. 30. Interval 5349 - 5355 feet

1st run - test failed, as packer seat failed.

2nd run - packer set at 5326 feet. Open for 300 minutes - received good blow throughout flowing period. No fluid recovery as ball valve of tool failed to close and fluid lost from pipe. No pressures recorded.

D.S.T. No. 31. Interval 5349 - 5355 feet

Packer set at 5326 feet. Open for 80 minutes. Received good blow throughout flow period. Shut in for 60 minutes. Recovered 15.3 barrels gas-cut mud and 1.1 barrels gas-cut water. Salinity 6350 ppm. chlorides. Pressure bomb not operating correctly.

I.H.P. - 2670 p.s.i.	F.H.P. - 2540 p.s.i.
I.F.P. - 560 p.s.i.	F.F.P. - 560 p.s.i.
I.S.I.P. - 560 p.s.i.	F.S.I.P. - 1580 p.s.i.

D.S.T. No. 32. Interval 5349 - 5355 feet

Packer set at 5323 feet. Open for 300 minutes - received fair blow, almost dead before shut in. Shut in for 60 minutes. Recovered 17.9 barrels water. Salinity 9685 ppm. chlorides. Pressure bomb not working correctly.

I.H.P. - 1560 p.s.i.	F.H.P. - 2000 p.s.i.
I.F.P. - 500 p.s.i.	F.F.P. - 500 p.s.i.

No S.I.P.'s recorded.

INTERPRETATION OF FORMATION TESTS

PORT CAMPBELL NO. 2

by

J.A.W. White*

8735 - 8725 feet. This zone is shown as impermeable on the logs and although the testing of this section was in some ways inconclusive, it would have been surprising if any appreciable quantity of fluid had been produced on test.

8592 - 8586 feet. This is the lowest sand to be tested and the fluid produced on test had a measured resistivity of 0.40 ohm at 80°F. At bottom hole temperature this becomes 0.17 ohm (at 188°F). This is equivalent to a NaCl solution of 14,000 ppm. but it should be emphasized that the maximum possible chloride concentration of the formation fluid is 14,000/1.65 or in round figures 8500 ppm. This factor of 1.65 assumed that the chloride present in the solution is in the form of common salt (NaCl) - this is the usual case. Factors for converting a chemical analysis of a solution to the corresponding resistivity are given on page A-5 of Schlumberger "Log Interpretation Charts".

The SP log over this section requires careful study. There is some evidence that sediments below about 8510 feet were laid down at a time when the shoreline was fluctuating, some of them being laid down in brackish water whilst others were laid down in truly marine conditions. It is believed that the SP base line should not be taken at the points 8560 feet and 8675 feet but rather at 8460 feet and 8700 - 8730 feet. Unfortunately throughout this section of the hole no good clays or shales are available to give a point of comparison for evaluating the true base line. Taking the base line mentioned above, an SP deflection of 11 mV is arrived at, which corrected for bed thickness and the resistivity of the invaded zone gives a true SP (SSP) of 12 mV. Rmf/(Rw)e is therefore 1.3 and this gives an Rw of 0.11 ohm at BHT. This is a little lower than the measured value of 0.17 ohm from the water sample. The difference may be due either to a small amount of electro-filtration potential present, or more likely to the change in the ionic composition of the mud filtrate under bottom hole conditions of temperature and pressure.

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* Schlumberger Seaco, Inc.

8405 - 8395 feet. The water from this formation appears from its resistivity to be identical with the water from the zone 8592 - 8586 feet.

8350 - 8338 feet. Prolonged swabbing from this formation has enabled the resistivity to be measured from many different samples - they consistently give an Rw of 0.16 ohm at bottom hole temperature, which gives an equivalent concentration of NaCl of 15,000 ppm. (9000 ppm. of chloride). From the interpretation of the logs an Rw of 0.12 ohm at BHT has been calculated which is somewhat lower than the measured value. The same remarks apply as for the zone at 8592 - 8586 feet.

APPENDIX 6

EVALUATION OF FORMATION FLUIDS

PORT CAMPBELL NO. 1 and NO. 2 WELLS

CONTENTS

FORMATION FLUID DATA AND ANALYSES

PORT CAMPBELL NO. 1

1. Drill Stem Tests, Port Campbell No. 1

(i) Water

Test No.	Depth (feet)	Recovery	Salinity
1	5653-5718	Gas (see below)	
2	5908-5920 and 5924-5928	Gas-cut salt water	13,700 mgm/l equivalent NaCl
3	5756-5766	"	12,700 "
4	5695-5701	"	12,800 "
5	4815-4820 and 4830-4840	Gas-cut water	4,934 mgm/litre chloride
6	4696-4702	"	1,065 "
7	4498-4515	"	1,136 "
8	4463-4475	"	994 "

(ii) Gas

Drill Stem Test No. 1. Open hole, 5653-5718 feet
Recovered gas.

	Standard Vacuum Refining Co. (Aust.) Pty Ltd (%)	Gas and Fuel Corporation, Melbourne (%)
Hydrogen	Not determined	0.022
Oxygen	"	1.14
Nitrogen	3.3	8.13
Carbon Dioxide	23.0	10.0
Methane	63.2	68.7
Ethane	5.4	6.1
Propane	2.7	3.0

	Standard Vacuum Refining Co. (Aust.) Pty Ltd (%)	Gas and Fuel Corporation, Melbourne (%)
Isobutane	0.7	0.67
n-Butane	0.7	0.76
Isopentane	0.1	0.26
n-Pentane	0.1	0.21
C_6 Series	Not determined	Traces
Water Vapour	0.8	Not determined

2. Cores, Port Campbell No. 1

(i) Gas

Core number	19	23	24
Depth (feet)	5021 (%)	5701 (%)	5932 (%)
Hydrogen	7.6	0.11	Reported to be similar to the gas recovered from Core No. 23
Methane	52.1	6.5	
Ethane	32.5	31.5	
Propane	4.9	41.3	
Isobutane	1.7	4.9	
n-Butane	0.7	7.0	
Isopentane	0.36	1.56	
n-Pentane	0.17	1.61	
Neopentane?		0.063	
C_6 and C_7 Series		5.3	

Analyses by Gas and Fuel Corporation, Melbourne.

(ii) Water

Core No. 6 1970 feet, less than 10 ppm. NaCl

Core No. 7 2450 feet, " " " "

Core No. 9 3148 feet, " " " "

Analyses by Bureau of Mineral Resources, Canberra.

3. Production Tests 1(a) and 1(b), 5656 - 5666 feet, Port Campbell No. 1

Recovered gas, condensate, oil, and salt water

(i) Gas Analysis

Analysis by	Standard Vacuum Refinery	Gas and Fuel Corporation	Standard Vacuum Refinery	Standard Vacuum Refinery	Gas and Fuel Corporation	Standard Vacuum Refinery	Standard Vacuum Refinery	Gas and Fuel Corporation
Date Collected	2.1.1960	2.1.1960	3.1.1960	4.1.1960	4.1.1960	5.1.1960	6.1.1960	21.1.1960
	(%)	(%)	(%)	Vapour Phase (%)	(%)	(%)	Gas Chromatograph Method (%)	(%)
Helium		0.02						0.02
Hydrogen					0.02			0.18
Oxygen		1.1			0.02			3.5
Nitrogen	3.5	6.8	3.4	3.5	3.7	3.4	3.4	
Carbon Dioxide	15.6	12.5	14.9	15.6	16.1	16.2	16.2	14.2
Methane	71.6	51.8	70.5	71.6	71.2	70.1	70.1	72.5
Ethane	4.8	5.4	4.7	4.8	4.9	5.1	5.1	5.5
Propane	2.6	5.1	2.8	2.6	2.1	2.8	2.8	1.8
Isobutane	1.7	6.3	0.8	0.7	1.2	0.7	1.4	0.5
n-Butane			1.1	1.0		0.7		0.5
Isopentane	0.2		0.7	0.2		0.2	0.2	0.5
n-Pentane			0.3					
Hexane		11.0	0.3					Trace
Water Vapour						0.8	0.8	

PE907147

This is an enclosure indicator page.
The enclosure PE907147 is enclosed within the container PE906833 at this location in this document.

The enclosure PE907147 has the following characteristics:

ITEM_BARCODE	= PE907147
CONTAINER_BARCODE	= PE906833
NAME	= Water Analysis
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= GEOCHEM_RPT
DESCRIPTION	= Water Analysis, Production Tests, Port Campbell-1
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	=
W_NO	= W460
WELL_NAME	= PORT CAMPBELL-1
CONTRACTOR	= BUREAU OF MINERAL RESOURCES
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

PE907146

This is an enclosure indicator page.
The enclosure PE907146 is enclosed within the container PE906833 at this location in this document.

The enclosure PE907146 has the following characteristics:

ITEM_BARCODE	= PE907146
CONTAINER_BARCODE	= PE906833
NAME	= Condensate and Oil Analysis
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= GEOCHEM_RPT
DESCRIPTION	= Condensate Analysis Data, Production Tests, Port Campbell-1
REMARKS	=
DATE_CREATED	=
DATE_RECEIVED	=
W_NO	= W460
WELL_NAME	= PORT CAMPBELL-1
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

4. Water Analysis, Port Campbell No. 1

		Drill Stem Test 4 5695 - 5701 feet	Drill Stem Test 8 4463 - 4475 feet
Total solids in solution		ppm. 19,710	ppm. 4,592
Chloride	(Cl)	8,020	1,160
Carbonate	(CO_3)	127	184
Bicarbonate	(HCO_3)	4,657	1,694
Sulphate	(SO_4)	102	19
Calcium	(Ca)	66	22
Magnesium	(Mg)	71	3
Iron (Soluble)	(Fe)	2	-
Sodium (by difference)		6,665	1,510
Total Hardness (as $CaCO_3$)		458	66
pH		8.8	8.8
Hypothetical combinations are as follows:			
Calcium bicarbonate		268	89
Magnesium bicarbonate		427	118
Ferrous bicarbonate		7	-
Sodium bicarbonate		5,637	2,220
Sodium carbonate		-	325
Sodium sulphate		151	28
Sodium chloride		13,220	1,912

Analyses by State Laboratories, Melbourne.

ANALYSES OF FLUID SAMPLES

PORT CAMPBELL NO. 2

by

State Laboratories, Melbourne

Two samples of core from Port Campbell No. 2 Well were received for testing. The samples were obtained from a depth of 7904-7913 feet and were considered to contain some interstitial gases.

The following analytical information was obtained through the courtesy of the Research Division of the Gas and Fuel Corporation of Victoria.

Description of Samples

No. 914, Core No. 6. 7904 - 7913 feet, recovery 9 feet. Top foot, sealed. Hydrocarbon fraction comprised approximately 0.20% of the gas evolved from this core.

No. 915, Core No. 6. 7904 - 7913 feet, recovery 9 feet. Bottom foot sealed. Hydrocarbon fraction comprised approximately 0.13% of the gas evolved from this core.

Results (Hydrocarbon Fraction):

No.	914 (%)	915 (%)
Methane	74.8	58.2
Ethane	11.4	5.4
Ethylene	3.2	1.2
Propane	3.2	1.7
Propylene	0.14	0.23
Isobutane	0.30	0.76
n-Butane	0.60	1.3
Butylenes	0.30	0.53
Isopentane	0.05	0.15
n-Pentane	0.15	0.83
Benzene	5.5	23.4
Toluene	0.25	6.2
C_6 and C_7	0.1	0.1
Xylenes	-	Trace

Evolved Gas from No. 915

	(%)
Hydrocarbons	0.13
Oxygen	2.9
Nitrogen	30.4
Carbon dioxide	66.5

Hydrogen and helium were not determined.

Comments:

The constituents of the hydrocarbon mixture differ in one essential aspect from those obtained from Port Campbell No. 1 in that the above analysis shows the presence of unsaturateds such as propylene, butylenes etc., and, in addition, benzene and other ring-type compounds.

While remembering that these figures are obtained from one core and the amount of gas recovered was remarkably little, the evidence of the analytical figures indicates the possibility of the gas being derived, in part at least, from solid carbonaceous fuel such as coal.

The continued presence of the paraffinic hydrocarbons still points to a petroliferous origin.

A third sample (Sample No. 963/60) from Port Campbell No. 2 was tested.

The sample consisted of a section from Core No. 11, from 8340 to 8341 feet. Other sections of this core contained bituminous material and were tested by the Vacuum Oil Company.

The following analytical information was obtained through the courtesy of the Research Division of the Gas and Fuel Corporation of Victoria.

Results:

(i) The section of core, which was sealed at the well-site contained gas.

(ii) The gas consisted mainly of saturated hydrocarbons up to hexane at least. Some unsaturated hydrocarbons were present, but in quite small amount, and in this respect the gas differed from the previous samples from this well but resembled the gas obtained from cores in Port Campbell No. 1.

(iii) Methane amounted to about 0.2% of the gas collected.

WATER ANALYSES

PORT CAMPBELL NO. 2

by

State Laboratories, Melbourne

Three samples of water were received for analysis.

Details of Samples:

Laboratory No.	1376	1377	1378
U.W.R.S.	2182	2183	2184
Well	2	2	2
Sample	53	60	70
Drill Stem Test	12	12	12
Depth (feet)	8338-8350	8338-8350	8338-8350
Date	13.12.60	13.12.60	13.12.60

Results: (In parts per million)

Total solids in solution (by evaporation)		16,960	16,760	16,720
Chloride	(Cl)	7,534	7,704	8,098
Carbonate	(CO_3)	316	326	252
Bicarbonate	(HCO_3)	2,300	1,962	1,673
Sulphate	(SO_4)	Present	Present	Present
pH		8.8	8.8	8.8

Appearance, etc:

The samples were dark brown in colour and were contaminated with oil used in the testing operations.

Filtration made no difference to the colour of the water.

Three further samples of water were tested.

Particulars:

Sample No.	1387
U.W.R.S.	2185
Well	2
Depth (feet)	8338-8350
	Drill Stem Test No. 14.
	Fluid from bottom of 91 barrels recovered.

Results: (In parts per million)

Total solids in solution (by evaporation)		16,820
Chloride	(Cl)	9,142
Carbonate	(CO_3)	147
Bicarbonate	(HCO_3)	1,330
Sulphate	(SO_4)	Present

Appearance, etc:

The water was light brown in colour with a yellow opalescence after filtering. There was a little sediment and the water smelt of oil.

Particulars:

Sample Nos	87	88
U.W.R.S.	2235	2236
Well	2	2
Drill Stem Test	31	32
Depth (feet)	5349-5355	5349-5355
Date	8.1.61	8.1.61

Results: (In parts per million)

Total solids in solution (by evaporation)		13,188	15,793
Chloride	(Cl)	7,424	9,390
Carbonate	(CO_3)	222	Nil
Bicarbonate	(HCO_3)	396	234
Sulphate	(SO_4)	28	263
Nitrate	(NO_3)	Nil	Nil
Calcium	(Ca)	87	531
Magnesium	(Mg)	9	355
Iron - total	(Fe)	204	24
Iron - soluble	(Fe)	2.9	5.1
Total Hardness (as $CaCO_3$)		255	2,785
pH		9.2	7.6

RESULTS OF ANALYSES OF SAMPLES OF FORMATION WATER FROM PORT CAMPBELL NO. 2

	D.S.T. No. 14 8338 - 8350 feet Bottom of 91 bbl.		D.S.T. No. 18 8294 - 8299 feet Above tool		D.S.T. No. 22 8188 - 8196 feet After 65 bbl.		D.S.T. No. 23 8188 - 8192 feet Above tool	
	ppm.	me/l	ppm.	me/l	ppm.	me/l	ppm.	me/l
HCO_3^-	2,820	46	1,910	31.3	1,830	30	1,930	31.6
$CO_3^=$	Nil		Nil		Nil		Nil	
$SO_4^=$	154	3.2	173	3.6	258	5.4	345	7.2
Cl^-	8,650	244	8,650	244	8,830	249	9,230	260
SiO_2	50	-	40	-	70	-	80	-
Total anions	11,670	293	10,670	279	10,790	284	11,580	299
Na^+	6,060	263	5,740	250	5,590	243	6,060	263
Ca^{++}	86	4.3	51	2.5	146	7.3	181	9.0
Mg^{++}	25	2.1	29	2.4	27	2.2	41	3.4
Fe^{+++}	3	0.16	4	0.21	10	0.54	8	0.43
Total cations	6,170	269	5,820	255	5,770	253	6,290	276
Total ions	17,840		16,490		16,560		17,870	
Dissolved non-volatile (105^oC) solids at N.T.P.	16,050		15,830		16,400		17,470	
Insoluble solids at N.T.P.	310		430		400		1,610	
Suspension-free samples: pH at 24^oC	8.0		8.05		8.05		8.0	
Suspension-free samples: Conductivity at 24^oC mhos/cm	2.51×10^{-2}		2.51×10^{-2}		2.54×10^{-2}		2.67×10^{-2}	

Analyses by Bureau of Mineral Resources, Canberra.

RESULTS OF ANALYSES OF SAMPLES OF FORMATION WATER FROM PORT CAMPBELL NO. 2

	D.S.T. No. 24 8188 - 8194 feet Above tool		D.S.T. No. 25 8188 - 8194 feet Drill stem above packer		D.S.T. No. 26 8188 - 8194 feet 82nd Stand		D.S.T. No. 29 7910 - 7918 feet Single above tool	
	ppm.	me/l	ppm.	me/l	ppm.	me/l	ppm.	me/l
HCO_3^-	2,130	35	1,440	23.6	1,600	26.2	262	4.3
$CO_3^=$	Nil		Nil		Nil		225	7.5
$SO_4^=$	370	7.7	248	5.2	285	5.9	785	16.4
Cl^-	8,440	238	9,460	267	8,930	251	695	19.6
SiO_2	80	-	70	-	40	-	Nil	
Total anions	11,020	281	11,220	296	10,850	283	1,970	47.8
Na^+	5,740	250	5,740	250	6,220	270	1,100	48
Ca^{++}	186	9.3	176	8.8	131	6.5	Nil	
Mg^{++}	25	2.1	26	2.2	32	2.7	Nil	
Fe^{+++}	14	0.75	1		Nil		Nil	
Total cations	5,960	262	5,940	261	6,380	279	1,100	48
Total ions	16,980		17,160		17,230		3,070	
Dissolved non-volatile (105^oC) solids at N.T.P.	16,990		17,540		16,540		3,460	
Insoluble solids at N.T.P.	1,690		1,420		1,280		420	
Suspension-free samples: pH at 24^oC	8.1		7.75		7.4		10.8	
Suspension-free samples: Conductivity at 24^oC mhos/cm	2.60×10^{-2}		2.73×10^{-2}		2.58×10^{-2}		0.402×10^{-2}	

Analyses by Bureau of Mineral Resources, Canberra.

GAS ANALYSES

PORT CAMPBELL NO. 2

	D.S.T. No. 9 8586-8592 ft (%)	D.S.T. No. 11 8395-8405 ft (%)	D.S.T. No. 12 8338-8350 ft (%)	D.S.T. No. 14 8338-8350 ft (%)	D.S.T. No. 16 8294-8299 ft (%)	D.S.T. No. 18 8294-8299 ft (%)	D.S.T. No. 22 8188-8196 ft (%)
Air	8.0	0.4	0.3	11.2	5.9	21.0	2.0
Methane	76.6	93.1	94.6	72.4	81.8	63.4	93.2
Ethane	3.2	2.9	2.5	2.8	3.4	2.1	2.2
Propane	0.4	0.4	0.2	0.4	0.8	0.2	0.2
Isobutane	-	-	-	-	0.2	-	-
Butane	-	-	-	-	0.2	-	-
CO_2	9.4	0.8	Nil	10.8	5.3	10.9	Nil
Water Vapour	2.4	2.4	2.4	2.4	2.8	2.4	2.4

Analyses by Standard Vacuum Refining Company.

Date Submitted :	15.12.1960	15.12.1960	20.12.1960	20.12.1960	23.12.1960
Samples Labelled:	DST. No. 11 8395-8405 ft	DST. No. 12 8338-8350 ft	DST. No. 14 8338-8350 ft Fluid from bottom of 91 barrels recovered	DST. No. 18 8294-8299 ft Water above tool	DST. No. 22 8188-8196 ft Fluid after 61 barrels recovered
Steam Distillable Oil	Nil	Nil	Nil	Nil	Nil
Hexane Extract	Nil	Nil	Nil	Nil	Nil
Explosive Gases	Nil	Present	Present	Present	Present
Chloride gm/litre	7.3	7.5	8.75	8.55	9.20
Sodium Chloride gm/litre	12.0	12.3	14.4	14.0	14.9
Sulphate gm/litre	0.47	-	0.26	0.30	-
Alkalinity (Methyl Orange) gm/litre	1.63	-	0.85	0.78	-

Analyses by Vacuum Oil Company Pty Ltd.

FLUID ANALYSES

PORT CAMPBELL NO. 2

Date Submitted:	12.12.1960	12.12.1960
Samples Labelled:	DST. No. 9 8586-8592 ft Fluid from 3rd stand above tool (2 sample bottles)	DST. No. 9 8586-8592 ft Above tool
Specific Gravity	1.001	1.001
Steam Distillable Oil	Nil	Nil
Hexane Extract	Nil	Nil
Explosive Gases	Nil	Nil
Chloride as Cl gm/litre	8.20	5.60
as NaCl gm/litre	13.40	9.20
Sulphate gm/litre	0.057	0.044
Alkalinity (Methyl Orange) gm/litre	1.36	2.20
Calcium gm/litre	1.70	1.20
Magnesium gm/litre	Nil	Trace
Total Dissolved Solids gm/litre	13.4	11.0

Analyses by Vacuum Oil Company Pty Ltd.

Date Submitted:	9.1.1961 (6 samples)					
Samples Labelled:	DST. No. 23 8188-8192 ft Fluid from above tool	DST. No. 24 8188-8194 ft Fluid from above tool	DST. No. 25 8188-8194 ft Fluid from drill stem above packer	DST. No. 26 8188-8194 ft Fluid from 49th Stand	DST. No. 28 7910-7918 ft Water from Stand above tool	DST. No. 29 7910-7918 ft Water from single above tool
Steam Distillable Oil	Trace	Nil	Nil	Nil	Nil	Nil
Hexane Extract	Trace	Nil	Nil	Nil	Nil	Nil
Explosive Gases	Trace	Present	Present	Present	Present	Absent
Chloride gm/litre	9.05	8.76	9.50	7.71	1.06	0.78
Sodium Chloride gm/litre	14.90	14.40	15.60	13.60	1.74	1.28

The oil recovered by steam distillation and hexane extract from D.S.T. No. 23 was light brown in colour and waxy when cooled. A benzene solution of this oil dropped the refractive index of benzene from 1.4955 to 1.4935 indicating possibly a paraffinic base oil. This oil could probably have been obtained from the drilling mud.

Analyses by Vacuum Oil Company Pty Ltd.

FLUID ANALYSES

PORT CAMPBELL NO. 2

by

Vacuum Oil Company Pty Ltd

Date Submitted:	19.1.1961	19.1.1961
Samples Labelled:	DST. No. 31 5349-5355 ft Fluid from 50th Stand	DST. No. 32 5349-5355 ft Fluid from 52nd Stand
Steam Distillable Oil (%)	Nil	9.5 (by volume)
Hexane Extract (%)	Nil	7.0
Explosive Gases	Present	Present
Chloride gm/litre	10.1	4.8
Sodium Chloride gm/litre	16.6	7.9

The pour point of the oil recovered from DST. No. 32 was 20^{o}F, specific gravity 0.828, refractive index 1.464. These figures are also characteristic of the type of Automotive Diesel Oil and Industrial Diesel Oil available in that area and it is understood to have originated from the drilling mud. The sample itself contained a large quantity of mud.

FLUID ANALYSES

PORT CAMPBELL NO. 2

by

Vacuum Oil Company Pty Ltd

Sample from Core No. 14, 8313-8314 feet

Results of Examination:

	Sample Submitted	I.D.O. (Altona)
Recovery by steam distillation	0.1%	0.2% (from 0.7 gm I.D.O. in sand)
Hexane extract of core	0.71%	-
Nature of Hexane extract	Light brown oil; low viscosity; not waxy.	Dark brown to black. (Normal product)

Specific Gravity at 60°F	0.835	0.853
Refractive Index 20°C	1.467	1.465

Test for Volatiles:

50 grams of the sample submitted were placed in a glass tube connected to a combustible gas detector calibrated in ppm. for petroleum vapours. Air was drawn over the sample at 70°F and again at higher temperatures up to 240°F.

Results obtained were as follows:

	Meter Reading ppm. Vapour	
	Sample	I.D.O. on Sand
Temperature 70°F	50 ppm.	50 ppm.
" 120°F (approx.)	60	120
" 200/240°F	1000	450

Presence of Salt:

Chloride was present in a water extract of the sample submitted.

Conclusions:

Steam distillation does not confirm the presence of volatiles in the core sample. The 0.1% recovered is expected to be obtained from I.D.O. which was known to be present in the drilling mud and the odour of the core sample submitted confirmed this. Since I.D.O. often incorporates steam distillable kerosene fractions it is most likely that the 0.1% recovery was from I.D.O. Tests carried out on I.D.O. mixed with sand gave the equivalent of 0.2% steam distillable material.

Specific gravity of the Hexane extract is lower than that of the normal Altona product; but it is in line with the product often supplied by Geelong Refinery, which is supplied to that area. Refractive index of the extract is very close to that of I.D.O.

Tests for volatiles using a combustible gas indicator did not confirm the presence of petroleum vapours in excess of those expected from I.D.O.

ANALYSIS OF CORE NO. 11

PORT CAMPBELL NO. 2

by

Vacuum Oil Company Pty Ltd

Greyish sandstone containing shiny blackish material heterogeneously dispersed but concentrated mainly towards the centre of the core.

Black Material

Analysis of the shiny black material gave the following results:

Ash content	65% of sample
Solvency:	
Benzene/alcohol/acetone 70/15/15%	13% of sample (37% of volatile matter)
Carbon tetrachloride	20% of sample (57% of volatile matter)

Nature of carbon tetrachloride extract:

Hard and resinous with melting point greater than 210°F

Specific Gravity	0.86
Elemental Analysis:	
Carbon	81.9
Hydrogen	9.9
H/C Atomic Ratio	1.46

The black material begins to decompose and swell when heated to 400°C with evolution of combustible gases. This behaviour was similar to that of coal and also oil bearing shale from New South Wales.

Proximate analysis of the black material gave:

Moisture	3.6%
Volatile Matter	25.8%
Fixed Carbon	3.3%
Ash	67.3%

The ratio of Volatile Matter to Fixed Carbon is 7.4 which is of the order of that obtained from oil bearing shale while similar ratios for coal are in the order of 0.5.

On comparison of the H'C Atomic Ratio with other similar naturally occurring deposits, the following results are obtained:

$C Cl_4$ extract of sample submitted	1.46
Oil bearing shale	1.49
Crude oil	1.66 to 1.92
Asphaltenes and Pyrobitumens	1.27 to 1.52
Coal - Bituminous	0.86
Brown	0.845
Anthracite	0.38

Conclusion:

The high temperature to which the black material can be heated before decomposition takes place indicates either coal, oil shale or pyrobitumens. The high ratio of Volatile Matter to Fixed Carbon and also H'C Atomic Ratio in the $C Cl_4$ extract, however, indicate that this matter is of an asphaltic pyrobitumen nature or an oil shale. In view of the slight solubility of oil shale in solvents used in this examination compared with the solubility of the sample examined, the tests and comparisons outlined above favour the opinion that the material is of an asphaltic pyrobitumen nature.

Inorganic Matter

Analysis of inorganic matter (next to shiny black material):

Volatiles	7.8%
SiO_2	18.8%
Fe	34.3%
Sulphur	38.7%
Ca	0.3%
Na_2O	0.4%

The Atomic Ratio of Fe and S is 1:1.97 which approximates the ratio in pyrites. This is also confirmed by the yellowish appearance of the inorganic matter adjacent to the black organic material. The SiO_2 indicates the remainder of the inorganic material is sand.

APPENDIX 7

ADDITIONAL DATA FILED IN THE

BUREAU OF MINERAL RESOURCES

The following additional data relating to Port Campbell No. 1 and No. 2 Wells have been filed in the Bureau of Mineral Resources, Canberra, and are available for reference:

(i) Port Campbell No. 1 Lithological Log

(ii) Port Campbell No. 1 Composite Electric Log (3300-5934 feet) Scale: 1" = 50'

(iii) Port Campbell No. 1 Temperature Survey Log

(iv) Port Campbell No. 2 Schlumberger Well Logs including the following:

Electrical Log, Run 5, 5650-7924 feet
Scale: 1" = 100' and 5" = 100'

Electrical Log, Run 8, 8056-8544 feet
Scale: 1" = 100' and 5" = 100'

Electrical Log, Run 9, 8344-8838 feet
Scale: 1" = 100' and 5" = 100'

Laterolog, Run 4, 8049-8542 feet
Scale: 1" = 100' and 5" = 100'

Laterolog, Run 5, 8342-8835 feet
Scale: 1" = 100' and 5" = 100'

Microlog, Run 5, 5648-7921 feet
Scale: 1" = 100' and 5" = 100'

Microlog, Run 8, 7780-8542 feet
Scale: 1" = 100' and 5" = 100'

Microlog, Run 9, 8342-8836 feet
Scale: 1" = 100' and 5" = 100'

Section Gauge, Run 1, 5650-6402 feet
Scale: 1" = 100' and 5" = 100'

Temperature Log, 5000-8810 feet
Scale: 1" = 100'

PE604796

This is an enclosure indicator page.
The enclosure PE604796 is enclosed within the container PE906833 at this location in this document.

The enclosure PE604796 has the following characteristics:

ITEM_BARCODE	= PE604796
CONTAINER_BARCODE	= PE906833
NAME	= Composite Well Log, 3 of 3
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= COMPOSITE_LOG
DESCRIPTION	= Composite Well Log, 3 of 3, Port Campbell-2
REMARKS	=
DATE_CREATED	= 1/12/60
DATE_RECEIVED	=
W_NO	= W463
WELL_NAME	= PORT CAMPBELL-2
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

PE604795

This is an enclosure indicator page.
The enclosure PE604795 is enclosed within the container PE906833 at this location in this document.

The enclosure PE604795 has the following characteristics:

ITEM_BARCODE	= PE604795
CONTAINER_BARCODE	= PE906833
NAME	= Composite Well Log, 2 of 3
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= COMPOSITE_LOG
DESCRIPTION	= Composite Well Log, 2 of 3, Port Campbell-2
REMARKS	=
DATE_CREATED	= 1/12/60
DATE_RECEIVED	=
W_NO	= W463
WELL_NAME	= PORT CAMPBELL-2
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

PE604794

This is an enclosure indicator page.
The enclosure PE604794 is enclosed within the container PE906833 at this location in this document.

The enclosure PE604794 has the following characteristics:

ITEM_BARCODE	= PE604794
CONTAINER_BARCODE	= PE906833
NAME	= Composite Well Log, 1 of 3
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= COMPOSITE_LOG
DESCRIPTION	= Composite Well Log, 1 of 3, Port Campbell-2
REMARKS	=
DATE_CREATED	= 1/12/60
DATE_RECEIVED	=
W_NO	= W463
WELL_NAME	= PORT CAMPBELL-2
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

PE604793

This is an enclosure indicator page.
The enclosure PE604793 is enclosed within the container PE906833 at this location in this document.

The enclosure PE604793 has the following characteristics:

ITEM_BARCODE	PE604793
CONTAINER_BARCODE	PE906833
NAME	Composite Well Log, 2 of 2
BASIN	OTWAY
PERMIT	PEP6
TYPE	WELL
SUBTYPE	COMPOSITE_LOG
DESCRIPTION	Composite Well Log, 2 of 2, Port Campbell-1
REMARKS	
DATE_CREATED	9/12/59
DATE_RECEIVED	
W_NO	W460
WELL_NAME	PORT CAMPBELL-1
CONTRACTOR	
CLIENT_OP_CO	FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

PE604792

This is an enclosure indicator page.
The enclosure PE604792 is enclosed within the container PE906833 at this location in this document.

The enclosure PE604792 has the following characteristics:

ITEM_BARCODE	= PE604792
CONTAINER_BARCODE	= PE906833
NAME	= Composite Well Log, 1 of 2
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= COMPOSITE_LOG
DESCRIPTION	= Composite Well Log, 1 of 2, Port Campbell-1
REMARKS	=
DATE_CREATED	= 9/12/59
DATE_RECEIVED	=
W_NO	= W460
WELL_NAME	= PORT CAMPBELL-1
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)