Natural Resources and Environment

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WCR PORT CAMPBELL-3 W465

WELL COMPLETION REPORT

PORT CAMPBELL-3

W 465

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LOCATION

FROME-BROKEN HILL COMPANY PTY. LTD.

Report No. 7200-G-80

WELL COMPLETION REPORT

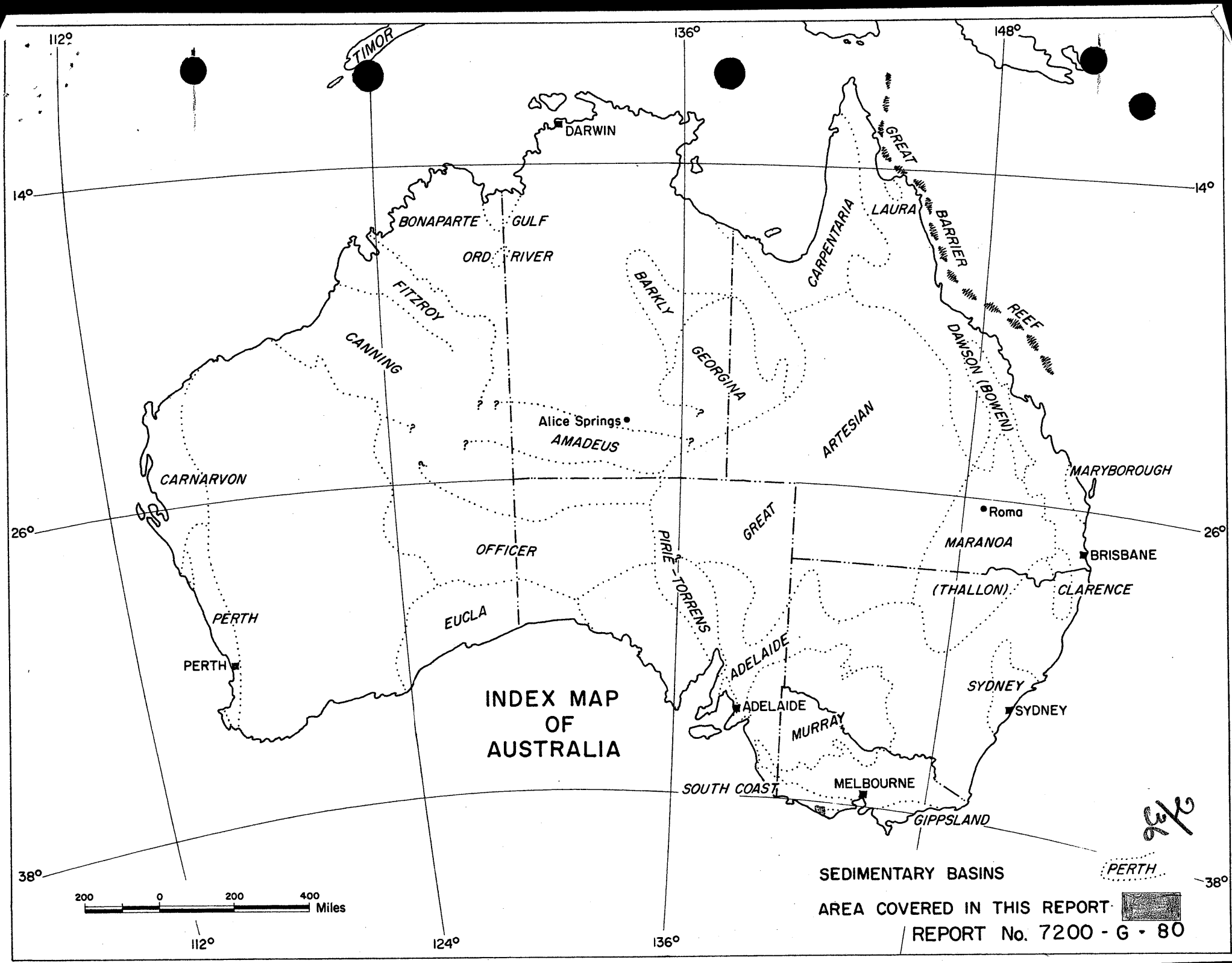
PORT CAMPBELL NO. 3

by

J. S. Bain and S. Benedek

Melbourne

May, 1961


112°
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ORD RIVER
FITZROY
CANNING
BARKLY
GEORGINA
CARPENTARIA
LAURA
GREAT BARRIER REEF
DAWSON (BOWEN)
Alice Springs
AMADEUS
ARTESIAN
CARNARVON
MARYBOROUGH
26°
Roma
GREAT
MARANOA
BRISBANE
OFFICER
PIRIE-TORRENS
(THALLON)
CLARENCE
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INDEX MAP
OF
AUSTRALIA
SOUTH COAST
MELBOURNE
GIPPSLAND
38°
PERTH
200 0 200 400 Miles
112°
124°
136°
SEDIMENTARY BASINS
AREA COVERED IN THIS REPORT
REPORT No. 7200 - G - 80

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I SUMMARY

Port Campbell No. 3 was drilled to a total depth of 5530 feet within the southeastern part of the Otway Basin.

The well penetrated Tertiary sediments and bottomed in sediments of the Otway Group similar in lithology to those in outcrop sections along the coast at Cape Otway. The age of these sediments is still indefinite but they are generally regarded as Cretaceous-Jurassic.

No unconformity appeared to exist between the Otway Group and the Waarre Formation in the well and it is further suggested that the Waarre Formation may eventually prove to be the topmost unit within the Otway Group. Based on evidence from Port Campbell Nos. 1 and 2 wells, it is apparent that an unconformity exists between the Waarre Formation and the Belfast Mudstone in No. 3 with probably much the same time break as was evident in the No. 1 well.

Sediments of the Otway Group yielded on testing a small amount of free gas with water of a fairly high salinity, and it is apparent that these sediments cannot be overlooked for petroleum possibilities. The previously accepted freshwater nature of these sediments may need revising as further subsurface information is obtained.

The Belfast Mudstone in this well was much sandier than that encountered in No. 1 and, with the top Waarre sand being cleaner here than in No. 1, a slightly shallower depositional environment for these two formations is indicated in comparison with No. 1.

From the subsurface information obtained from this well it is obvious that the well penetrated a fault trending roughly east-west downthrown to the south and bottomed in sediments on the upthrown side of this fault.

The well did not indicate any free hydrocarbons other than the small amount of free gas obtained from the Otway Group sediments and was abandoned as a dry hole.

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II INTRODUCTION

Port Campbell No. 3 was drilled to further evaluate the petroleum possibilities of the eastern portion of the Otway Basin.

The well was drilled on seismic reflection evidence which, before drilling, indicated that the well was located fairly near the crest of a structure showing good east-west relief and southerly closure, but with somewhat indefinite closure towards the north. Closure on the north was considered to be fault controlled.

III WELL HISTORY

(1) General Data

(a) Well Name and Number:

Port Campbell No. 3

(b) Location: See card.

823451 Port Campbell 1 mile series No. 932, zone 6, Victoria.
1230 feet S 15.30°W of northeast corner of Allotment 32.
Parish: Narrawaturk. County: Heytesbury. State: Victoria.

(c) Name and Address of Tenement Holder:

Frome-Broken Hill Company Pty. Ltd.,
53 Flemington Road,
North Melbourne, Victoria.

(d) Details of Petroleum Tenement:

Petroleum Exploration Permit No. 6 issued by the State of Victoria.

(e) District:

Southwest Victoria.

(f) Total Depth:

5530 feet.

(g) Date Drilling Commenced:

January 31, 1961.

(h) Date Drilling Completed:

February 25, 1961.

(i) Date Well Suspended:

March 13, 1961.

(j) Date Rig Released:

Rig not released. Stacked awaiting confirmation of next location.

(k) Drilling Time in Days to Total Depth:

20 days

(l) Elevation:

Ground	195 feet
Rotary Table	210 "
Kelly Bushing	212 "

(m) Status:

Abandoned. 1958 feet of $5\frac{1}{2}$ inch casing recovered, cement placed in open $12\frac{1}{4}$ inch hole from 1961 to 1931 feet and in $13\frac{3}{8}$ inch casing from 1315 to 1285 feet.

(n) Cost of Well:

Access and site preparation, water supply		£1,985
Transportation to and from site		3,889
Drilling contractor's time charge		
Rigging up and rigging down	£8,841	
Drilling and coring	16,612	
Logging and testing	5,539	
Running Casing	1,610	
Pulling casing	3,025	
Other	597	36,224
Material and supplies used		
Chemicals, mud	£2,212	
Fuel and lubricants	3,118	
Casing, drill pipe	5,788	
Bits and coreheads	2,301	
Cement	457	
Miscellaneous	497	14,373
Logging and cementing services		7,989
Supervision, wellsite geologists, laboratory		3,461
Miscellaneous, including equipment hire		736
TOTAL TO END MAY, 1961 (INCOMPLETE)		£68,657

(2) Drilling Data

(a) Name and Address of Drilling Contractors:

Oil Drilling and Exploration Limited,
93 York Street,
Sydney, N.S.W.

(b) Drilling Plant:

Make:	National
Type:	55
Rated Capacity with $4\frac{1}{2}$" drill pipe:	10,000 feet
" " " $3\frac{1}{2}$" " "	14,000 "

Motors:

Make:	Caterpillar
Type:	136' x 30' base
Rated Capacity:	800,000 lbs.

(d) Pumps:

Make:	Gardner Denver
Type:	GR-GXP
Size:	$7\frac{3}{4}$" x 16"
Motors:	Caterpillar D.375

(e) Blowout Preventor Equipment:

Make:	Cameron (2) A.R.C.
Size:	12"
Series: A.P.I.	900

(f) Hole and Casing Sizes and Depths:

(1) 25" hole to 47 feet
22" conductor pipe set at 43 feet

(2) 17" hole to 1290 feet
$13\frac{3}{8}$" casing set at 1286 feet

(3) (i) $12\frac{1}{2}$" hole to 4676 feet
(ii) $8\frac{3}{4}$" hole to 5526 feet
(iii) $7\frac{7}{8}$" hole to 5530 feet
(iv) $5\frac{1}{2}$" casing set at 5080 feet

(g) Casing and Liner Details:

Size:	$13\frac{3}{8}$"
Weight:	47 lbs/ft.
Grade:	H40
Range:	2
Setting Depth:	1286 feet

Size:	$5\frac{1}{2}$"
Weight:	17 lbs/ft.
Grade:	N80
Range:	2
Setting Depth:	5080 feet

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(h) Casing and Liner Cementing Details:

Size:	22" conductor
Setting Depth:	43 feet
Quantity Cement Used:	58 sacks
Cemented to:	Surface
Method Used:	Pumped by rig pump into annulus through 2" line.

Size:	$13\frac{3}{8}$"
Setting Depth:	1286 feet
Quantity Cement Used:	631 sacks
Cemented to:	Surface
Method Used:	Circulated with plugs by rig pumps.

Size:	$5\frac{1}{2}$"
Setting Depth:	5080 feet
Quantity Cement Used:	560 sacks
Cemented to:	3210 feet
Method Used:	Circulated with plugs by O.D.E. cementing truck.

(i) Drilling Fluid:

Well was spudded in with water. Native mud was built up during the drilling of Upper Heytesbury section. The mud was replaced with water after cementing the $13\frac{3}{8}$" casing. Besides water, myrtan and caustic soda were added to the native mud on three occasions to the depth of 4200 feet. From this depth it was controlled with bentonite, myrtan and caustic soda. The weight of native mud to 4200 feet varied between 10.3 and 14 lb/gal., the viscosity 30 to 42 seconds and the water loss 50 to 82 cc. The weight of controlled mud varied from 10.3 to 10.4 lb/gal., the viscosity 34 to 43 secs. The filter loss was reduced to 34 cc. Shortage of water made good mud control impossible during drilling.

(j) Water Supply:

Water was pumped from Spring Creek which runs about west from the well. During the dry summer months, however, the creek almost ran dry and was not able to supply the rig's needs. A water well, 25 inches in diameter, was drilled to 150 feet under the derrick. It produced an estimated 4 bbl/hour water by compressed air lift. As the above-mentioned supplies were still insufficient, a local contractor, with a 2200 gallon tank mounted on a low-boy trailer, hauled brackish water from Curdie's River. A 20,000 gallon tank was used to store water on site. Chloride content of the water varied according to sources of supply. Average was 3500 ppm chlorides.

(k) Perforation and Shooting Record:

(a) For testing -

(1) 4956 to 4963 feet
(2) 4716 to 4726 "
(3) 4608 to 4620 "
(4) 4164 to 4176 "
(5) 3856 to 3868 "

(b) For breaking circulation behind $5\frac{1}{2}$" casing -

3167 to 3166 feet

Perforations were made with Schlumberger's 4" shaped charge gun at a density of 4 shots per foot. No open hole shooting was undertaken.

(l) Plugging Back and Squeeze Cement Jobs:

During testing:

(1) Over zone 4956 to 4963 feet. Set Model 'K' Retainer at 4942 feet. Mixed 12 sacks and squeezed out 4.5 bbl. at 1900 to 2000 psi. Top of plug 4942 feet.

(2) Over zone 4716 to 4726 feet. Open ended tubing set at 4680 feet, mixed 20 sacks, squeezed out 6.25 bbl. at 2700 psi. Top of plug 4689 feet.

(3) Over zone 4608 to 4620 feet. Open-ended tubing set at 4660 feet. Mixed 25 sacks, squeezed out 1 bbl. at 3200 psi. Top of plug 4450 feet.

(4) Over zone 4164 to 4176 feet. Open-ended tubing set at 4204 feet. Mixed 25 sacks, squeezed out 4 bbls. at 1600 psi. Top of plug 4137 feet.

(5) Over zone 3856 to 3868 feet. Open-ended tubing set at 3902 feet. Mixed 25 sacks, squeezed out 2 bbls. at 1900 psi. Top of plug 3207 feet

For abandonment of well:

(1) Over the top of $5\frac{1}{2}$" casing. Plug spotted from 1961 to 1931 feet with 25 sacks.

(2) Below the shoe of $13\frac{3}{8}$" casing. Plug spotted from 1315 to 1285 feet with 50 sacks.

(m) Fishing Operations:

None.

(n) Side-tracked Hole:

None.

(3) Logging and Testing

(a) Ditch Cuttings:

Cuttings were taken over a normal shale-shaker. Interval sampled was every 10 feet to 4670 feet, and every 5 feet to 5530 feet.

(b) Coring:

The original program was that no core was to be taken before the setting of $9\frac{5}{8}$" casing unless:

(1) Any oil or gas shows were observed, or

(2) Any unexpected lithology was encountered, or

(3) Fossiliferous section which might be useful for age determination or correlation was cut.

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After setting $9\frac{5}{8}$" casing cores were to be taken:

(1) When oil or gas shows were observed.

(2) At formation change or significant drilling rate change.

(3) If a sudden marked increase in mud chloride was noted.

(4) If a porous sand or sandstone was detected.

(5) If loss of circulation took place.

The $9\frac{5}{8}$" casing was not set in the hole. One core was cut above the planned setting of $9\frac{5}{8}$" casing.

Five cores were cut for a total footage of 63 feet. Forty-two feet, six inches were recovered for a total recovery of 67%.

Coring equipment used was a conventional Hughes Type 'J' core barrel with $7\frac{7}{8}$" and $8\frac{3}{4}$" Hughes Hard Formation core heads.

(c) Sidewall Samplings:

No Sidewall samples were attempted in Port Campbell No. 3.

(d) Electrical and Other Logging:

Logging was done by Schlumberger Seaco Inc. Schlumberger site engineer was Mr. John White. Logs were run as follows:

Electric Logs	Micrologs	Laterologs
46 to 1262 feet	1264 to 3287 feet	1284 to 3287 feet
1284 to 3289 "	3082 to 4495 "	3086 to 4404 "
3089 to 4407 "	4204 to 5528 "	4204 to 5530 "
4207 to 5530 "		

Gamma Ray Log	Temperature Log
1281 to 5040 feet	1220 to 5042 feet

(e) Drilling Time Log:

A Geolograph Continuous Time Depth Recorder was used during the drilling of Port Campbell No. 3. This instrument recorded the time taken for each foot penetrated. A drilling time log was drawn up from the Geolograph charts.

(f) Formation Testing:

For details see Appendix No. 3.

(i) No open hole testing was attempted.

(ii) Tests through casing perforations were as follows:

D.S.T. No. 1 4956 to 4963 feet. Recovered free inflammable gas with salt water.

D.S.T. No. 2 4716 to 4726 feet. Recovered gas-cut salt water.

D.S.T. No. 3 4608 to 4620 feet. Recovered gas-cut salt water.

D.S.T. No.4 & 4A 4164 to 4176 feet. Recovered gas-cut salt water.

D.S.T. No. 5 3856 to 3868 feet. Recovered salt water.

(g) Deviation Surveys:

Depth (feet)	Deviation (degrees)	Depth (feet)	Deviation (degrees)
150	¼	2400	1½
291	⅛	2600	¾
500	1	2855	½ - 1?
560	¼	3005	1
760	¾	3617	¾
880	¼	3860	½
1095	½	4000	1
1240	1	4085	½
1490	½	4340	1¼
2010	¾	4670	1

(h) Temperature Survey:

A temperature survey was run on March 1, 1961, to determine the height of cement column behind the 5½" casing. The cement was found at 3210 feet. Bottom hole temperature was 138°F.

(i) Other Well Surveys:

A well geophone velocity survey was run on February 26, 1961. Readings were taken at formation breaks and at 500 foot intervals.

IV GEOLOGY

1. Summary of Previous Work:

This has been covered by the two earlier reports on Port Campbell Nos. 1 and 2, and since that time no further geological work has been done in the area.

Robert H. Ray continued their seismic survey over the area towards Warrnambool for the company. The Mines Department of Victoria drilled a water well at Warrnambool. Very little Belfast and no Waarre sediments were present in that bore.

2. Stratigraphy:

The lithology of Port Campbell No. 3 was very similar to that cut in Port Campbell No. 1 well, No 3 well being about 3 miles west-northwest from No. 1.

The section is as follows:-

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Surface to 1534 feet	Heytesbury Group
Surface to 290 feet	Light grey, fossiliferous, skeletal, very porous limestone.
290 to 1534 "	Dominantly light grey to blue-grey, fossiliferous, soft, argillaceous marl becoming more sandy towards the base. Sandy limestone marker bed at 1248 feet.
1534 to 3913 feet	Wangerrip Group Dominantly quartz sand and sandstones with interbedded siltstones and conglomerates. Pyrite common. Trace of ankerite towards base.
3913 to 4230 "	Paaratte Formation Transition zone consisting of siltstone, mudstone and sandstone with minor ankerite concretions and carbonaceous material.
4230 to 4608 "	Belfast Mudstone Dark grey fossiliferous sandy (up to granules) glauconitic mudstones and siltstones, with scattered ankerite concretions.
4608 to 4810 "	Waarre Formation Light grey, very porous, friable sandstones and gravels with interbedded dark grey pyritic mudstones and siltstones.
4810 to 5530 "	Otway Group Grey-green to blue-green feldspathic and micaceous sandstones (subgreywackes) and siltstones and mudstones. Chloritic with abundant dark rock fragments.

A correlation between Port Campbell Nos. 1 and 3 is summarised below. Figures in brackets refer to the depth of the various horizons below sea level.

	Port Campbell No. 3	Port Campbell No. 1
Thickness of Heytesbury Group	1519 feet	1365 feet
Top of Wangerrip Group	1544 (-1334) feet	1375 (-1208) feet
Thickness of Wangerrip Group	2369 feet	2870 feet
Top of Paaratte Formation	3913 (-3703) feet	4245 (-3898) feet
Thickness of Paaratte Formation	317 feet	685 feet
Top of Belfast Mudstone	4230 (-4020) feet	4930 (-4583) feet
Thickness of Belfast Mudstone	378 feet	726 feet
Top of Waarre Formation	4608 (-4398) feet	5656 (-5309) feet
Thickness of Waarre Formation	202 feet	+309 feet
Top of Otway Group	4810 (-4600) feet	-
Thickness of Otway Group	+722 feet	-

The only new lithology encountered in this well is the section from surface to 290 feet which is a light grey, porous (freshwater bearing) limestone. This would probably correlate with Baker's Port Campbell limestone member (or equivalent) along the coastal outcrops. Approximately 20 feet of limestone was cut at the top of Port Campbell No. 1 well and this limestone unit probably thickens towards the west.

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From the above correlations it can be seen that the sediments cut in No. 3 well were very much thinner than their equivalents in the No. 1 well, with the top of the Waarre being over 1000 feet higher in No. 3 than in No. 1.

Information obtained from No. 2 well supports the contention that an unconformity exists between the Waarre and the Belfast in the No. 1 well, and it is assumed that an unconformity is also present between the same two formations in the No. 3 well.

As regards the Waarre-Otway contact, it appears that no unconformity exists between these two units here, as the basal Waarre is very similar to the topmost Otway, except that the Otway has a higher percentage of dark rock fragments within it. It is probable that, with future work, the Waarre Formation will be adopted as the topmost unit within the Otway Group. Correlating No. 3 with No. 2 well, it now seems that the top of the Otway Group has probably been put too high in No. 2. Sandstones (feldspathic) without a very high percentage of dark rock fragments, but otherwise like the Otway, were placed within the Otway Group in No. 2. However, similar sandstones to these are evident at the base of Port Campbell No. 1 which did not reach true Otway. Another factor evident in No. 3 well is the marked Waarre interval on the electric logs. For the above reasons, it now seems that a better Otway top for Port Campbell No. 2 is approximately 8770 feet.

The Belfast Mudstone in Port Campbell No. 3 was much more sandy than in No. 1 and the top Waarre sandstone is cleaner here than in No. 1. These facts could indicate that the depositional environment is becoming shallower towards the west in these formations.

It is fairly certain that the well started on the downthrown side of a fault, passed through the fault and bottomed in sediments on the upthrown side of the fault.

(3) Structure:

Before Port Campbell No. 3 was drilled, seismic work indicated a similar thickness of sediments down to the top of the Waare as that cut in No. 1. With the very much thinner section (approximately 1000 feet) the evidence of faulting in cores, and recent seismic work, it was obvious that the well drilled through a fault.

Core No. 4 showed good evidence of faulting and limestone breccia within it is probably of a fault nature as well. As yet, it is not known where the fault (or fault zone) cut the well. It could have cut out the basal Wangerrip and topmost Paaratte, as it was in the interval 3800 to 4200 feet approximately that the highest readings on the gas detector were obtained. The last test over some of this zone showed no evidence of gas.

Seismic work has shown that the fault is trending roughly east-west through the well and that the well bottomed in sediments on the upthrown side of it. None of the cores recovered exhibited any true dip, although cross-bedding was common in Core Nos. 2, 3 and 5.

It is recommended that in future wells a Continuous Dipmeter (now available) be run in order to further define these faults and elucidate some of the structural problems in the area.

(4) Relevance to the Occurrence of Petroleum

Testing in Port Campbell No. 3 indicated small amounts of solution gas in all tests excpet DST's Nos. 1 and 5. DST No. 5 gave no evidence of gas while DST No. 1 showed the presence of a small amount of free gas.

DST No. 1 (4956 to 4963 feet) was carried out on Otway Group sediments which have previously been thought to be economic basement, or at least non-productive. Although the gas was only of a small volume (a flow rate could not be obtained due to flowing pressures dropping to zero at each test) it is significant that it came from sediments of the Otway Group. Whether the gas is indigenous to the Otway, or has migrated across the fault from possible gas zones in the Waarre on the down-thrown side is as yet unknown. However, the occurrence with this gas of formation waters of salinity up to 17,000 ppm chlorides gives added evidence to the suggestion that the gas is indigenous to the Otway Group. Analyses of the gas showed a much higher percentage of methane (91%) than was present in the gas from the Waarre in No. 1. Carbon dioxide and nitrogen, both present in No. 1, do not occur in No. 3 well. This also suggests that the gas in the Otway Group is not in communication with the Waarre gas.

High percentage (50 to 90%) gas readings on the continuous gas recorder from 3800 to 4200 feet (basal Wangerrip and Paaratte) could have been due to the release of gas from siltstones in this zone, or to the well crossing a gas bearing fault zone about this depth. A drill stem test within this interval yielded no evidence of gas.

There were no shows of oil present in this well, either in the mud or cuttings and cores.

(5) Porosity and Permeability of Sediments Penetrated

These formation parameters were estimated qualitatively at the well site from the cores and cuttings and also from the Microlog.

Core No. 2, in sandstone at the top of the Waarre Formation, appears to have a very high porosity and permeability although the following analyses show permeability to be low.

Core Depth (feet)	Permeability (Darcy)	Porosity (%)	Saturation (% porosity)		Chlorides as Cl.
			oil	water	
4678	4.84	23.6	Nil	7%	5400 ppm
4681	1.00	23.8	Nil	7%	3440 ppm

These results were determined in the Petroleum Technology Laboratory of the Bureau of Mineral Resources, using a Ruska field porosimeter and permeameter and nitrogen as flowing medium. This porous sand is much cleaner than at No. 1 well, with a lower percentage of clay matrix and comprised almost entirely of quartz grains.

Porosity was also evident from the Microlog in a few zones within the Otway, although of a much lower value than that of the Waarre, and this was confirmed by testing.

(6) Contribution to Geological Concepts Resulting from Drilling

Port Campbell No. 3, although not finding any commercial accumulation of hydrocarbons, contributed to our knowledge of this end of the basin.

Firstly, it appears that the Waarre sandstones may have a reasonably wide areal extent, and their excellent reservoir characteristics gives added scope for exploration. A further fact about these sandstones is that they appear to be cleaner in this well than their equivalents in Port Campbell No. 1 (cf. Core No. 22, Pt. C. No. 1, and Core No. 2, Pt. C. No. 3). It is also apparent that the unconformity between the Belfast and the Waarre present in Port Campbell No. 1 is also present in No. 3, probably with much the same time break.

Other information emerging from this well is in regard to the nature of the Otway Group. The previously accepted idea that it is composed of non-marine rocks may need revising in the future. Certainly, formation water from some of these sediments is definitely not fresh and, with gas also in them, their petroleum possibilities cannot now be overlooked. Further drilling should help to clarify the nature of the beds within the basin, where lateral facies changes could also be expected. Another point is that there does not appear to be any unconformity between the Otway Group and the Waarre Formation in this well. It is further suggested that, with later work, the Waarre Formation will probably turn out to be the topmost unit of the Otway Group itself. Naturally this will only be applicable to subsurface sections.

As mentioned under Stratigraphy, this well has given some evidence that the Waarre and the Belfast formations were laid down under slightly shallower conditions at No. 3 site than at No. 1.

A well on the downthrown side of the fault south of Port Campbell No. 3 would determine (if the seismic interpretation is correct) whether any likely commercial accumulation is present in the Port Campbell structure. However, as it is higher structurally than No. 1, it could be expected that only gas might be present here. Drilling is the only method to solve these problems.

J. S. BAIN
S. BENEDEK

REFERENCES

1. Bain, J. S. and McQueen, A. F. — Well Completion Report - Port Campbell No. 1, Victoria. Frome Report 7200-G-65.

2. Wood, R. L. and Bain, J. S. — Well Completion Report - Port Campbell No. 2, Victoria. Frome Report 7200-G-77.

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See also: "Lithofacies Data Sheet (B)" prepared by Cundill Meyers & Assoc. for Shell ~~Del~~ Developments (Aust.) P/L. 1967.

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APPENDIX 1

PALAEONTOLOGICAL REPORT

by

Department of Mines Victoria

18/36

APPENDIX NO. 1

PORT CAMPBELL NO. 3 WELL

An addition to "Explanatory Notes to accompany Faunal Correlation Chart of the Lower Cretaceous Section in Southwestern Victoria".

For the purposes of micro-faunal correlation with other wells, the samples submitted from Port Campbell No. 3 well have proved inadequate. The rotary cutting samples were badly contaminated with Foraminifera from higher levels, and Core No. 1 (4400-10 feet) was the only core which contained micro-fauna. Despite these inherent difficulties the following observations are noted:-

(1) The first appearance of Cretaceous micro-faunas (mainly arenaceous Foraminifera but including some lagenid Foraminifera and Ostracoda) was recorded at 4100-10 feet. Because of contamination it is difficult to place the base of the Tertiary, although an abundant Palaeocene to ?Lower Eocene fauna at 3900-10 feet would suggest that the Tertiary extended down to this level if not a little below. Thus for convenience the Tertiary-Cretaceous contact is placed at 4000 feet, remembering that this is an arbitrary depth. It is noteworthy that I have already suggested that the Tertiary-Cretaceous contact in Port Campbell No. 1 well is at 4000 feet.

(2) Cretaceous Foraminifera (arenaceous and lagenids) and Ostracoda occur sparsely below 4100 feet to the bottom of the well. However, it is strongly suspected they are of no consequence below 4676 feet (Core No. 2) as no core at or below this depth contains any fauna, thus the fauna must be regarded as caving or mud contamination in the rotary cuttings. Therefore, between 4000 feet and 4676 feet the sediments are Cretaceous in age and contain marine fossils. These sediments are equivalents of those between 4000 feet and 5656 feet in Port Campbell No. 1, and between 5300 feet and 7904-14 feet in Port Campbell No. 2 well. Surely the marine Cretaceous section is thinning away from the present shoreline.

(3) Not only is thinning evident but the lower two faunules present in Port Campbell No. 2 (drilled thickness of 850 feet) are missing in Port Campbell No. 3. As the lowest faunule of the Cretaceous section is not present in Port Campbell No. 1 only 300 feet of the Port Campbell No. 1 section is not represented in Port Campbell No. 3. It is evident that a marine Cretaceous sedimentation commenced in Port Campbell No. 2 before it did in Port Campbell No. 1 which in turn was before sedimentation in Port Campbell No. 3.

(4) The arenaceous species present in Port Campbell No. 3 are those of the upper three faunules of Port Campbell No. 1 and 2, but the lack of diagnostic calcareous species does not allow any more precise correlation.

(5) The Foraminifera in Port Campbell No. 3 well comprise a definite facies fauna suggestive of disturbed and/or anaerobic benthonic conditions which would be expected in a deltaic or barred basin environment. However, the presence of some calcareous forms (ex. lagenids and Ostracoda) could dismiss the restricted circulation surmise (eg. barred basin) and could support the supposition of deltaic brackish water environment.

(6) Close similarity was noted between the Cretaceous faunas of Port Campbell No. 3 well and those of Heywood No. 10 well. But a correlation between the sections in these two wells may be merely a correlation of similar facies.

(7) It is noteworthy that the Heywood No. 10 Cretaceous sediments contained a glauconite which turned brown on heating. Port Campbell No. 3 well contained the only other Cretaceous sediments in which this phenomenon was noted. This fact may also suggest similarity in environmental features between these two wells.

7th April, 1961 D. J. Taylor

N.B. The above assessment allows for the possibility of faulting between Port Campbell No. 3 and Port Campbell No. 1 prior to marine Cretaceous sedimentation.

APPENDIX 2

CORE ANALYSIS

CORE ANALYSIS

Core No. 1 4400 to 4410 feet. Recovery 4 feet.

4" ankerite; light brown, hard, dense, sandy, glauconitic.
3' 8" mudstone to siltstone; grey to dark brownish-grey, micaceous, highly glauconitic, pyritic, in form of very fine crystalline pyrite pockets. Sandy, fine to coarse grained quartz grains, white and clear, glauconitic - well rounded glauconite pellets scattered in core, highly glauconitic sandstone pockets in white slightly calcareous matrix. Fossiliferous, slickensided.
Density mudstone 2.5; ankerite 3.35
Acetone test: Negative. Soxhlet: No cut.
No fluorescence.

Core No. 2 4676 to 4695 feet. Recovery 17 feet.

10' sandstone to loose sand; quartzitic, white, clear, angular, fine to very coarse grained, unsorted, uncemented, very porous, friable, pyritic. Fossil wood partly replaced by pyrite. Some brown, soft material giving good acetone reaction.
7' siltstone; grey, scattered with very fine pyrite, very cross bedded, forming lenses, alternating with mudstone, dark grey, pyritic. The amount of siltstone increasing towards bottom, light grey to greenish-grey, containing chlorite?. Thin streaks of mudstone with carbonaceous material. Very cross bedded. Apparent dip 13°.
Density: sandstone 2.2; siltstone 2.4

Core No. 3 4781 to 4801 feet. Recovery 11 feet.

9' 6" sandstone; light brownish grey quartz, feldspar, chlorite, dark minerals and fragments. Fine grained, angular, well sorted, pyritic, micaceous. Thin streaks of carbonaceous sandstones, dark grey coloured. The core is intensively microfaulted. Towards the bottom chlorite increases and the core also becomes calcareous.
1' limestone; brecciated, light brown, hard, sandy with sandstone fragments enclosed.
6" sandstone; greenish-grey, fine grained, angular, well sorted, quartz, feldspar, chlorite, dark minerals and fragments. Highly calcareous, soft, micaceous, pyritic.
Density: 2.4. Acetone test: Negative. Ultra violet: Negative.

Core No. 4 5155 to 5165 feet. Recovery 9 feet.

Sandstone to greywacke; greenish-grey, fine to medium grained, unsorted quartz feldspar, dark minerals. Pyritic, red mineral, chlorite, micaceous (biotite). Quartz and feldspar grains are angular, dark grains are subrounded.
1' from the top there is a 2" wide band of calcareous sandstone, harder and lighter coloured than the rest of the core, also calcareous concretions are present.
Density: 2.2 Acetone test: Negative. Ultra violet: Negative.

Core No. 5 5526 to 5530 feet. Recovery 18 inches.

Siltstone; light grey to grey, fine grained, approaching mudstone in places. Hard, tight, contains finely disseminated carbonaceous material and biotite. Very fine pyrite replaces plant remains. Very fine cross bedding is common and several small load-cast structures are recognised.
Density: 2.3

APPENDIX 3

FORMATION TESTING

APPENDIX NO. 3

FORMATION TESTING

Drill stem tests through casing perforations:

D.S.T. No. 1. 4956 to 4963 feet. Otway Group

Johnston 2⅞" B.O.E.5 tester. Packer set at 4940 feet. Immediate blow, inflammable gas to surface in 2 minutes. No flowing pressure. Liquid came to surface in 1 hour. Recovered mud and water. Highest shut-in pressure on surface 700 psi. Approximate flow in volume of water 2.5 bbls/hour. No gas flow volume determined due to flowing pressure dropping to zero. Probably less than 250 Mcf/24 hours. Salinity 15,000 ppm.
Pressures recorded:-

Hydrostatic -	Initial:	1800 psi	Final:	1270 psi
Flow Period -	"	310 "	"	1160 "
Shut-in Period -	"	1160 "	"	1500 "

D.S.T. No. 2 4716 to 4726 feet. Waarre Formation

Johnston 2⅞" B.O.E.5 tester. Packer set at 4697 feet. Good blow. Inflammable gas to surface after 14 minutes. Swabbed 46.8 bbls. of gas-cut water. Recovered 4547 linear feet of water from tubing. Total liquid recovered from test 64.4 bbls. Salinity 14,500 to 14,700 ppm chlorides. Pressure chart was unreadable.

D.S.T. No. 3 4608 to 4620 feet. Waarre Formation

Johnston 2⅞" B.O.E.5 tester. Packer set at 4575 feet. Fair blow of gas to surface in 15 minutes. Swabbed 25.5 bbls. gas-cut muddy water. Total water 42.8 bbls. Salinity 10,500 ppm chlorides. Lot of loose medium to coarse clean sand found in tool.
Pressures recorded:-

Hydrostatic -	Initial:	1750 psi	Final:	1700 psi

No flowing or shut-in pressures recorded on the chart.

D.S.T. No. 4 4164 to 4176 feet. Paaratte Formation

Johnston 2⅞" B.O.E.5 tester. Packer set at 4150 feet. Fair blow gas to surface 12 minutes. Swab bar held up at 690 feet from surface. Recovered 3880 linear feet of gas-cut water from string (15 bbls.). Salinity 4400 ppm. Pulled out to ascertain trouble.
Pressures recorded:-

Hydrostatic -	Initial:	1800 psi	Final:	1800 psi
Flow Period -	"	1200 "	"	1680 "

Tool was plugged with sand.

D.S.T. No. 4a 4164 to 4176 feet. Paaratte Formation

Johnston 2⅞" B.O.E.5 tester. Packer set at 4118 feet. Fair blow. No gas to surface. Swabbed 27.75 bbls. of gas-cut water. Recovered 3943 linear feet of gas-cut water from string. Total water recovered from D.S.T. 4 and 4a = 58.5 bbls. Salinity 4400 ppm chlorides.
Pressures recorded: -

Hydrostatic -	Initial:	1800 psi	Final:	1800 psi
Flow Period -	"	1500 "	"	1670 "

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D.S.T. No. 5 3856 to 3868 feet. Wangerrip Group

Johnston $2\frac{7}{8}$" B.O.E. 5 tester. Packer set at 3845 feet. Fair blow. No gas to surface. Swabbed 29.6 bbls. of water. Recovered 3800 linear feet of water from string. Total water recovered 44.2 bbls. Salinity 2600 ppm clorides.
Pressures recorded:-

Hydrostatic	- Initial:	1690 psi	Final:	1610 psi
Flow Period	- "	1000 "	"	1550 "

APPENDIX 4

DETAILED LITHOLOGICAL DESCRIPTION

APPENDIX NO. 4

DETAILED LITHOLOGICAL DESCRIPTION

Heytesbury Group

Surface to 290 feet	Limestone; white to very light grey. Fossiliferous, very porous with trace of pyrite and light green glauconite.
290 to 1250 "	Marl; very clayey, bluish-grey to greenish-grey, puggy, highly fossiliferous, trace of glauconite.
1250 to 1289 "	Limestone; light brown to brown to pinkish-brown. Sandy, tight, compact and hard. Fossiliferous with limonitic pellets.
1289 to 1534 "	Marl to calcareous siltstone to clay; medium to dark grey to brownish-grey to brown. Extremely fossiliferous, argillaceous in parts with mica, pyrite. Glauconite increases from traces to very glauconitic between 1510 and 1534 feet.

Wangerrip Group

1534 to 1544 feet	Limestone; white, very light grey, limonitic, sandy, tight, dense with limonite pellets. Traces of loose iron-stained, clear, medium to very coarse, subangular to rounded quartz grains.
1544 to 1720 "	Sand; clear, white to light brown from iron staining. Very fine to coarse grained, but mainly medium grained. Subangular to well rounded, mainly rounded, polished, loose. Traces of pyrite and glauconite.
1720 to 1840 "	Sand; white, minor light brown ,clean and clear. Fine to granuke size, mainly coarse, and loose, fairly well sorted, polished, traces of glauconite and pyrite.
1840 to 2390 "	Sand; white, clear, loose quartz, coarse, subangular to rounded, fairly well sorted. Interbedded with siltstone, dark grey, sandy, from non-calcareous to slightly calcareous. Very micaceous and pyritic.
2390 to 2521 "	Siltstone; dark grey to bluish-grey, compact, non-calcareous, micaceous, argillaceous, glauconitic.
2521 to 2534 "	Sand; white to light brown, clear quartz, medium to small pebbles, pyritic.
2534 to 2612 "	Siltstone; dark grey to bluish-grey, compact, non-calcareous, micaceous and argillaceous, glauconitic.
2612 to 2771 "	Sand; white to light brown, clear, fine to coarse, subrounded to rounded, poorly sorted, loose, pyritic.
2771 to 2821 "	Siltstone; dark grey.

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Wangerrip Group (Cont'd)

2821 to 3090 feet	Sand; white to light brown, clear to milky reef quartz, medium to small pebbles, subangular to rounded.
3090 to 3913 "	Sand to sandstone; white to light brown, clear quartz, very fine to coarse, subangular to sub-rounded, pyritic, glauconitic, interbedded with siltstone, dark grey, carbonaceous, micaceous, non-calcareous.

Paaratte Formation

3913 to 4230 feet	Siltstone to mudstone; medium to dark grey, glauconitic, pyritic with ankerite bands. Slightly sandy, carbonaceous, micaceous. Interbedded with sandstone to sand, light grey quartz, medium to coarse, subangular to subrounded.

Belfast Mudstone

4230 to 4608 feet	Siltstone to mudstone; dark grey, very glauconitic, fossiliferous, sandy. Interbedded with thin bands of ankerite.

Waarre Formation

4608 to 4810 feet	Sandstone; light grey, medium to very coarse, angular to subrounded, friable, poorly sorted, pyritic with carbonaceous material. Interbedded with siltstone, light grey to greenish-grey to dark grey. Pyritic, carbonaceous, chloritic. Very cross bedded.

Otway Group

4810 to 5530 feet	Sandstone to greywacke; greenish-grey, angular to subrounded, fairly well sorted, pyritic, tight. Feldspar, chlorite, mica, abundant dark rock fragments. Calcareous bands and lenses. Interbedded with siltstone, medium to light grey, fine textured biotite, hard, tight, very finely disseminated, carbonaceous matter with plant remains. Very fine, cross bedded.

APPENDIX 5

FLUID ANALYSES

PORT CAMPBELL NO. 3 EXPLORATION WELL

GAS ANALYSES

	D.S.T. No. 1 4956 to 4963 ft.	D.S.T. No. 2 4716 to 4726 ft. Waarre Formation		D.S.T. No. 3 4608 to 4620 ft. Top of Waarre Formation	D.S.T. No. 4a 4164 to 4176 ft. Paaratte Formation
		From drill stem	Gas sample at surface		
	%	%	%	%	%
Methane	91.5	92.2	97.8	98.8	99.1
Ethane	4.9	0.8	2.2	1.2	0.9
Propane	2.2	-	-	-	-
Isobutane	0.7	-	-	-	-
n-Butane	0.7	-	-	-	-
CO_2	-	7.0	less than 0.5	less than 0.5	less than 0.5

ANALYSES BY STANDARD VACUUM REFINERY PTY. LTD.

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WATER ANALYSIS

Samples labelled:

Date Sampled	4th March	5th March	6th March	8th March	8th March
D.S.T. No.	1	2	3	4A	5
Depth (feet)	4956-4963	4716-4726	4608-4620	4164-4176	3856-3868

Results:

Presence of gas	Nil	Present	Present	Present	Trace
Steam Distillables	Nil	Nil	Nil	Nil	Nil
Hexane Extract	Nil	Nil	Nil	Nil	Nil
Chlorides as Cl gms/litre	13.4	13.6	10.1	4.27	1.57
Chlorides as NaCl gms/litre	22.0	22.3	16.6	7.04	2.57

ANALYSES BY VACUUM OIL COY., MELBOURNE

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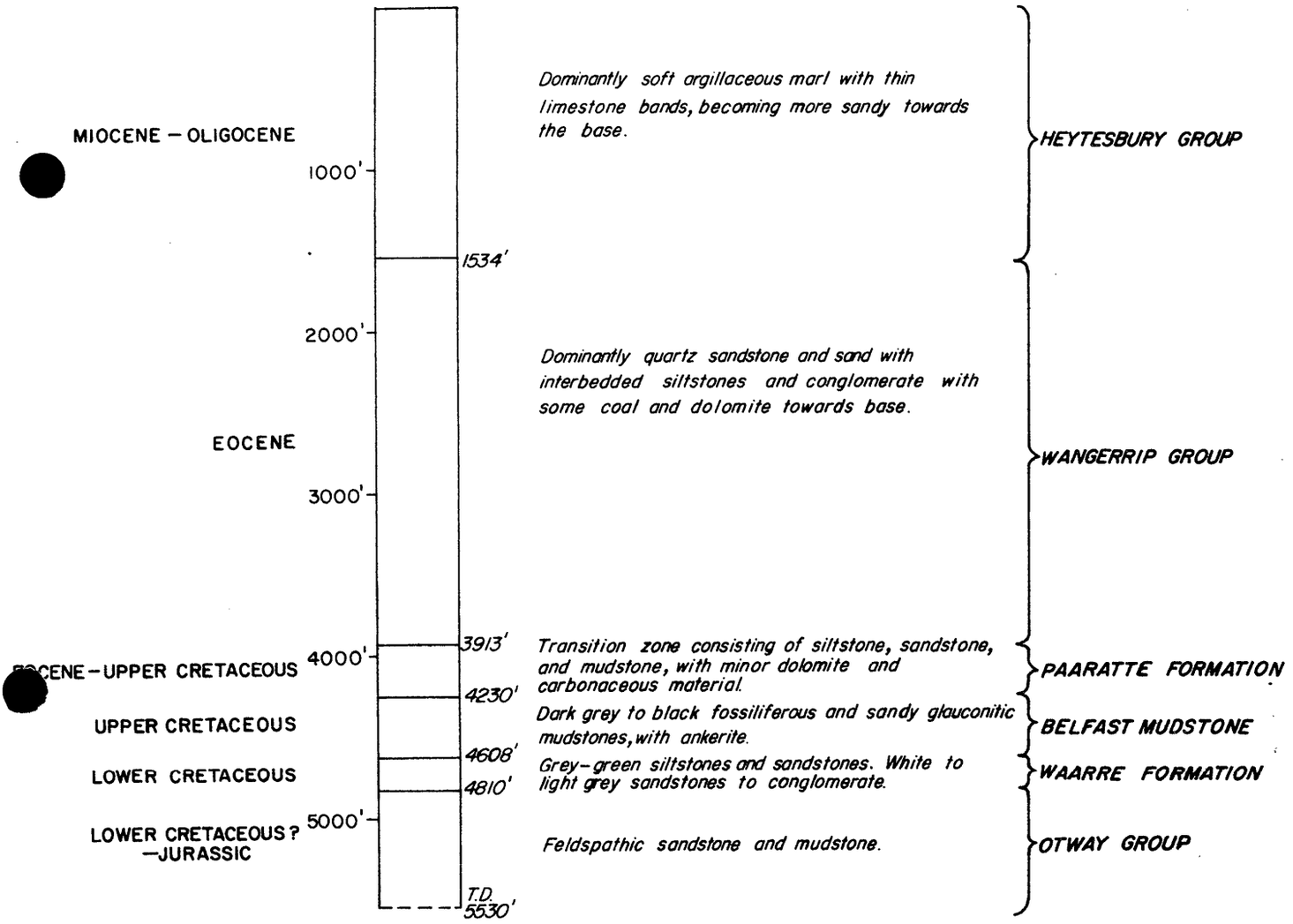
FROME-BROKEN HILL CO. PTY. LTD.

STRATIGRAPHIC COLUMN
PORT CAMPBELL N° 3.

Scale: 1 Inch = 1000 Feet.



April 1961

7200-G-80
PLATE 4

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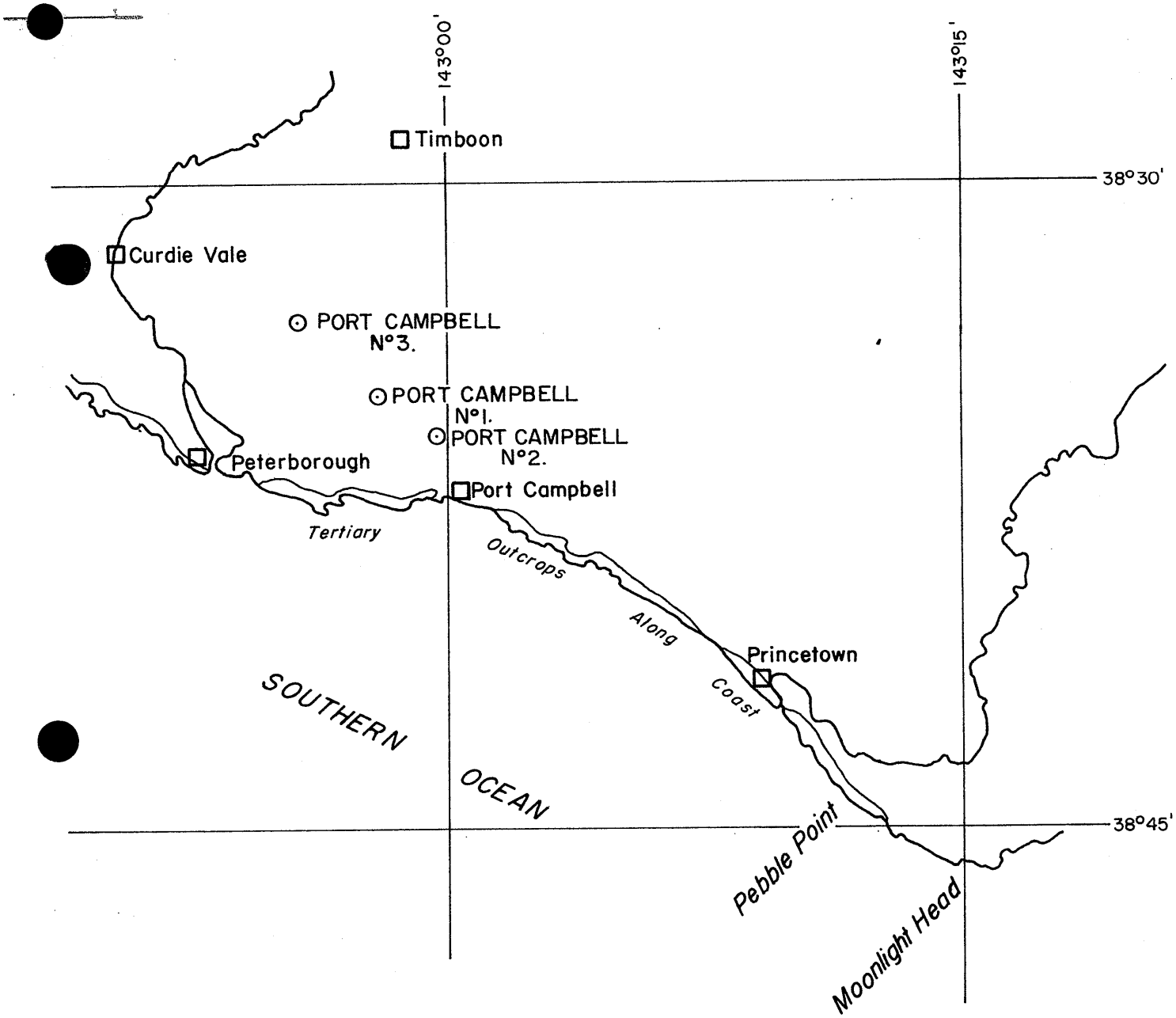
LOCALITY MAP



FROME BROKEN HILL CO. PTY. LTD.

WELL COMPLETION REPORT

PORT CAMPBELL N° 3

By J.S. BAIN & S. BENEDEK

7200-G-80

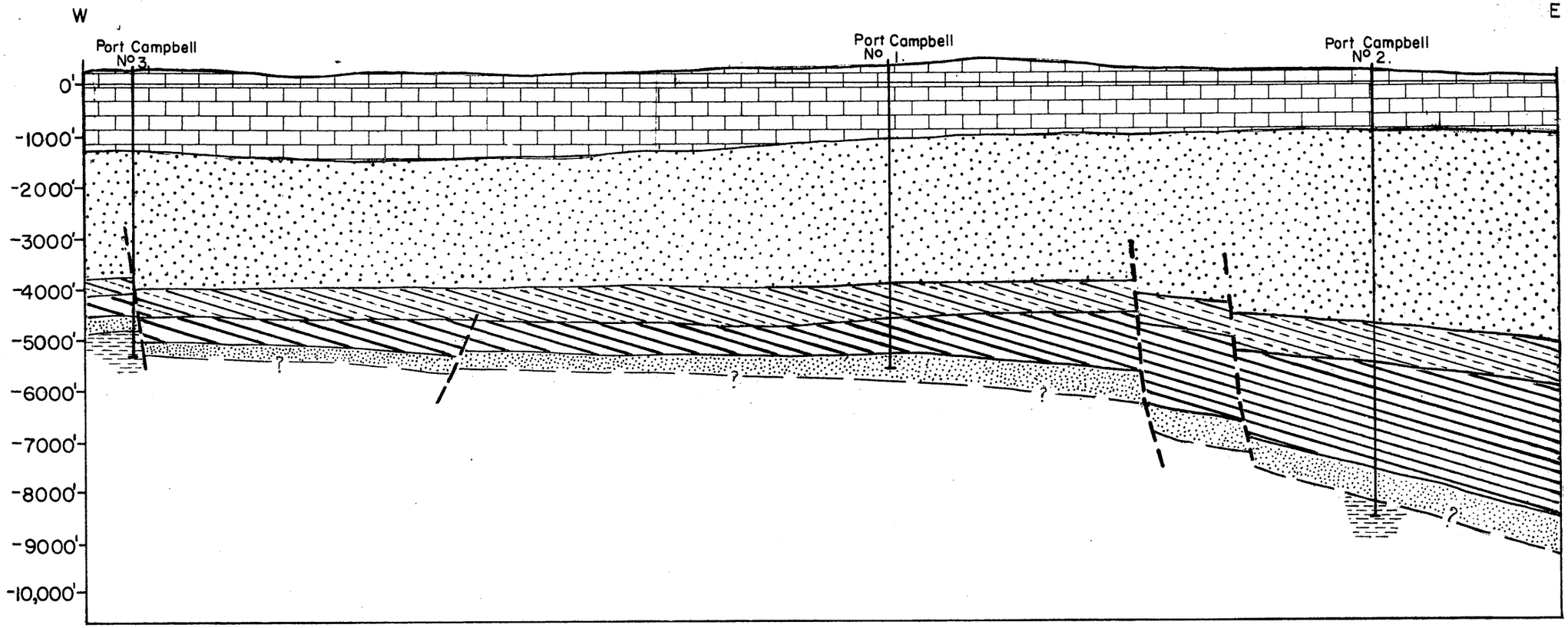
PLATE I.

March 1961

FROME-BROKEN HILL CO. PTY. LTD.

PORT CAMPBELL STRUCTURE

GEOLOGICAL CROSS SECTION
THROUGH PORT CAMPBELL N°1, N°2, & N°3 WELLS



LEGEND

Miocene – Oligocene:	Heytesbury Group.	*Upper Cretaceous.*	Belfast Mudstone.
Eocene.	Wangerrip Group.	*Lower Cretaceous.*	Waarre Formation
Eocene Upper Cretaceous.	Paaratte Formation.	*Lower Cretaceous ? Jurassic.*	Otway Group.

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WELL COMPLETION REPORT — PORT CAMPBELL No. 3

By J.S. Bain & S. Benedek

APR. 1961.

Scale : 2 Inches = 1 Mile.

7200-G-80
PLATE 3

(COPY)

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DEPARTMENT OF MINES

Melbourne

7th October, 1960.

Palynological Examination of Coal Samples from Frome-Broken Hill Co. Pty. Ltd., Port Campbell No. 2 Bore

Coal from two horizons in the Port Campbell No. 2 bore was treated by the Hydrofluoric acid - Schulzes Solution method, and the residue examined under the microscope.

Sample 1 Depth: 8140' - 43'
Type: Cuttings

This sample consisted of drill cuttings and contained much contaminant from higher horizons. Few diagnostic microspores were isolated, but as the treatment schedule was shortened to facilitate quick examination this may not be a true indication of the microfossil content of the coal. Kuylisporites sp., Cyathidites sp., Gleichenia cf. cercinidites, Cookson, along with Gymnosperm pollens, justify a Mesozoic age determination, but any more specific determination is difficult because of the contaminant.

Sample 2 Depth: 8339' - 46'
Type: Core

Many slides were prepared for examination, but no microfossils were isolated, with the exception of cellular fragments of no stratigraphic value. The sample consisted primarily of amorphous material probably derived from the breakdown of humic acids etc.

Footnote: Subsequent examination of sediments from nearby and deeper horizons has revealed Mesozoic marine microplankton and plant microfossils, confirming the Mesozoic age of the coals sampled.

(Sgd) John Douglas
Geologist

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Preliminary Examination of Plant Impressions, Port Campbell No.2 Bore

Locality: Port Campbell; Frome Broken Hill Co.Pty.Ltd., Bore No.2

Depth: 8409 - 11 feet

Rock Type: Black carbonaceous fine-grained mudstone with plant impressions.

Date: 7.12.60.

Core supplied from this bore contained numerous plant impressions, including fragmentary stems and isolated leaves. Preliminary examination shows that the finely ribbed stems and leaves belong to the order Equisetales of the Sphenopsida. Generic and specific identification will be aided by a very thin fragile cuticle which has been isolated from the stem remains by maceration in Schulze's Solution on a hot plate. No leaf cuticle has as yet been isolated.

Equisetalean impressions have been found in many localities in Victorian non-marine Mesozoic sediments, and also in probable estuarine sediments at 5930' feet in Port Campbell No.1 bore. However, the leaf remains under discussion indicate that the impressions may belong to a species previously undescribed from Victoria.

A final identification, full description, comparison with Port Campbell No.1 specimens and geological age determination will be forwarded when completed.

J. Douglas

Geologist.

19th December, 1960.

PE604798

This is an enclosure indicator page.
The enclosure PE604798 is enclosed within the container PE907156 at this location in this document.

The enclosure PE604798 has the following characteristics:

ITEM_BARCODE	= PE604798
CONTAINER_BARCODE	= PE907156
NAME	= Well Completion Log
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= COMPLETION_LOG
DESCRIPTION	= Well Completion Log, 1" = 100', (Plate 2 from WCR), J.S.Bain & S.Benedek, Recorded by Schlumberger for Frome-Broken Hill Company Pty. Ltd., 25 February 1961, for Port Campbell-3.
REMARKS	=
DATE_CREATED	= 25/02/61
DATE_RECEIVED	=
W_NO	= W465
WELL_NAME	= PORT CAMPBELL-3
CONTRACTOR	= SCHLUMBERGER
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

PE907157

This is an enclosure indicator page.
The enclosure PE907157 is enclosed within the container PE907156 at this location in this document.

The enclosure PE907157 has the following characteristics:

ITEM_BARCODE	= PE907157
CONTAINER_BARCODE	= PE907156
NAME	= Locality Map
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= GENERAL
SUBTYPE	= MAP
DESCRIPTION	= Locality Map, 4" = 1 mile, (enclosure from WCR), Frome-Broken Hill Co. Pty. Ltd., 1960, for Port Campbell-3.
REMARKS	=
DATE_CREATED	= 31/12/60
DATE_RECEIVED	=
W_NO	= W465
WELL_NAME	= PORT CAMPBELL-3
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

PE907158

This is an enclosure indicator page.
The enclosure PE907158 is enclosed within the container PE907156 at this location in this document.

The enclosure PE907158 has the following characteristics:

ITEM_BARCODE	= PE907158
CONTAINER_BARCODE	= PE907156
NAME	= Time-Depth Curve
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= VELOCITY_CHART
DESCRIPTION	= Time-Depth Curve (interpreted), Enclosure from WCR, By Ray Geophysics for Frome-Broken Hill Company Pty. Ltd, 26 February 1961, for Port Campbell-3
REMARKS	=
DATE_CREATED	= 26/02/61
DATE_RECEIVED	=
W_NO	= W465
WELL_NAME	= PORT CAMPBELL-3
CONTRACTOR	= ROBERT H.RAY SERVICE CO
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)

PE907159

This is an enclosure indicator page.
The enclosure PE907159 is enclosed within the container PE907156 at this location in this document.

The enclosure PE907159 has the following characteristics:

ITEM_BARCODE	= PE907159
CONTAINER_BARCODE	= PE907156
NAME	= Geological Cross-Section
BASIN	= OTWAY
PERMIT	= PEP6
TYPE	= WELL
SUBTYPE	= CROSS_SECTION
DESCRIPTION	= Geological Cross-Section through Port Campbell-3, 1" = 500', (Plate 5 from WCR), By J.S.Bain; Frome-Broken Hill Co. Pty. Ltd., April 1961.
REMARKS	= Colour
DATE_CREATED	= 30/04/61
DATE_RECEIVED	=
W_NO	= W465
WELL_NAME	= PORT CAMPBELL-3
CONTRACTOR	=
CLIENT_OP_CO	= FROME-BROKEN HILL COMPANY

(Inserted by DNRE - Vic Govt Mines Dept)