

INTERSTATE/SHELL SURROUNDING NO. 1

WELL COMPLETION REPORT

INTERSTATE/SHELL PURRUMBETE NO.I WELL

OTWAY BASIN, VICTORIA

WELL COMPLETION REPORT

by

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and

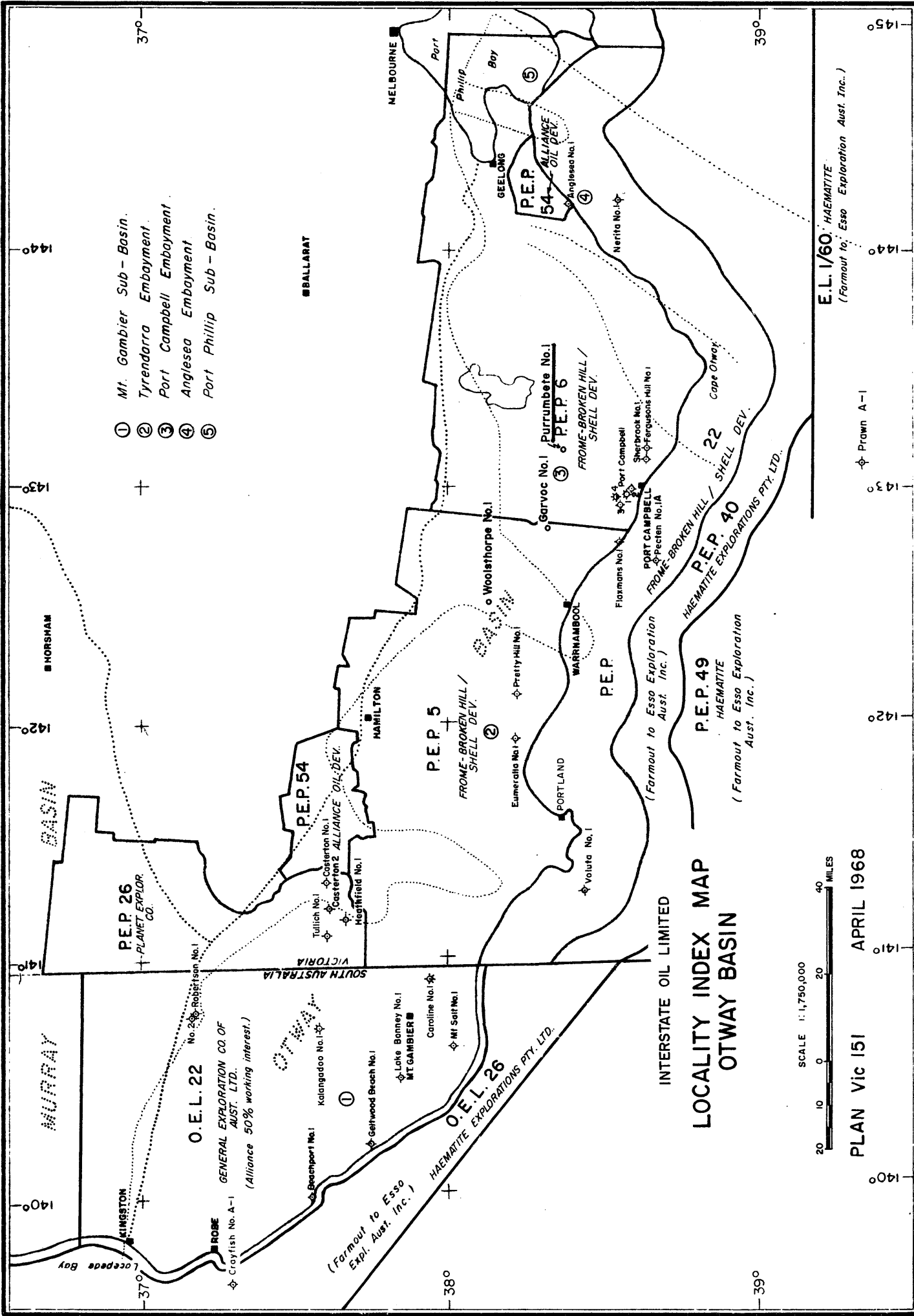
B.H. Sell (Mines Administration Pty. Ltd.)

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SCALE 1:1,750,000
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PROW A-1

I SUMMARY

(1) Drilling

Interstate/Shell Purrrumbete No.1 was located approximately 9½ miles south-southeast of Camperdown in southwestern Victoria and drilled to a total depth of 6005 feet with a Brewster N-4 rig by Richter Bawden Drilling Pty. Ltd. for the operator, Interstate Oil Limited.

Drilling commenced on 13th July 1968 and was completed on 30th July 1968.

Induction - Electric, Sonic-Gamma Ray/Caliper and Continuous Dipmeter logs were run and 27 sidewall samples were taken.

The well was plugged back and abandoned as a dry hole on 1st August, 1968.

(2) Geological

Interstate/Shell Purrrumbete No.1 was designed as a test of postulated permeable sands in the basal portion of the Lower Cretaceous, Otway Group sequence in a position of suspected stratigraphic wedge-out. Prior to drilling, basement had been predicted at approximately 4800 feet depth.

The sequence penetrated consisted of 1549 feet of predominantly marine Tertiary sediments and 4445 feet of non-marine Mesozoic sediments.

No significant hydrocarbons were encountered and neither permeable basal sands nor basement were intersected.

At 6005 feet total depth the well had penetrated in excess of 4000 feet of a monotonous, tight, Lower Cretaceous sequence considered unlikely to represent a zone of stratigraphic wedge-out. Log correlation suggested that basement could be expected to occur at considerably greater depth.

Since the structural prognosis was obviously in error and the target zone apparently beyond the limited depth capacity of the drilling rig the hole was plugged and abandoned.

II INTRODUCTION

Purrumbete No.1 was the third of a series of three wells drilled in the general area to the north of Port Campbell and designed to test postulated permeable basal sands of the Lower Cretaceous, Otway Group sequence along the northern hinge zone of the basin in positions where stratigraphic wedge-outs were predicted. Significant but non-commercial showings of hydrocarbons had previously been encountered within the Lower Cretaceous sequence in wells drilled in the Port Campbell area.

Existing seismic interpretation suggested that basement could be expected at approximately 5000 feet depth at each of the three locations and in the first two wells, Woolsthorpe No.1 and Garvoc No.1, the target permeable sands were encountered at 4790 feet and 4470 feet respectively. In Garvoc No.1 well metamorphic basement was penetrated at 4970 feet depth in close agreement with the seismic prediction.

Drilling in Purrumbete No.1 was continued for 1000 feet beyond the programmed depth without encountering any permeable sand development or significant indication of hydrocarbons. The lower 4000 feet of section penetrated consisted of monotonous, uniformly tight sediments considered unlikely to be involved in significant stratigraphic wedge-out. Log correlation with the Fergusons Hill No.1 well suggested basement could be expected at considerably greater depth and beyond the capability of the drilling rig. The well was therefore plugged and abandoned as a dry hole.

Palynological determinations reveal that some 1500 feet of Lower Albian sequence was penetrated in Purrumbete No.1 which had been absent in Garvoc No.1. At total depth Purrumbete No.1 had penetrated 4070 feet of Geltwood Beach Formation in contrast to a total thickness of only 1030 feet in Garvoc No.1.

A review of the seismic data has been made as a result of the stratigraphy revealed in Purrumbete No.1 and it is now postulated that the well was positioned adjacent to and on the down-thrown side of a significant northwest-southeast trending cross fault.

Purrumbete No.1 failed to achieve the programmed objectives but has provided useful information regarding the stratigraphy and structure in this portion of the Otway Basin.

III WELL HISTORY(1) General Data

- (i) Well name and number: Interstate/Shell Purrrumbete No.1
- (ii) Name and address of Operator: Interstate Oil Limited,
95 Collins Street,
Melbourne Vic. 3000
- (iii) Name and address of Joint Tenement Holders: Frome-Broken Hill Company Pty.
Limited,
31 Queen Street,
Melbourne Vic. 3000
- AND
- Shell Development (Australia)
Pty. Ltd.,
155 William Street,
Melbourne Vic. 3000

I.O.L. Purrrumbete No.1 was drilled by Interstate Oil Ltd. (a partner in Frome-Broken Hill Company Pty. Ltd.) and Shell Development (Australia) Pty. Ltd., under the provisions of the relevant Joint Venture and Partnership Agreements.

- (iv) Petroleum tenement: Petroleum Exploration Permit No.6
- (v) District: Colac (1:250,000)
- (vi) Location: Latitude: 38°21'56" South
143°12'27" East
- (vii) Elevation: Ground 475' A.S.L.
K.B.: 486' A.S.L. (datum for depth measurement)
- (viii) Total Depth: 6000 Driller
6005 Schlumberger
- (ix) Date drilling commenced: 13/1/68
- (x) Date total depth reached: 30/7/68
- (xi) Date well abandoned: 31/7/68
- (xii) Date rig released: 1/8/68
- (xiii) Drilling time in days to T.D.: 18
- (xiv) Status: Plugged and abandoned

Plugs:-	1450 - 1600	50 sax.
	985 - 1035	50 sax.
	0 - 20	10 sax.

Top plug was hand mixed. The first two plugs were set by conventional displacement.

(2) Drilling Data

(i) Name and address of Drilling Contractor: Richter Bawden Drilling Pty. Ltd.,
Perry House,
Elizabeth Street,
Brisbane 4000

(ii) Drilling Plant:

Make: Brewster
Type: N-4
Rated Capacity: 5000 ft. with 4½" D.P.
7500 ft. with 3½" D.P.

Motors:

Make: General Motors
Type: Twin 6-71 Model 12103
B.H.P.: 356

(iii) Mast:

Make: Lee C. Moore
Type: 126 ft. cantilever
Rated Capacity: 386,000 lbs.

(iv) Pumps:

Make: Oilwell
Type: 214 P (2)
Size: 7¼" x 14"

Pump Motors:

Make: General Motors
Type: Twin 6-71 Model 12103
B.H.P.: 356

(v) Blowout Preventer Equipment

Make:	(1) Regan ; (1) Cameron
Size:	10" ; 12"
Type:	Type K ; Type SS
Series (API)	900 ; 900

Operating Unit:

Payne accumulator
Model NSSUA-80-3

(vi) Hole sizes:

12¼" Surface to 1050 ft.
8¾" 1050 ft. to T.D.

(vii) Casing and Cementing
Details:

Size: 9⅝"
Weight: 36 lbs/ft.
Grade: J55
Range: 2
Setting Depth 1017 ft.

A Larkin float shoe was run on the bottom of the first joint of casing, with a Larkin Float collar between the first and second joints. Three B.J. centralizers were run - one six feet above the shoe, one at the top of the second joint, and one at the top of the third joint. Top and bottom B.J. plugs were used.

Quantity of cement used: 444 sax. + 896 lbs. CaCl₂
 Cemented: Surface
 Method used: Plug

(viii) Drilling Fluid:

Type: Fresh water bentonite
 Average weight: 9.6 lbs/gal.
 Treatment: The mud weight was kept at about the above figure by dumping and adding water. Fluid loss was controlled by adding C.M.C., and viscosity by treating with Q-Broxin and LoVis. pH was maintained at about 9.5 by addition of caustic soda.

Average weekly analysis:

Week Ending	Weight	Viscosity	Fluid Loss	Filter Cake	Sand	pH
20/7/68	9.5	54	5.8	2/32	1%	9.5
27/7/68	9.7	55	5.5	2/32	$\frac{3}{4}$ %	9.5

Total mud materials consumed:

Bentonite 127 x 100 lbs.
 Cellucol 154 lbs.
 Caustic Soda 1490 lbs.
 Myrtan 10 x 50 lbs.
 LoVis 39 x 50 lbs.
 Unical 5 x 50 lbs.
 Q-Broxin 67 x 50 lbs.
 C.M.C. 37 x 56 lbs.

- (ix) Water supply: Water was piped from a water main 100 yards from the wellsite.
- (x) Perforating and shooting: No perforating was carried out.
- (xi) Plugging back and squeeze cementation jobs:

Plug No.	Length of Plug	Sacks of Cement	Tested	Method
1.	1450-1600 (150')	50	No.	Conventional displacement
2.	985-1035 (50')	50	Yes Top at 990'	" "
3	0-20	10	No.	Hand mixed

- (x) Fishing Operations: Nil
- (xi) Side-tracked hole: Nil

(3) Formation Sampling

(i) Ditch Cuttings: Cuttings were collected from the shale shaker washed through a coarse sieve and retained and washed in a fine sieve. Samples were collected at 30 ft. intervals to 1050 ft. and thereafter at 10 feet intervals. The washed samples were dried, split 4 ways and placed in labelled polythene bags. The cuttings are stored at the following locations.

- (A) Bureau of Mineral Resources,
Core and Cuttings Laboratory,
Collie Street,
Fyshwick, Canberra, A.C.T.
- B/ (B) Department of Mines,
Core Laboratories,
Cook Street,
Port Melbourne, Vic.
- (C) Interstate Oil Limited,
95 Collins Street,
Melbourne, Vic.
- (D) Shell Development (Australia) Pty. Ltd.,
Shell Corner,
155 William Street,
Melbourne, Vic.

(ii) Coring: No cores were cut.

(iii) Sidewall Sampling

30 cores were attempted using a Schlumberger gun with hard formation core heads.

27 cores were accepted as tabulated below:

Depth	Recovery	Depth	Recovery	Depth	Recovery
1100	2"	2460	$\frac{1}{2}$ "	3830	$1\frac{3}{4}$ "
1200	$2\frac{1}{4}$ "	2600	$1\frac{3}{4}$ "	4008	$1\frac{1}{2}$ "
1300	2"	2707	2"	4220	$1\frac{1}{4}$ "
1355	$1\frac{1}{2}$ "	2800	$1\frac{1}{2}$ "	4490	$\frac{3}{4}$ "
1500	$1\frac{1}{2}$ "	2908	$1\frac{1}{2}$ "	4722	$\frac{3}{4}$ "
1602	$1\frac{3}{4}$ "	2995	$1\frac{1}{2}$ "	5070	$\frac{3}{4}$ "
1900	$1\frac{3}{4}$ "	3300	$1\frac{3}{4}$ "	5300	$\frac{3}{4}$ "
2100	2"	3510	$1\frac{1}{2}$ "	5695	$\frac{3}{4}$ "
2300	$1\frac{3}{4}$ "	3710	$1\frac{1}{2}$ "	5925	$\frac{1}{2}$ "

Following lithological description, the sidewall cores were used for petrographic and palynological determinations.

(4) Logging and Surveys

(i) Electrical and other logging - Schlumberger

Induction-Electric log	1017 - 6004
Sonic-Gamma Ray	1017 - 5997
Continuous Dipmeter	1016 - 6001

(ii) Penetration rate and Gas Logs:

Penetration rate: Drilling times for each 10 feet were taken from the geolograph. The penetration rate was plotted as minutes per 5 ft. on the composite log.

Gas Log: Casing shoe to T.D.
A continuous record of mud gas was kept using a Core Laboratories hot wire detector.

(iii) Deviation surveys:

A Totco 8⁰ double recorder was used at intervals not greater than 500 feet. Results are tabulated below; see also continuous dipmeter results.

Depth	Deviation	Depth	Deviation
211	3 ⁰	4087	1 ³ ₄ ⁰
419	4 ¹⁰	4182	2 ¹ ₄ ⁰
610	8 ¹⁰	4564	2 ³ ₄ ⁰
820	8 ¹⁰	4800	3 ² ₄ ⁰
1050	3 ³ ₄ ⁰	4888	3 ¹ ₄ ⁰
1550	4 ¹⁰	5244	3 ² ₄ ⁰
2029	2 ¹⁰	5690	3 ⁰
2454	2 ¹⁰	5805	3 ⁰
3100	3 ³⁰	6000	3 ⁰
3562	4 ¹⁰		3 ⁰
	1		

(iv) Temperature surveys: None

(v) Other well surveys: None

(5) Testing

(i) Formation Testing: None

(ii) Production Testing: None

PALAEONTOLOGY: Foraminifera Det by Taylor 1948 (Comp. Rept)

Palynology Det. by

Redatum	FU	TAYLOR
660' - 780'	6	H
780' - 1060'	5	I
1060' - 1260'	3	K
1260' - 1300'	2	L

GROUNDWATER DATA: (T.D.S., screened intervals, S.L., Drawdown, Yield)

GL datum



STRATIGRAPHY: Formation		Depth(m)	FROM	TO	Comments
Heytesbury Group (CMH)	Newer Basalt	CXNV			
	Whalers Bluff Fm	CQWB			
	Moorabool Viaduct Sds.	CXMO			
	PortCambell Lst Fm	CMPC	—		
	Gellibrand Marl	CMAM	0	0	
	Clifton Fm.	COCL	238		
Nirranda Group (CON)	Narrawaturk Marl	CONM	323		
	Mepunga Fm	CEME	408		
Wangerrrip Group (CPW)	Dilwyn Fm (Easter View)	CPDI	418		
	Older Volcanics	CEEV	—		
	Pember Mudstone	CPPM	—		
	Pebble Point Fm.	CPPP	442		
Sherbrook Group (MCS)	Paaratte Fm				
	Timboon Sd (Skull Ck)	MCPA			
	Nullawaare Fm	MCTS			
	Belfast Mudstone	MCNG			
	Flaxmans Fm	MCBM			
	Waarre Snds Fm	MCFL			
Otway Group (MCOZ)	Summeralla Fm ✓	MCEU	475		
	Pretty Hill Sds. <small>Gelwood B.</small>	MCPH			
	Palaeozoic mudstones	PSMV	1240	1830	

OTHER DATA: (Velocity survey, seismic line, gas/oil show, tests)

DATA SOURCE, REFERENCES, COMMENTS

PALAEONTOLOGY: Foraminifera Det. by

Palynology Det. by

GROUNDWATER DATA: (T.D.S., screened intervals, S.L., Drawdown, Yield)

Datum = R.B.

STRATIGRAPHY: Formation	30112	Depth(m)	R.L.	Thick	Comments
Gellibrand Marl ^{Tpb}	3	0			Based on palaeontology of section, some log control below ~320m. as per original well comp. report - 5/1990 (at P.P.) Corrections, S. Tickell 5/1990
Clifton Fm.	237	238 237			
Narrawatuk Marl	270	320 270			
U. Mepunga	408	405 300 ($\pm 50?$)			
Dilwyn	444	415 407			
Pebble Pt.	475	439	none		
Timboon		445			
Eumeralla Fm.		472 476			
M. Mepunga		316			
L. Mepunga		340			

OTHER DATA: (Velocity survey, seismic line, gas/oil show, tests)

A.O., 1990 (from well comp. rep., 1968)

DATA SOURCE, REFERENCES, COMMENTS

* From well comp. rep. (Leslie + Sell, 1968) - seismic data \Rightarrow this box is adjacent to, and on the down-thrown side of NW-SE trending fault.

IV GEOLOGY(1) General

Purrumbete No.1 well was designed to test postulated permeable sands ("Pretty Hill Sandstone") in the lower portion of the Lower Cretaceous, Otway Group sequence. It was anticipated that these sands would occur immediately above metamorphic basement at a depth of approximately 4800 feet in a zone of stratigraphic wedge-out on the northern hinge line of the basin.

The target sands were not intersected due to an incorrect structural prognosis which had been based upon seismic data of doubtful quality but supported in general by known geological and geophysical trends. A re-examination of the seismic data in the light of the drilling results suggests that the well was located on the down-thrown side of a significant fault (See Enclosure 4b)

A Tertiary section comparable to prognosis was encountered between the surface and 1560 feet depth. A Lower Cretaceous sequence considerably thicker than predicted had not been completely penetrated at total depth.

The uppermost 375 feet of the Lower Cretaceous, Otway Group sequence is assigned to the Eumeralla Formation on the basis of lithology, log character, and palynological determinations. It contains a microfloral assemblage representative of the Coptospora paradoxa Zone and is of Middle to Upper Albian age.

A disconformity is interpreted at 1935 feet from dipmeter results and corresponds to similar disconformities recognised in the earlier Woolsthorpe No.1 and Garvoc No.1 wells.

Below the disconformity to total depth the Purrumbete No.1 well penetrated 4070 feet of the Geltwood Beach Formation. On the basis of lithology and palynology this sequence may be subdivided into an upper unit (1935 to 3710 feet) containing microfloras of the Lower Albian, Crybelosporites striatus Subzone of the Dictyotosporites speciosus Zone and a lower unit (3710 to 6005 feet) containing microfloras of the Neocomian to Aptian, Cyclosporites hughesi Subzone of the Dictyotosporites speciosus Zone. The upper unit is further characterised by the presence of orange ?zeolite cement. The incomplete Geltwood Beach Formation sequence in Purrumbete No.1 is 300% greater than the thickness of this unit in Garvoc No.1 well.

The stratigraphic correlation and structural relationship of Purrumbete No.1 to Garvoc No.1 (situated 18 miles to the west) and Fergusons Hill No.1 (situated 18 miles to the South) is illustrated in Enclosures 2(a) and 2(b).

(2) Stratigraphic Table - Purrumbete No.1

K.B. 486 (A.S.L.)

<u>Age</u>	<u>Rock Unit</u>	<u>Top</u> (feet below K.B.)	<u>Thickness</u> (feet)
Middle Miocene to Upper Oligocene	Heytesbury Group	11 ^m 3.35	1049
Middle to Lower Miocene	Gellibrand Marl	11 3.35	769
Upper Oligocene	Clifton Formation	780 237.74	280
<u>Disconformity</u>			
Upper Eocene	Nirranda Group	1060	310
Upper Eocene	Narrawaturk Marl	1060 323.09	280
Upper Eocene	Mepunga Formation	1340 408.43	30
<u>Disconformity</u>			
? Upper to Middle Paleocene	? Wangerrip Group	1370 41	190
? Upper to Middle Paleocene	? Dilwyn Formation	1370 417.58	80
? Upper to Middle Paleocene	? Pebble Point Formation	1450 441.96	110
<u>Unconformity</u>			
Albian to Neocomian	Otway Group	1560 475.49	4445
Upper to Middle Albian	Eumeralla Formation	1560	375
<u>Disconformity</u>			
Lower Albian to Neocomian	Geltwood Beach Formation	1935	4070
		T.D. 6005 1830.32	1827.0

< - 557

(3) Lithologic DescriptionHeytesbury Group

(Middle Miocene to Upper Oligocene)

Surface to 780 feet:

Gellibrand Marl (Middle to Lower Miocene)

Marl, grey, abundant fossil debris, grading into silty shale toward base. Minor siltstone, dark brown-black, argillaceous.

Traces of pyrite and glauconite

780 to 1060 feet:

Clifton Formation (Upper Oligocene)

Calcareous sandstone, yellow to pale brown, poorly sorted with fine to coarse quartz, lithics, abundant glauconite in parts. Some coarse individual quartz grains.

Marl, medium grey, argillaceous, fossiliferous, glauconite.

Minor siltstone, grey to greenish brown argillaceous, glauconitic, calcareous.

Nirranda Group

(Upper Eocene)

1060 to 1340 feet:

Narrawaturk Marl (Upper Eocene)

Siltstone, grey, argillaceous, lithic, carbonaceous, quartzose, variably calcareous.

Marl, grey, silty, fossiliferous

Minor sandstone, white, fine grained, calcareous.

Traces of pyrite, glauconite, few coarse, subrounded, individual quartz grains.

Below 1300 feet depth weathered, iron-stained volcanic debris formed 20% of cuttings recovered.

1340 to 1370 feet:

Mepunga Formation (Upper Eocene)

Sand, mainly clear to yellowish and light brown, ironstained, well rounded medium grained, individual quartz grains.

Minor siltstone, grey, quartzose, lithic, very argillaceous, slightly carbonaceous

Minor red to brown, ironstained volcanic debris. Traces of pyrite and glauconite

? Wangerrip Group

(? Paleocene)

1370 to 1450 feet:

? Dilwyn Formation (? Paleocene)

Sand, yellowish to clear, medium grained, well rounded individual quartz grains.

Siltstone, medium grey, quartzose, lithic, very argillaceous, slightly micaceous and carbonaceous.

1450 to 1560 feet:

? Pebble Point Formation (? Paleocene)Sand, clean and clear, medium to coarse subrounded individual quartz grains

(Note: the tentative recognition of Wangerrip Group is based on correlation with Carpendeit Bore situated 2 miles to the east. The sequence is probably non marine and of flood plain to lagoonal environment)

Otway Group

(Lower Cretaceous)

1560 to 1935 feet:

Eumeralla Formation (Upper to Middle Albian)Sandstone, grey, fine to medium grained, subangular, tight, lithic with red and green fragments, argillaceous, calcareous. Some medium to coarse individual quartz grains.Siltstone, grey green, argillaceous, carbonaceous, quartzose.Traces of shale, grey black, argillaceous, carbonaceous, also coal and pyrite

1935 to 6005 feet:

Geltwood Beach Formation (Lower Albian to Neocomian)

1935 to 3400 feet:

Sandstone, greenish grey to white with multi-coloured red and green lithic fragments, mainly fine grained, subangular, tight, lithic, quartzose, argillaceous, occasional golden brown micas, common white clay matrix often strongly calcareous, some orange ?zeolite cement. Few medium to coarse individual quartz grains.Siltstone, grey, quartzose, lithic, argillaceous, micaceous, carbonaceous.Shale, greenish grey, silty, argillaceous, in part carbonaceous. Traces of coal.

3400 to 3710 feet:

Siltstone, grey, quartzose, lithic, argillaceous, micaceous, carbonaceous
Siltstone, buff, very calcareous, almost grading to silty limestone.
Sandstone, grey-white to grey-green, fine grained, lithic, quartzose, argillaceous, calcareous, tight.
Shale, light grey, silty and brown, carbonaceous. Minor coal.

3710 to 6005 feet:

Siltstone, grey to grey-brown, micaceous, argillaceous, carbonaceous, quartzose, lithic.

Sandstone, white to grey, mainly fine grained, subangular, tight, lithic, micaceous, feldspathic, argillaceous, quartzose, carbonaceous. Some medium to coarse individual quartz grains.

Shale, grey to brown, carbonaceous, micaceous, silty in part.

Minor coal.

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Appendix 1

Paleontological Report

TERTIARY FORAMINIFERAL SEQUENCE

INTERSTATE'S PURRUMBETE-1

OTWAY BASIN - VICTORIA

by

David J. Taylor

Summary:

	300'- 480'	middle Miocene
Gellibrand Clay	480'- 660'	lower Miocene
	660'- 780'	basal lower Miocene
Clifton Formation	780'-1060	upper Oligocene
Narrawaturk Marl*	1060'-1300'	upper Eocene
Mepunga Formation	1300'- ?	Eocene

* base doubtful

Introduction

Rotary cuttings were examined from 300' to 1700'. Down hole contamination was normal, not completely masking new faunas at depth and permitting use of Taylor's down hole biostratigraphic scheme. 5 sidewall cores were examined from 1100', 1200', 1300', 1355' and 1500'. The last three samples were barren of fauna.

The foraminiferal sequence extended from the upper Eocene Zonule L to middle Miocene. The lower Zonules of the upper Eocene, Zonules M and N, were not recognised.

MIDDLE MIOCENE 300' - 480'

The cutting sample at 300' contained Orbulina suturalis, Globigerinoides glomerosa and Globoquadrina dehiscens which is the association of planktonic species in Zonule E of the middle Miocene. The presence of the benthonic species Cibicides victoriensis supports this determination. The fauna has a rich arenaceous element including:- Ammosphaeroidia sphaeroidiformis, Clavulinoides victoriensis, Gaudyrina convexa, G. heywoodensis and Pseudoclavulinoides rudis. This element indicates inner continental shelf conditions, exposed to open oceanic currents.

LOWER MIOCENE 480' - 780'

The highest appearance of Globigerinoides bisphericus, G. rubrus, G. trilobus trilobus and especially G. trilobus altiapertura designates the top of Zonule F and the top of the lower Miocene. Cibicides opacus is replaced by C. perforatus and Operculina victoriensis is present. The arenaceous and miliolid elements are still rich and identical specifically with that in the middle Miocene.

The next notes faunal change is at 660' where number of Globigeroides decrease with an increase in Globigerina woodi and the highest appearance of G. woodi connecta. This planktonic change, though partially obscured by down hole contamination, marks the top of Zonule H which designates the base of lower Miocene. Sample quality does not permit the differentiation of Zonule G which is no doubt present.

The benthonic fauna from 300' to 780' is consistent despite changes within specific lineages. It is concluded that an inner shelf environment was present throughout the lower Miocene and the number of planktonic specimens show open oceanic conditions.

UPPER OLIGOCENE 780' - 1060'

The sediment from 300' to 780' is a grey byrozoal marl typical of the Gellibrand Clay. Cutting sample at 780' shows an abrupt change with sandstone cemented by brown iron oxide and some calcareous sandstone with oxidized glauconite. Below this level the faunas are dominated by an arenaceous element similar to that listed at 300' but the specimens are larger and the tests have agglutinated orange stained quartz grains. Stained specimens of Cibicides perforatus are common. Planktonic foraminifera are rare but Globigerina eupertura is present at 780'. Cassigerinella chipoloensis occurs at and below 840'. These 2 planktonic species do not appear above Zonule I which is equated with the upper Oligocene.

UPPER EOCENE 1060' - 1300'

The sample at 1060' contain a grey richly fossiliferous grey marl with the planktonic species Globigerina ampliapertura, G. angioporoides and G. linaperta, placing the fauna within Zonule K at the top of the Eocene. Zonule J is missing so obviously there is a disconformity between the Clifton Formation above the Narraturk Marl at 1060'. This disconformity is in all sections in the northern part of the Port Campbell Embayment and on the Warrnambool high.

The side wall cores at 1100' and 1200' demonstrate that sandy silt lens are present within the marl section. Environmental fluctuations are evident as both sidewall cores completely lack a planktonic fauna. The benthonic species in sidewall core at 1200' are typical of the whole interval from 1060' - 1300'. Species include:- Ammosphaeroidina sphaeroidiniformis, Haplophragmoides spp., Siphotextularia sp., Alabama cf. westraliensis, Cibicides perforatus, C. brevoralis, Gyroidinoides zealandica, Karrerria cf. pseudoconvexa, Trifarina spp. and Pullenia spp. Bryozoal and mollusca fragments are common. Very shallow water conditions are indicated.

Cutting samples below 1260' contain poorly developed specimens of Globigerapsis index which marks the top of Zonule L (mid-upper Eocene) However no fauna was found in sidewall core at 1300', 1355' and 1500' and well developed examples of G. index or other Zonule L or pre-Zonule L planktonic species were not isolated in cutting samples.

Conclusions

It is concluded that the marine sequence commenced in mid-upper Eocene times. The Victorian Mines Department Carpendeit-1 water bore commenced at the base of upper Eocene yet Purrumbete-1 has a thicker Tertiary marine section and is only 2 miles away from Carpendeit-1.

			Purrumbete-1	Carpendeit-1	
<u>MIOCENE</u>	H	6 (5)	660'- 780'	650'- 700'	
<u>OLIGOCENE</u>	I	5	780'-1060'	700'- 780'	Clifton Formation
	J		disconformity		
<u>UPPER</u>	K	3	1060'-1260'	780'- 847'	
<u>EOCENE</u>	L	2	1260'-1300'	847'-1006'	
	M		N.P.	1006'-1060'	
<u>MIDDLE</u>	N		N.P.	?	
<u>EOCENE</u>	O		N.P.	N.P.	

N.P. = not present

The above tabulation would suggest differential warping at the base of upper Eocene times with further readjustment in late Eocene times. Equilibrium in depths was reached in the lower Miocene.

October 14th, 1968.

Appendix 2.....

Palynology Report

PALYNOLOGICAL REPORT

ON INTERSTATE/SHELL PURRUMBETE NO. I WELL

1602 FEET - 5925 FEET

by

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TABLE I

PRESERVATION AND ZONAL ATTRIBUTION OF PLANT
MICROFOSSIL ASSEMBLAGES

PALYNOLOGICAL REPORT ON INTERSTATE/SHELL PURRUMBETE No.1WELL, 1602 FEET - 5925 FEET

Nineteen samples of sidewall cores obtained from Purrumbete No.1 well in the Otway Basin were submitted for palynological analyses by Shell Development (Australia) Pty. Ltd. The samples were taken from between 1602 feet and 5925 feet, and all are from the Otway Group which was encountered beneath Tertiary sediments at 1560 feet. The well was completed within the Otway Group at 6005 feet.

The samples examined include siltstones, sandstones, and shales and all were cleaned as thoroughly as possible before palynological processing by the method outlined by Dettmann (1968a). Plant material was extracted from all samples and includes spores, pollen, and occasional chlorophycean elements together with wood and cuticle; microplankton were not observed in any of the residues. In general, the residues obtained from siltstone and shale samples contain richer and more diverse microfloras than those obtained from the sandstones.

Preservation quality of the individual plant microfossils ranges from good to fair in the uppermost horizons (1602 - 2600 feet) and from fair to poor throughout the remainder of the section (see Table 1).

Specific analyses of the microfloras indicates that the Otway Group sediments penetrated in Purrumbete No.1 well range in age from Neocomian-Aptian to Middle-Upper Albian. This age determination is based upon the presence of basal horizons of the Coptospora paradoxa Zone at 1602 feet, the Crybelosporites striatus Subzone between 2100 feet and 3300 feet, and the Cyclosporites hughesi Subzone which was identified between 4220 feet and 5925 feet and probably extends up to 3510 feet.

The microfloral assemblages obtained from the samples are documented below with reference to their qualitative and quantitative content; the quantitative estimates are expressed in the following terms:-
 Ab (abundant) - numerical representation of a particular species totals at least 5% of total microflora, C (common) - numerical representation of a species forms 1-5% of total microflora, and R (rare) - numerical representation of a species is less than 1% of total microflora.

MICROFLORAL ASSEMBLAGES AND AGE DETERMINATIONS

A. 1602 feet

A reasonably well preserved assemblage of abundant spores and pollen grains was extracted from the sample. Species identified include:

Spores:	<u>Arcellites reticulatus</u> (Cookson & Dettmann)	R
	<u>Aequitriradites spinulosus</u> (Cookson & Dettmann)	R
	<u>Baculatisporites comaumensis</u> (Cookson)	C
	<u>Ceratosporites equalis</u> Cookson & Dettmann	R
	<u>Cicatricosporites australiensis</u> (Cookson)	C
	<u>C. hughesi</u> Dettmann	R
	<u>Cingutriletes clavus</u> (Balme)	R
	<u>Coptospora paradoxa</u> (Cookson & Dettmann)	C
	<u>C. striata</u> Dettmann	R
	<u>C. sp.A</u> Dettmann	R
	<u>Cyathidites australis</u> Couper	C
	<u>C. minor</u> Couper	Ab
	<u>C. punctatus</u> (Delcourt & Sprumont)	R
	<u>Crybelosporites striatus</u> (Cookson & Dettmann)	R
	<u>Dictyotosporites speciosus</u> Cookson & Dettmann	R
	<u>Foraminisporis asymmetricus</u> (Cookson & Dettmann)	R
	<u>F. wonthaggiensis</u> (Cookson & Dettmann)	R
	<u>Laevigatosporites ovatus</u> Wilson & Webster	R
	<u>Leptolepidites verrucatus</u> Couper	R
	<u>Lycopodiumsporites austroclavatidites</u> (Cookson)	C
	<u>L. eminulus</u> Dettmann	R
	<u>L. nodosus</u> Dettmann	R
	<u>Matonisporites cooksoni</u> Dettmann	R
	<u>Rouseisporites reticulatus</u> Pocock	R
	<u>Stereisporites antiquasporites</u> (Wilson & Webster)	C
	<u>Trilobosporites trioreticulosus</u> Cookson & Dettmann	R
Pollen:	<u>Araucariacites australis</u> Cookson	R
	<u>Alisporites grandis</u> (Cookson)	C
	<u>A. similis</u> (Balme)	R
	<u>Classopollis cf. classoides</u> Pflug	R

<u>Microcachryidites antarcticus</u> Cookson	Ab
<u>Podocarpidites cf. ellipticus</u> Cookson	C
<u>Podosporites microsaccatus</u> (Couper)	R

The presence of Coptospora paradoxa and Dictyotosporites speciosus indicates that the sample was taken from a basal horizon of the Middle - Upper Albian Coptospora paradoxa Zone. Thus, the sediment is considered to be equivalent to horizons at 3334 feet in Garvoc No.1 well.

B. 2100 feet - 3300 feet

2100 feet

A sparse assemblage of fairly preserved spores and pollen grains occur in the sample. Species identified include:

- Spores: Baculatisporites comaumensis (Cookson)
Ceratospores equalis Cookson & Dettmann
Cyathidites australis Couper
C. minor Couper
Dictyotosporites speciosus Cookson & Dettmann
Foraminisporis asymmetricus (Cookson & Dettmann)
Gleicheniidites cf. circinidites (Cookson)
- Pollen: Alisporites grandis (Cookson)
A. similis (Balme)
Cycadopites nitidus (Balme)
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson
- Remanié: Lundbladispora sp. - Triassic

2300 feet

The following types of extremely rare spores and pollen grains were recovered from the sediment:

- Spores: Baculatisporites comaumensis (Cookson)
- Pollen: Araucariacites australis Cookson
Cycadopites nitidus (Balme)
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

2600 feet

The sample provided a rich and diverse assemblage of well preserved spores and pollen grains together with minor amounts of wood and cuticular fragments. The following species were identified:

Spores:	<u>Aegitriradites spinulosus</u> (Cookson & Dettmann)	R
	<u>Baculatisporites comaumensis</u> (Cookson)	C
	<u>Cicatricosporites australiensis</u> (Cookson)	C
	<u>Crybelosporites striatus</u> (Cookson & Dettmann)	R
	<u>Crybelosporites</u> sp.	R
	<u>Cyathidites australis</u> Couper	Ab
	<u>C. minor</u> Couper	Ab
	<u>C. punctatus</u> (Delcourt & Sprumont)	C
	<u>Dictyotosporites speciosus</u> Cookson & Dettmann	R
	<u>D. filiosus</u> Dettmann	R
	<u>Foraminisporis asymmetricus</u> (Cookson & Dettmann)	C
	<u>F. dailyi</u> (Cookson & Dettmann)	R
	<u>F. wonthaggiensis</u> (Cookson & Dettmann)	R
	<u>Klukisporites scaberis</u> (Cookson & Dettmann)	R
	<u>Laevigatosporites ovatus</u> Wilson & Webster	R
	<u>Leptolepidites verrucatus</u> Couper	R
	<u>Lycopodiumsporites austroclavatidites</u> (Cookson)	R
	<u>L. eminulus</u> Dettmann	R
	<u>L. facetus</u> Dettmann	R
	<u>L. nodosus</u> Dettmann	R
	<u>Neoraistrickia truncata</u> (Cookson)	R
	<u>Pilosporites parvispinosus</u> Dettmann	R
	<u>Rouseisporites reticulatus</u> Pocock	R
	<u>Reticulatisporites pudens</u> Balme	R
	<u>Stereisporites antiquasporites</u> (Wilson & Webster)	C
	<u>Trilites</u> cf. <u>tuberculiformis</u> Cookson	R
Pollen:	<u>Araucariacites australis</u> Cookson	C
	<u>Alisporites grandis</u> (Cookson)	Ab
	<u>A. similis</u> (Balme)	R
	<u>Microcachryidites antarcticus</u> Cookson	Ab
	<u>Podosporites microsaccatus</u> (Couper)	R
	<u>Podocarpidites</u> cf. <u>ellipticus</u> Cookson	Ab

2800 feet

Fairly preserved spores and pollen are of rare occurrence in the residue which also contains minor quantities of wood and cuticular material. Spore-pollen species identified include:

Spores:	<u>Baculatisporites comaumensis</u> (Cookson)
	<u>Cicatricosporites australiensis</u> (Cookson)
	<u>Crybelosporites striatus</u> (Cookson & Dettmann)
	<u>Cyathidites australis</u> Couper
	<u>Dictyotosporites speciosus</u> Cookson & Dettmann
	<u>Neoraistrickia truncata</u> (Cookson)
	<u>Rouseisporites reticulatus</u> Pocock
	<u>Stereisporites antiquasporites</u> (Wilson & Webster)
Pollen:	<u>Alisporites grandis</u> (Cookson)
	<u>Araucariacites australis</u> Cookson
	<u>Classopollis</u> cf. <u>classoides</u> Pflug
	<u>Microcachryidites antarcticus</u> Cookson

2908 feet

The small residue extracted from the sample contains occasional specimens of the following spore-pollen species:

- Spores: Baculatisporites comaumensis (Cookson)
Aequitriradites spinulosus (Cookson & Dettmann)
Cicatricosisporites australiensis (Cookson)
Cyathidites minor Couper
Dictyotosporites speciosus Cookson & Dettmann
Foraminisporis wonthaggiensis (Cookson & Dettmann)
Klukisporites scaberis (Cookson & Dettmann)
- Pollen: Araucariacites australis Cookson
Alisporites grandis (Cookson)
Classopollis cf. classoides Pflug
Podocarpidites cf. ellipticus Cookson

2995 feet

The sample yielded a small residue composed chiefly of wood fragments.

3300 feet

Reasonably well preserved spores and pollen grains are of common occurrence and are referable to the following species:

- | | | |
|---------|---|----|
| Spores: | <u>Aequitriradites spinulosus</u> (Cookson & Dettmann) | R |
| | <u>Baculatisporites comaumensis</u> (Cookson) | C |
| | <u>Cicatricosisporites australiensis</u> (Cookson) | C |
| | <u>Crybelosporites striatus</u> (Cookson & Dettmann) | R |
| | <u>Cyathidites australis</u> Couper | Ab |
| | <u>C. minor</u> Couper | Ab |
| | <u>C. punctatus</u> (Delcourt & Sprumont) | R |
| | <u>Dictyotosporites speciosus</u> Cookson & Dettmann | R |
| | <u>Foraminisporis asymmetricus</u> (Cookson & Dettmann) | R |
| | <u>F. wonthaggiensis</u> (Cookson & Dettmann) | R |
| | <u>F. dailyi</u> (Cookson & Dettmann) | R |
| | <u>Ischyosporites punctatus</u> Cookson & Dettmann | R |
| | <u>Klukisporites scaberis</u> (Cookson & Dettmann) | R |
| | <u>Leptolepidites verrucatus</u> Couper | R |
| | <u>L. major</u> Couper | R |
| | <u>Lycopodiumsporites austroclavatidites</u> (Cookson) | C |
| | <u>L. nodosus</u> Dettmann | R |
| | <u>L. reticulumsporites</u> (Rouse) | R |
| | <u>Pilososporites notensis</u> Cookson & Dettmann | R |
| | <u>Rouseisporites reticulatus</u> Pocock | R |
| Pollen: | <u>Araucariacites australis</u> Cookson | R |
| | <u>Alisporites grandis</u> (Cookson) | C |
| | <u>Classopollis</u> cf. <u>classoides</u> Pflug | R |

<u>Microcachryidites antarcticus</u> Cookson	Ab
<u>Podocarpidites</u> cf. <u>ellipticus</u> Cookson	Ab

Sediments between 2100 feet and 5300 feet in Purrumbete No.1 well yielded microfloras in which Dictyotosporites speciosus and Crybelosporites striatus are components. Accordingly, they are referred to the Lower Albian Crybelosporites striatus Subzone of the Dictyotosporites speciosus Zone. The C. striatus Subzone was not recognized in Woolsthorpe No.1 or Garvoc No.1 wells (Dettmann 1968a,b).

C. 3510 feet - 5925 feet

3510 feet

Fair to poorly preserved spores and pollen grains occur commonly in the residue and include the following species:

Spores:	<u>Baculatisporites comaumensis</u> (Cookson)	Ab
	<u>Ceratosporites equalis</u> Cookson & Dettmann	R
	<u>Cicatricosisporites hugnesi</u> Dettmann	R
	<u>C. australiensis</u> (Cookson)	C
	<u>Cyathidites australis</u> Couper	C
	<u>C. minor</u> Couper	C
	<u>Dictyotosporites speciosus</u> Cookson & Dettmann	R
	<u>Foraminisporis asymmetricus</u> (Cookson & Dettmann)	R
	<u>F. dailyi</u> (Cookson & Dettmann)	R
	<u>F. wonthaggiensis</u> (Cookson & Dettmann)	R
	<u>Klukisporites scaberis</u> (Cookson & Dettmann)	R
	<u>Lycopodiumsporites austroclavatidites</u> (Cookson)	C
	<u>L. reticulumsporites</u> (Rouse)	R
	<u>Pilosporites notensis</u> Cookson & Dettmann	R
	<u>Rouseisporites reticulatus</u> Pocock	R
	<u>Stereisporites antiquasporites</u> (Wilson & Webster)	C
Pollen:	<u>Araucariacites australis</u> Cookson	C
	<u>Classopollis</u> cf. <u>classoides</u> Pflug	R
	<u>Microcachryidites antarcticus</u> Cookson	Ab
	<u>Podocarpidites</u> cf. <u>ellipticus</u> Cookson	C
	<u>Tsugaepollenites dampieri</u> (Balme)	R
Remanié:	<u>Lundbladispora</u> sp. - Triassic	

3710 feet

The fairly preserved microfloral assemblage extracted from the sample includes common spores and pollen grains referable to the following species:

Spores:	<u>Baculatisporites comaumensis</u> (Cookson)	C
	<u>Cicatricosporites australiensis</u> (Cookson)	C
	<u>Cyathidites asper</u> (Bolkhovitina)	R
	<u>C. australis</u> Couper	Ab
	<u>C. minor</u> Couper	Ab
	<u>Foraminisporis asymmetricus</u> (Cookson & Dettmann)	R
	<u>F. dailyi</u> (Cookson & Dettmann)	R
	<u>Klukisporites scaberis</u> (Cookson & Dettmann)	R
	<u>Lycopodiumsporites austroclavatidites</u> (Cookson)	C
	<u>Matonisporites cooksoni</u> Dettmann	R
	<u>Neoraistrickia truncata</u> (Cookson)	R
	<u>Stereisporites antiquasporites</u> (Wilson & Webster)	Ab
Pollen:	<u>Araucariacites australis</u> Cookson	R
	<u>Alisporites grandis</u> (Cookson)	R
	<u>A. similis</u> (Balme)	R
	<u>Classopollis</u> cf. <u>classoides</u> Pflug	R
	<u>Cycadopites nitidus</u> (Balme)	R
	<u>Microcachryidites antarcticus</u> Cookson	Ab
	<u>Podosporites microsaccatus</u> (Couper)	R
	<u>Podocarpidites</u> cf. <u>ellipticus</u> Cookson	C

3830 feet

Fair to poorly preserved spores and pollen grains are of common occurrence in the residue and include the following species:

Spores:	<u>Baculatisporites comaumensis</u> (Cookson)	C
	<u>Cicatricosporites australiensis</u> (Cookson)	R
	<u>Contignisporites</u> sp.	R
	<u>Cyathidites australis</u> Couper	C
	<u>C. minor</u> Couper	Ab
	<u>Dictyotosporites speciosus</u> Cookson & Dettmann	R
	<u>Foraminisporis asymmetricus</u> (Cookson & Dettmann)	R
	<u>Gleicheniidites</u> cf. <u>circinidites</u> (Cookson)	R
	<u>Ischyosporites punctatus</u> Cookson & Dettmann	R
	<u>Leptolenidites verrucatus</u> Couper	R
	<u>Lycopodiumsporites austroclavatidites</u> (Cookson)	C
	<u>L. nodosus</u> Dettmann	R
	<u>Neoraistrickia truncata</u> (Cookson)	R
	<u>Rouseisporites reticulatus</u> Pocock	R
	<u>Stereisporites antiquasporites</u> (Wilson & Webster)	C
Pollen:	<u>Alisporites grandis</u> (Cookson)	C
	<u>Araucariacites australis</u> Cookson	C
	<u>Classopollis</u> cf. <u>classoides</u> Pflug	R
	<u>Microcachryidites antarcticus</u> Cookson	Ab
	<u>Podocarpidites</u> cf. <u>ellipticus</u> Cookson	Ab
	<u>Tsugaepollenites dampieri</u> (Balme)	R

4008 feet

A small residue containing rarely occurring spores and pollen

together with wood and cuticular material was extracted from the sample.

The following species were identified:

- Spores: Baculatisporites comaumensis (Cookson)
Ceratosporites equalis Cookson & Dettmann
Cicatricosisporites australiensis (Cookson)
C. ludbrooki Dettmann
Cyathidites australis Couper
C. minor Couper
Dictyotosporites speciosus Cookson & Dettmann
Foraminisporis dailyi (Cookson & Dettmann)
F. wonthaggiensis (Cookson & Dettmann)
Foveosporites canalis Balme
Ischyosporites punctatus Cookson & Dettmann
Klukisporites scaberis (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)
L. circolumenus Cookson & Dettmann
- Pollen: Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Cycadopites nitidus (Balme)
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

4220 feet

Abundant spores and pollen grains obtained from the sample form the following diverse assemblage. In addition occasional specimens referred to Schizosporis reticulatus of possible aquatic (chlorophycean) origin were recovered.

- Spores: Aequitriradites verrucosus (Cookson & Dettmann) R
Baculatisporites comaumensis (Cookson) C
Cicatricosisporites australiensis (Cookson) C
Ceratosporites equalis Cookson & Dettmann C
Cyclosporites hugnesi (Cookson & Dettmann) R
Cyathidites australis Couper Ab
C. minor Couper Ab
Dictyotosporites speciosus Cookson & Dettmann R
D. filusus Dettmann R
Dictyophyllidites crenatus Dettmann R
Foraminisporis asymmetricus (Cookson & Dettmann) R
F. dailyi (Cookson & Dettmann) C
F. wonthaggiensis (Cookson & Dettmann) R
Januasporites spinulosus Dettmann R
Klukisporites scaberis (Cookson & Dettmann) R
Leptolepidites verrucatus Couper R
L. major Couper R

	<u>Lycopodiumsporites austroclavatidites</u> (Cookson)	C
	<u>L. circolumenus</u> Cookson & Dettmann	R
	<u>L. eminulus</u> Dettmann	C
	<u>L. facetus</u> Dettmann	R
	<u>L. nodosus</u> Dettmann	C
	<u>Lycopodiacidites asperatus</u> Dettmann	R
	<u>Kuylisporites lunaris</u> Cookson & Dettmann	R
	<u>Matonisporites cooksoni</u> Dettmann	R
	<u>Neoraistrickia truncata</u> (Cookson)	R
	<u>Pilosisorites notensis</u> Cookson & Dettmann	R
	<u>Reticulatisporites pudens</u> Balme	R
	<u>Stereisorites antiquasporites</u> (Wilson & Webster)	R
Pollen:	<u>Alisporites grandis</u> (Cookson)	C
	<u>Araucariacites australis</u> Cookson	C
	<u>Classopollis</u> cf. <u>classoides</u> Pflug	C
	<u>Microcachryidites antarcticus</u> Cookson	Ab
	<u>Podocarpidites</u> cf. <u>ellipticus</u> Cookson	Ab
Incertae	<u>Schizosporis spriggi</u> Cookson & Dettmann	R
Sedis:	<u>S. reticulatus</u> Cookson & Dettmann	R

4490 feet

Spores and pollen grains are of common occurrence in the residue which also contains wood and cuticle fragments. The following types were observed:

Spores:	<u>Baculatisporites comaumensis</u> (Cookson)	C
	<u>Ceratosporites equalis</u> Cookson & Dettmann	C
	<u>Cicatricosisporites australiensis</u> (Cookson)	R
	<u>C. ludbrooki</u> Dettmann	R
	<u>Cooksonites variabilis</u> Pocock	R
	<u>Cyathidites australis</u> Couper	Ab
	<u>C. minor</u> Couper	Ab
	<u>Dictyophyllidites crenatus</u> Dettmann	C
	<u>Dictyotosporites comlex</u> Cookson & Dettmann	R
	<u>D. speciosus</u> Cookson & Dettmann	R
	<u>Foraminisporis dailyi</u> (Cookson & Dettmann)	R
	<u>F. wonthaggiensis</u> (Cookson & Dettmann)	R
	<u>Klukisporites scaberis</u> (Cookson & Dettmann)	R
	<u>Leptolepidites verrucatus</u> Couper	R
	<u>Lycopodiumsporites austroclavatidites</u> (Cookson)	C
	<u>L. eminulus</u> Dettmann	R
	<u>L. facetus</u> Dettmann	R
	<u>L. nodosus</u> Dettmann	R
	<u>Neoraistrickia truncata</u> (Cookson)	R
	<u>Pilosisorites notensis</u> Cookson & Dettmann	R
	<u>Rouseisorites reticulatus</u> Pocock	R
Pollen:	<u>Alisporites grandis</u> (Cookson)	C
	<u>Microcachryidites antarcticus</u> Cookson	Ab
	<u>Podocarpidites</u> cf. <u>ellipticus</u> Cookson	C
	<u>Podosporites microsaccatus</u> (Couper)	R

4722 feet

Spores and pollen grains are of rare occurrence in the sample.

Occasional specimens of the following species were observed:

- Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Ceratosporites equalis Cookson & Dettmann
Cyathidites australis Couper
Dictyotosporites speciosus Cookson & Dettmann
Leptolepidites verrucatus Couper
Lycopodiumsporites austroclavatidites (Cookson)
L. circolumenus Cookson & Dettmann
Stereisporites antiquasporites (Wilson & Webster)
- Pollen: Alisporites grandis (Cookson)
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

5070 feet

A small residue containing the following species of spores and pollen grains was obtained from the sample:

- Spores: Baculatisporites comaumensis (Cookson) C
Ceratosporites equalis Cookson & Dettmann R
Cicatricosisporites australiensis (Cookson) R
Cyclosporites hughesi (Cookson & Dettmann) R
Cyathidites australis Couper Ab
C. minor Couper Ab
Dictyophyllidites crenatus Dettmann R
Dictyotosporites speciosus Cookson & Dettmann R
Klukisporites scaberis (Cookson & Dettmann) C
Leptolepidites verrucatus Couper R
Lycopodiumsporites eminulus Dettmann R
L. nodosus Dettmann R
Neoraistrickia truncata (Cookson) R
Pilosisporites notensis Cookson & Dettmann R
Rouseisporites reticulatus Pocock R
Stereisporites antiquasporites (Wilson & Webster) R
- Pollen: Classopollis cf. classoides Pflug C
Microcachryidites antarcticus Cookson C
Podocarpidites cf. ellipticus Cookson C

5300 feet

Plant microfossils extracted from the sample include common spores and pollen grains together with wood and cuticular fragments. The following species were observed:

Spores:	<u>Baculatisporites comaumensis</u> (Cookson)	C
	<u>Cicatricosisporites australiensis</u> (Cookson)	C
	<u>Cyclosporites hugnesi</u> (Cookson & Dettmann)	R
	<u>Cyathidites australis</u> Couper	Ab
	<u>C. minor</u> Couper	Ab
	<u>Dictyophyllidites crenatus</u> Dettmann	R
	<u>Dictyotosporites speciosus</u> Cookson & Dettmann	C
	<u>Foraminisporis dailyi</u> (Cookson & Dettmann)	R
	<u>F. wonthaggiensis</u> (Cookson & Dettmann)	R
	<u>Gleicheniidites circinidites</u> (Cookson)	R
	<u>Klukisporites scaberis</u> (Cookson & Dettmann)	C
	<u>Leptolepidites verrucatus</u> Couper	C
	<u>Lycopodiumsporites austroclavatidites</u> (Cookson)	C
	<u>L. eminulus</u> Dettmann	R
	<u>L. facetus</u> Dettmann	R
	<u>L. nodosus</u> Dettmann	R
	<u>Neoraistrickia truncata</u> (Cookson)	R
	<u>Stereisporites antiquasporites</u> (Wilson & Webster)	C
Pollen:	<u>Alisporites grandis</u> (Cookson)	C
	<u>Araucariacites australis</u> Cookson	C
	<u>Classopollis</u> cf. <u>classoides</u> Pflug	C
	<u>Microcachryidites antarcticus</u> Cookson	Ab
	<u>Podocarpidites</u> cf. <u>ellipticus</u> Cookson	C

5695 feet

Spores and pollen grains are of common occurrence in the sample and are referable to the following species:

Spores:	<u>Baculatisporites comaumensis</u> (Cookson)	C
	<u>Aequitriradites spinulosus</u> (Cookson & Dettmann)	R
	<u>A. verrucosus</u> (Cookson & Dettmann)	R
	<u>Cicatricosisporites australiensis</u> (Cookson)	C
	<u>Couperisporites tabulatus</u> Dettmann	R
	<u>Cooksonites variabilis</u> Pocock	R
	<u>Cyclosporites hugnesi</u> (Cookson & Dettmann)	R
	<u>Cyathidites australis</u> Couper	Ab
	<u>C. minor</u> Couper	Ab
	<u>Ceratosporites equalis</u> Cookson & Dettmann	R
	<u>Dictyophyllidites crenatus</u> Dettmann	C
	<u>Foraminisporis wonthaggiensis</u> (Cookson & Dettmann)	R
	<u>Klukisporites scaberis</u> (Cookson & Dettmann)	R
	<u>Lycopodiumsporites austroclavatidites</u> (Cookson)	C
	<u>Pilosisporites notensis</u> Cookson & Dettmann	R
	<u>Rouseisporites reticulatus</u> Pocock	R
Pollen:	<u>Araucariacites australis</u> Cookson	C
	<u>Alisporites grandis</u> (Cookson)	C
	<u>Cycadopites nitidus</u> (Balme)	R
	<u>Microcachryidites antarcticus</u> Cookson	Ab
	<u>Podocarpidites</u> cf. <u>ellipticus</u> Cookson	C

5925 feet

A small residue in which spores and pollen are of infrequent occurrence was extracted from the sample. Species identified include;

Spores:	<u>Aequitriradites verrucosus</u> (Cookson & Dettmann)	R
	<u>A. spinulosus</u> (Cookson & Dettmann)	C
	<u>Baculatisporites comaumensis</u> (Cookson)	C
	<u>Cicatricosporites australiensis</u> (Cookson)	C
	<u>Ceratosporites equalis</u> Cookson & Dettmann	R
	<u>Cyathidites australis</u> Couper	Ab
	<u>C. minor</u> Couper	Ab
	<u>Dictyotosporites speciosus</u> Cookson & Dettmann	R
	<u>Foraminisporis dailyi</u> (Cookson & Dettmann)	R
	<u>F. wonthaggiensis</u> (Cookson & Dettmann)	R
	<u>Dictyophyllidites crenatus</u> Dettmann	C
	<u>Leptolepidites verrucatus</u> Couper	R
	<u>Lycopodiumsporites eminulus</u> Dettmann	R
	<u>Pilososporites notensis</u> Cookson & Dettmann	R
Pollen:	<u>Alisporites grandis</u> (Cookson)	R
	<u>Araucariacites australis</u> Cookson	R
	<u>Microcachryidites antarcticus</u> Cookson	Ab
	<u>Podocarpidites cf. ellipticus</u> Cookson	C
Incertae		
Sedis:	<u>Schizosporis spriggi</u> Cookson & Dettmann	R

Sediments between 4220 feet and 5925 feet contain diagnostic elements of the Neocomian-Aptian Cyclosporites hughesi Subzone of the Dictyotosporites speciosus Zone. This subzone may also include sediments as high as 3510 feet although Cyclosporites hughesi was not identified in the microfloras. The C. hughesi Subzone has been recognized in Woolsthorpe No.1 well between 4500 feet and 6230 feet (Dettmann 1968a, and subsequent recovery of C. hughesi from sample at 4300 feet) and in Garvoc No.1 well between 3549 feet and 4964 feet (Dettmann 1968b).

CONCLUSIONS

Microfloras obtained from the Otway Group in Purrumbete No.1 well are referable to the Middle-Upper Albian Coptospora paradoxa Zone (1602 feet), the Lower Albian Crybelosporites striatus Subzone (2100 - 3300 feet), and to the Neocomian -Aptian Cyclosporites hughesi Subzone (?3510 -4008 feet, and 4220 - 5925 feet). The assemblages are composed almost exclusively,

PALYNOLOGICAL CORRELATION OF LOWER CRETACEOUS SEDIMENTS IN
WOOLSTHORPE No.1, GARVOC No.1, AND PURRUMBETE No.1
WELLS

Three reports recently submitted to Shell Development (Australia) Pty. Ltd. contain results of microfloral studies on sediments in Woolsthorpe No.1, Garvoc No.1, and Purrumbete No.1 wells (Dettmann 1968a,b,c). In these reports microfloras obtained from all samples studied are documented in detail, and the ages of the individual spore-pollen suites are discussed. The samples investigated were shown to be mostly, if not all, of Lower Cretaceous age, and the three well sequences were subdivided in terms of the spore-pollen zones of Dettmann and Playford (1968). The zones recognized in the sequences include: the Middle-Upper Albian Coptospora paradoxa Zone; the Lower Albian Crybelosporites striatus Subzone of the Dictyotosporites speciosus Zone; the Neocomian-Aptian Cyclosporites hughesi Subzone of the D. speciosus Zone; and possibly the ?uppermost Jurassic - lowermost Cretaceous Crybelosporites stylosus Zone.

The purpose of the present report is to discuss more fully the palynological contents of the spore-pollen zones recognized within the wells, and to outline a palynologically-based method by which the Cyclosporites hughesi Subzone and the Coptospora paradoxa Zone may be further subdivided. The vertical distribution of the biostratigraphic units thus recognized in each well sequence is recorded, and correlations of the sequences are illustrated in Figure 1. Comments on the distribution of the spore-pollen zones in F.B.H. Pretty Hill No.1 and F.B.H. Eumeralla No.1 wells are also included.

THE SPORE-POLLEN ZONES

The Crybelosporites stylosus Zone

Sediments containing spore-pollen suites referable to the Stylosus Assemblage of Dettmann (1963a) are referred to the Crybelosporites stylosus Zone of ?uppermost Jurassic - lowermost Cretaceous age (Dettmann and Playford 1968). In the Otway Basin, sediments comprising this zone appear to be of limited distribution and are best known in Penola No.1 well, 4766-76 feet (Dettmann 1963a). The zone is probably developed in Woolsthorpe No.1 well at 6580 feet, although only doubtful specimens of the index species, Crybelosporites stylosus, were recovered (Dettmann 1968a). The zone has not been recognized in Garvoc No.1 or Purrumbete No.1 wells (Dettmann 1968b,c).

The Cyclosporites hughesi Subzone of the Dictyotosporites speciosus Zone

Sediments comprising this subzone contain microfloras diagnostic of the older category of Dettmann's (1963a) Speciosus Assemblage, which is recognized by the association of Dictyotosporites speciosus and Cyclosporites hughesi and lack of Crybelosporites stylosus. The subzone is considered to be of Neocomian-Aptian age (Evans and Hawkins 1967). It occurs over wide areas of the Otway Basin and has been recognized in Woolsthorpe No.1, Garvoc No.1, and Purrumbete No.1 wells as follows:

Woolsthorpe No.1 well, 4300 - 6230 feet (cf. Dettmann 1968a).

The assignment of the deposit at 4300 feet to the subzone is based upon a study of additional palynological residue in which Cyclosporites hughesi and Cooksonites variabilis were identified.

Garvoc No.1 well, 3549 - 4964 feet (Dettmann 1968b).

Purrumbete No.1 well, 4220 - 5925 feet with a possible extension to 3830 feet (cf. Dettmann 1968c). A further study of the sample at 3710 feet indicates that it is from the succeeding Crybelosporites striatus Subzone (see below).

Three, distinct, successive microfloral suites are recognizable within sediments referred to the Cyclosporites hughesi Subzone. Present records indicate that the three spore-pollen suites possess wide lateral distribution within the Otway Basin Lower Cretaceous sequence, and that their distribution is not facies controlled. The assemblages are therefore considered to provide suitable bases for biostratigraphic subdivision of sediments comprising the C. hughesi Subzone. The criteria upon which the subzone is subdivided into, what are here termed for convenience, "units" are outlined below with reference to the distribution of each "unit" in Woolsthorpe No.1, Garvoc No.1, and Purrumbete No.1 wells. The "units" are defined in order of decreasing age.

- 1) The Murospora florida "Unit" is diagnosed by the presence of Murospora florida in association with Dictyotosporites speciosus and Cyclosporites hughesi. Thus, the base of the unit immediately succeeds horizons containing the last appearances of Crybelosporites stylosus and the top contains the final occurrences of M. florida. Cooksonites variabilis is a component of the microfloras but is not restricted to the unit. The M. florida "Unit" is equivalent to the upper part of Evans's (1966) Unit K1a, and has been recognized in both eastern and western portions of the basin. It occurs in Woolsthorpe No.1, 5005 - 6230 feet and in Garvoc No.1, 4878 - 4964 feet (Dettmann 1968a,b), but has not been recognized in Purrumbete No. 1 well (Dettmann 1968c).
- 2) The Rouseisporites reticulatus "Unit" recognized at the base by the initial appearances of Rouseisporites reticulatus and the continued presence of D. speciosus, Cyclosporites hughesi, and Cooksonites variabilis. Introduction of new elements of the

succeeding unit mark the upper limit of the R. reticulatus "Unit". Present records indicate that the R. reticulatus "Unit" is of widespread areal distribution in the Otway Basin. It has been recognized in Woolsthorpe No.1 at 4515 feet (samples at 4750 ft. and 4841 ft. did not provide diagnostic floras); Garvoc No.1, 3642 - 4489 feet (diagnostic species were not encountered in samples between 4532 - 4798 ft.); and Purrumbete No.1, 5300 - 5695 feet and ?5925 feet (Dettmann 1968a,b,c).

- 3) The Foraminisporis asymmetricus "Unit" defined basally by the incoming of Foraminisporis asymmetricus, and at the top by the final appearances of Cyclosporites hughesi. D. speciosus occurs throughout the unit and Cooksonites variabilis makes its last appearances in the basal part of the unit. The Foraminisporis asymmetricus "Unit" is known from numerous subsurface sections in the Otway Basin including Woolsthorpe No.1 at 4300 feet; Garvoc No.1 at 3549 feet; and Purrumbete No.1, 4220 - 5070 feet, with a possible extension to 3830 feet (results based upon Dettmann 1968a,b,c and subsequent records of F. asymmetricus from 5070 feet in Purrumbete No.1, and C. hughesi and C. variabilis from 4300 feet in Woolsthorpe No.1).

The Crybelosporites striatus Subzone of the Dictyotosporites speciosus Zone

Microfloras diagnostic of this subzone are referable to the younger category of the Speciosus Assemblage (Dettmann 1963a). They contain D. speciosus in association with Crybelosporites striatus and lack Coptospora paradoxa, the index of the succeeding zone. In the Otway Basin, Cyclosporites hughesi makes its final appearances in horizons that are considered to represent the boundary between the C. hughesi and Crybelosporites striatus

Subzones. Burger (1968) reports a different situation in the northern Eromanga Basin where C. hughesi survives into basal horizons of the Coptospora paradoxa Zone. This evidence suggests that C. hughesi possesses a greater stratigraphical range in northern Australia, but, nevertheless, the C. striatus Subzone is still adequately distinguished by the incoming of C. striatus.

The C. striatus Subzone is of Lower Albian age (Evans and Hawkins, 1967) and is equivalent to Evans's (1966) Unit K1d. It has been recognized over wide areas of the Otway Basin and occurs in Purrumbete No.1 well, 2600 - 3710 feet with a possible extension to 2100 feet (results based upon Dettmann 1968c and subsequent record of C. striatus from 3710 feet). The subzone was not sampled in Woolsthorpe No.1 well and Garvoc No.1 well (Dettmann 1968a,b). In the latter sequence there is a distinct microfloral unconformity between 3354 feet (Coptospora paradoxa Zone) and 3549 feet (Foraminisporis asymmetricus "Unit"), and the C. striatus Subzone, if present, would only include a thin development of sediments.

The Coptospora paradoxa Zone

Sediments containing microfloras in which Coptospora paradoxa is a component and in which angiosperm forms referable to Tricolpites pannosus are absent are referred to the Coptospora paradoxa Zone of Middle-Upper Albian age (Dettmann and Playford 1968, Evans and Hawkins 1967). The zone is equivalent to Evans's (1966) Unit K2a and most, if not all, of his Unit K2b. The zone is of wide lateral distribution within the Otway Basin, and as outlined below basal horizons of the zone occur in Garvoc No.1 and Purrumbete No.

The microfloral sequence occurring within the C. paradoxa Zone is not considered in detail in this report. However, as noted by Evans (1966), basal horizons of the zone are distinguishable by their content of the last appearances of Dictyotosporites speciosus. This and other

criteria documented below are considered sufficient basis for preliminary subdivision of the zone.

The Dictyotosporites filorus "Unit" contains the earliest appearances of Coptospora paradoxa and the final occurrences^{cf} Dictyotosporites speciosus. D. filorus and Coptospora striata complete their ranges near the top of the unit; the former species extends down to within the Foraminisporis asymmetricus "Unit", and the latter to within the Crybelosporites striatus Subzone. The D. filorus "Unit" is equivalent to Evans's Unit K2a and current records indicate that it comprises a thin development of sediments that occur in both eastern and western portions of the basin. It has been recognized in Garvoc No.1 well at 3534 feet and Purumbete No.1 well at 1602 feet. (Dettmann 1960b,c).

Horizons of the C. paradoxa Zone succeeding those of the D. filorus "Unit" contain the first and continued appearances of Pilososporites grandis. Microfloras diagnostic of this^{portion} the bulk, of the C. paradoxa Zone were not obtained from material of the three well sections under consideration.

CORRELATION OF LOWER CRETACEOUS SECTIONS IN WOOLSTHORPE NO.1, GARVOC NO.1, AND PURUMBETE NO.1 WELLS

Correlation of the Lower Cretaceous sediments in the three well sequences is illustrated in Fig. 1, and is based upon the vertical distribution of the various biostratigraphic units within each well sequence. The Crybelosporites striatus Subzone as recognized in Purumbete No.1 well either shows a marked reduction in thickness, or is expressed as a disconformity in Garvoc No.1 well. The Foraminisporis asymmetricus "Unit" is also of lesser development in Garvoc No.1 well as compared

to Purrumbete No.1, but this may be due in part to the fact that a greater amount of sediment was deposited in the area of Purrumbete No.1 during the time interval in which the F. asymmetricus "Unit" was developed.

Cretaceous sedimentation appears to have commenced earlier in Woolsthorpe No.1 than in Garvoc No.1. The complete development of the Murospora florida "Unit" in Woolsthorpe No.1 is to be compared with a thinner suite of sediments of the same unit in Garvoc No.1. Conversely, The Rouseisporites reticulatus "Unit" includes a thicker sequence in Garvoc No.1 than in Woolsthorpe No.1. No palynological disconformity was detected in Woolsthorpe No.1, but should other geological evidence point conclusively to the occurrence of a disconformity within the well, it would most likely occur in or near the base of the Rouseisporites reticulatus "Unit".

LOWER CRETACEOUS SEQUENCES IN F.B.H. PRETTY HILL No.1
AND F.B.H. EUMERALLA No.1 WELLS

Spore-pollen suites of Lower Cretaceous age have been reported from Pretty Hill No.1 and Eumeralla No.1 wells by Evans (1963, 1966) and Dettmann (1963b). The latter author documents the contained microfloras in terms of her (1963a) microfloral assemblages. An assessment of her records and of additional evidence obtained from further studies of the microfloras enables subdivision of the sequences in terms of the biostratigraphic scheme outlined above..

Pretty Hill No.1 well

?Crybelosporites stylosus Zone: 6690-7214 feet; based upon the presence of Dictyotosporites speciosus at 7200-14 feet and the recovery of a fragmented specimen of Crybelosporites stylosus at 6690-72 feet. The sample at 7585-97 feet did not provide diagnostic floras.

Dictyotosporites speciosus Zone: 5420-6385 feet. Although only impoverished microfloras were obtained from several samples, the following subdivisions of the zone have been recognized:-

Cyclosporites hughesi Subzone 5935-6385 feet.

Foraminisporis asymmetricus "Unit" 5935-47 feet.

Coptospora paradoxa Zone: 3340-4960 feet. The Dictyotosporites filiosus "Unit" may be represented at 4940-60 feet.

Tricolpites pannosus Zone: 2923-40 feet.

Eumeralla No.1 well

Dictyotosporites speciosus Zone: 7225-10,303 feet, comprising:-

a) Cyclosporites hughesi Subzone at 7225-10,303 feet in which are represented 1) Rouseisporites reticulatus "Unit" 8143-9890 feet
2) Foraminisporis asymmetricus "Unit" 7225-7712 feet. (The sample at 10,300-08 did not provide species diagnostic of the units).

b) Crybelosporites striatus Subzone between 6034 feet and 6720 feet.

Coptospora paradoxa Zone: 5300-5316 feet. The Dictyotosporites filiosus "Unit" has not been recognized; the record of Coptospora striata at 5300-12 feet is interpreted to indicate redeposition (recycling) of the specimen.

Tricolpites pannosus Zone: 3311-21 feet.

CONCLUSIONS

Lower Cretaceous sequences in Woolathorpe No.1 Garvoc No.1, and Purrumbete No.1 wells have been subdivided and correlated in terms of the palyno-stratigraphic zonal scheme proposed by Dettmann and Playford (1963) and modified herein. The modified zonal scheme is shown to be applicable to two other Lower Cretaceous sections in the Otway Basin.

Further palynological work is required to establish the applicability of the scheme to Lower Cretaceous sequences developed in other areas of the Australian continent.

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14th November, 1968.

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WOOLSTHORPE NO.1

GARVOC NO.1

PURRUMBETE NO.1

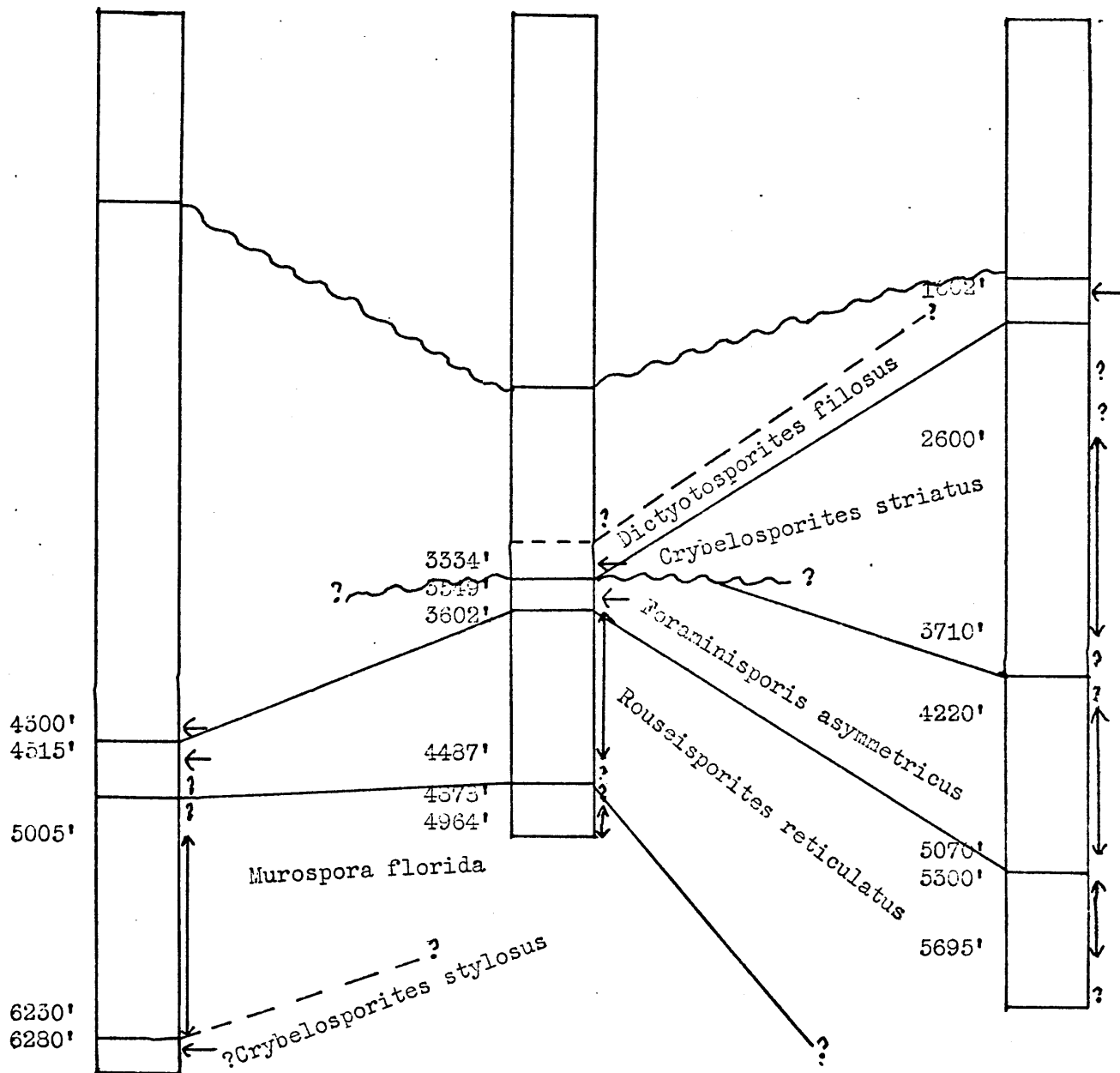


FIGURE 1

Palynological correlation Woolsthorpe No.1, Garvoc No.1, and Purrumbete No.1 wells.

Vertical scale 1" = 1000'; no horizontal scale.

BORE NAME : PURRUM BETE 1

① of 2

DEPTH OF SAMPLE	TYPE	DETERMINATION	REFERENCES
1602 ft. 488.3 m	SIDE WALL CORE	C. PARADOXA (D. FILIOSUS)	DETMANN 1969 1988 c, d.
2100 ft. 640 m	"	? C. STRIATUS	"
2300 ft. 701 m	"	"	"
2600 ft. 792.4 m	"	C. STRIATUS	"
2800 ft. 853.4 m	"	"	"
2908 ft. 886.3 m	"	"	"
2995 ft. 912.8 m	"	"	"
3300 ft. 1005.8 m	"	"	"
3510 ft. 1069.8 m	"	"	"
3710 ft. 1130.7 m	"	"	"
3830 ft. 1167.3 m	"	F. ASYMMETRICUS	"
4008 ft. 1221.6 m	"	"	"
4220 ft. 1286.2 m	"	"	"
4490 ft. 1368.5 m	"	"	"

SOURCE :

BORE NAME : PURRUMBETE 1

② of 2

DEPTH OF SAMPLE	TYPE	DETERMINATION	REFERENCES
4722 ft. 1439.2 m	SIDEWALL CORE	F. ASYMMETRICUS	DETMANN 1969 1968c, d
5070 ft. 1545.3 m	"	"	"
5300 ft. 1615.4 m	"	R. RETICULATUS	"
5695 ft. 1735.7 m	"	"	"
5925 ft. 1805.8 m	"	? R. RETICULATUS.	"

SOURCE :- DETMANN M.E (1969) PALYNOLOGICAL ZONATION OF LOWER CRETACEOUS SEDIMENTS OF THE OTWAY BASIN, VICTORIA S.D.A FILING NR 1817.

- DETMANN M.E (1968c) PALYNOLOGICAL REPORT ON INTERSTATE/SHELL PURRUMBETE NR 1 WELL 1062 ft. - 5925 ft. UNR. REP. SUBM. TO SHELL DEVELOPMENT (AUST.) PTY LTD 31/10/68.
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of land derived types, although possible aquatic derivatives were identified at 4220 feet. Recycled specimens of probable Triassic age are of rare occurrence in samples from 2100 feet and 3510 feet.

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EXPLANATION OF TABLE 1

Preservation and zonal attribution of plant microfossil assemblages in Interstate/Shell Purrumbete No.1 well, 1602 feet - 5925 feet.

Abbreviations:

Yield expresses frequency of spores and pollen in the palynological residues as follows:-

Ab = abundant
C = common
Sp = sparse
B = barren

Colour and preservation. Spores, pollen, wood, and cuticle present in the residues are denoted by their colour (col.) and quality of preservation (pres.) thus:-

DY = dark yellow
LBr = light brown
DBr = dark brown
Br = brown
Bl = black
good = well preserved
fair = fairly preserved
poor = poorly preserved

Spore-pollen zones are those defined by Dettmann and Playford (1968).

TABLE 1

Depth (feet)	Yield	Spore-Pollen		Wood		Cuticle		Spore - Pollen Zone
		Col.	Pres.	Col.	Pres.	Col.	Pres.	
1602	C	DY-LBr	good-fair	Br-BI	fair	-	-	Coptospora paradoxa Zone
2100	SP	LBr	fair	"	fair-poor	LBr	fair-poor	
2300	"	"	"	"	"	"	"	Dictyotosporites speciosus Zone
2600	Ab	DY-LBr	good-fair	"	"	Y-LBr	"	
2800	SP	LBr	fair-poor	"	"	LBr	"	
2908	"	Br	"	"	"	"	"	
2995	B	-	-	"	"	-	-	
3300	Ab	DY-Br	fair	"	"	DY-Br	fair-poor	
3510	C	"	fair-poor	"	"	"	"	
3710	"	"	"	"	"	"	"	
3830	"	"	"	"	"	"	"	
4008	SP	"	"	"	"	"	"	
4220	Ab	"	"	"	"	"	"	Cyclasporites hughesi Subzone
4490	C	"	"	"	"	"	"	
4722	SP	"	"	"	"	"	"	
5070	"	"	"	"	"	"	"	Subzone
5300	C	Br	"	"	"	Br	"	
5695	"	"	"	"	"	"	"	
5925	SP	"	"	"	"	"	"	

Appendix 3....

Description of Sidewall
Cores

INTERSTATE/SHELL PURRUMBETE NO.1 WELLSIDEWALL SAMPLE DESCRIPTIONS

by

Shell Development (Australia) Pty. Ltd.

<u>Depth</u> (Below K.B.)	<u>Description</u>
1100'	<u>Claystone</u> , dark grey to black, very silty, calcareous, carbonaceous, compact; many very fine Quartz grains and some of them with iron-stain, somewhat pyritic, rare greenish patches (Glauconite?); abundant shell fragments. 2" size.
1200'	<u>Claystone</u> , purplish to dark brownish, very silty, slightly calcareous, ferruginous, compact; abundant patches of Pyrite, abundant grains of glauconite, fine grains of iron-stained quartz, well rounded; a few fossiliferous fragments; sediment vaguely burrowed. 2 $\frac{1}{4}$ " size.
1300'	<u>Siltstone</u> , dark grey to black, very clayey, carbonaceous, hardly calcareous, compact; fine grains of Quartz and some of them iron-stained abundant Pyrite, very rare Glauconite; vague burrows. 2" size.
1355'	<u>Quartz Sand</u> , loose grains, clear, milky, brownish and iron-stained, fine to coarse, moderately sorted, well rounded, high sphericity, some clayey matrix, friable, rare cherty grains. 1 $\frac{1}{2}$ " size; broken.
1500'	<u>Quartz Sand</u> , completely disintegrated grains, clear to milky-yellowish, medium to coarse, well sorted, well rounded, high sphericity. 1 $\frac{1}{2}$ " size; disintegrated.
1602'	<u>Siltstone</u> , medium grey-pale greenish, very clayey, micaceous; very homogeneous sediment, very compact; vague rare laminations 1 $\frac{3}{4}$ " size.
1900'	<u>Lithic Sandstone</u> , dense, pale greenish and salt and pepper colour, fine to medium grained, well sorted, angular, a few white clayey cement, consolidated; many greenish (chloritic), dark grey (volcanics), yellowish-whitish (Feldspar) and light orange brownish (altered Zeolite?) lithic fragments with Quartz grains.
2100'	<u>Lithic Sandstone</u> , as 1900', but very fine to fine grained and grading into Siltstone. 2" size.

- 2300' Lithic Sandstone, as 2100', with very rare carbonaceous specks.
1 $\frac{3}{4}$ " size.
- 2460' Lithic Sandstone, light grey greenish, very fine grained and very abundant dark grey lithics, altered brownish cement; as 1900'
 $\frac{1}{2}$ " size.
- 2600' Siltstone, medium grey to dark grey; as 1602'
1 $\frac{3}{4}$ " size.
- 2707' Lithic Sandstone, dark greenish, as 2100'
2" size.
- 2800' Lithic Sandstone, as 2100'
1 $\frac{1}{2}$ " size; half-broken
- 2908' Lithic Sandstone, as 2100', but less consolidated and with rare Coal thin laminae.
1 $\frac{1}{2}$ " size; broken
- 2995' Siltstone, pale grey - light greenish, clayey, quartzitic and lithic; consolidated.
1 $\frac{3}{4}$ " size
- 3300' Siltstone (to very fine grained lithic Sandstone), dense, medium grey, carbonaceous specks, clayey cement; consolidated; vague laminations.
1 $\frac{3}{4}$ " size; half-broken
- 3510' Siltstone, as 3300', with carbonaceous laminae.
1 $\frac{1}{2}$ " size, broken.
- 3710' Siltstone, medium grey to dark grey, as 3300'.
1 $\frac{1}{2}$ " size.
- 3830' Lithic Sandstone grading into Siltstone, dense, greenish to medium grey, very fine grained, with carbonaceous specks and rare coal vague laminations; as 2100'
1 $\frac{3}{4}$ " size; broken.
- 4008' Lithic Sandstone grading into Siltstone, as 3830'
1 $\frac{1}{2}$ " size; broken.
- 4220' Siltstone, as 3710'
1 $\frac{1}{4}$ " size.
- 4490' Siltstone, as 3300'
 $\frac{3}{4}$ " size; broken
- 4722' Shale, pale grey-greenish, very silty; very compact and homogeneous sediment, grading into Siltstone.
 $\frac{3}{4}$ " size.
- 5070' Shale, as 4722'
 $\frac{3}{4}$ " size.
- 5300' Shale, medium grey- greenish, as 4722'
 $\frac{3}{4}$ " size.
- 5695' Lithic Sandstone, light greenish-grey, as 2100'
 $\frac{1}{2}$ " size; broken
- 5925' Lithic Sandstone, as 5695'
 $\frac{1}{2}$ " size; broken.

Appendix 4. . . .

Logs & Interpretations

INTERSTATE/SHELL PURRUMBETE NO. I WELL

LOG INTERPRETATION

by

SCHLUMBERGER SEACO INC.

Logs available: Induction Electrical
Sonic Gamma Ray Caliper

1340-1370: This sand appears to be clay filled. The Gamma Ray indicates the presence of radioactive material, the SP is reduced and there is little mud cake. Due to the high clay content it is difficult to accurately calculate a porosity or water saturation. If we use a ϕ of 35% derived from the Sonic and the most optimistic R_w from the SP, i.e. $R_w = .65$ and $R_t = 4.2$, we obtain an S_w of 87%. This does not allow for the effect of Shale which is partially compensating on RIL and ϕ Sonic.

1400-1560: As the sand section from 1400 to 1450 appears to be very shaly, we will not try to determine ϕ and S_w .

The sand from 1450 to 1560 is cleaner, so we make a sonic resistivity plot to analyse the zone.

As the sands at this depth are poorly compacted; we use the $C\Delta T$ SH calibration line of 160 to calculate ϕ .

<u>Point</u>	<u>Depth</u>	<u>RIL</u>	<u>ΔT</u>	<u>ϕ_s</u>	<u>S_w</u>
1	1460	5	155	42 est.	58
2	1470	4	130	35	85
3	1504	3	140	39	85
4	1534	3	132	36	98
5	1540	2.6	135	28	100

5922: Porosity = 9% from sonic
Rt = 25 from induction
SP = .10
RmF = .9 at 170
Rwe = .65
Sw greater than 100%

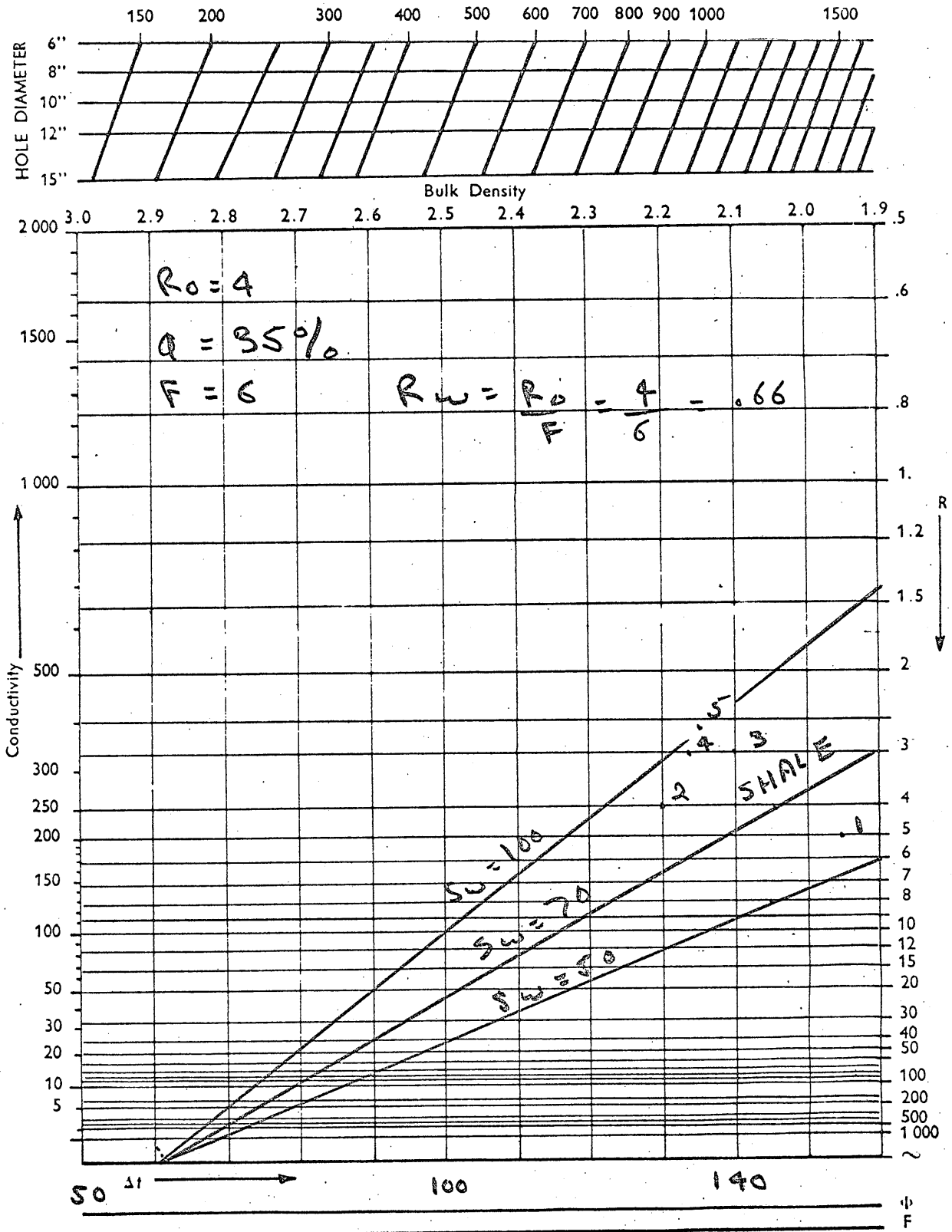
INTERSTATE/SHELL PURRUMBETE NO.I WELL

LIST OF SCHLUMBERGER LOGS

<u>Log</u>	<u>Run No.</u>	<u>Date</u>	<u>Interval Logged</u>	<u>Scale (ins/100 ft.)</u>
Induction - Electric	1	30/7/68	1007'-6004'	1 & 5
Sonic/Gamma Ray/ Caliper	1	30/7/68	1007'-5997'	1 & 5
Continuous Dipmeter	1	31/7/68	1016'-6001'	2 & 5

GRID FOR SONIC — RESISTIVITY OR — RESISTIVITY PLOTS

PGT — (A or B) LIQUID FILLED HOLES

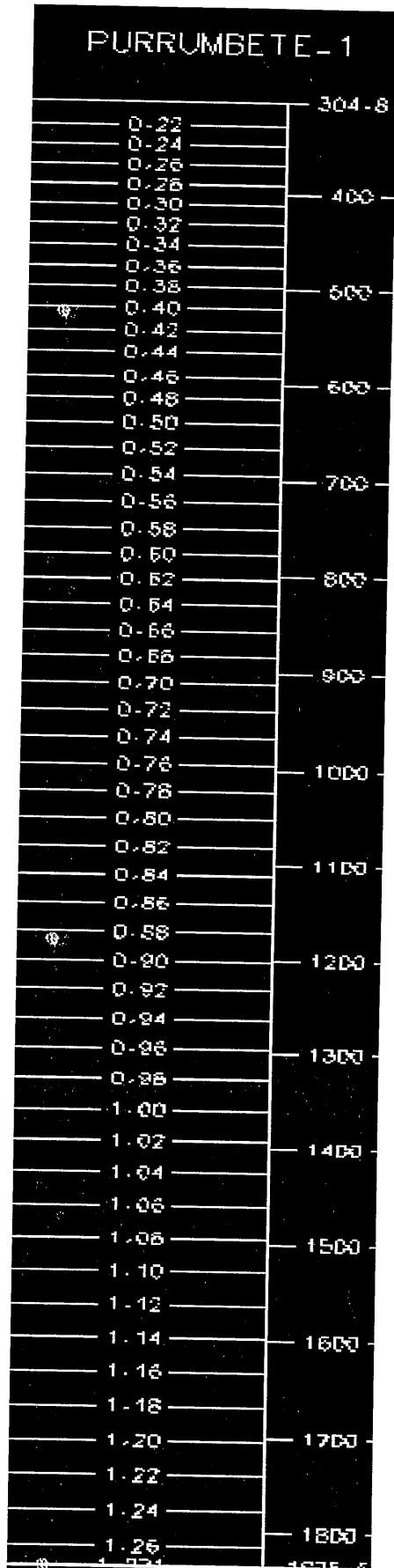


Grid for Resistivity vs Sonic or vs Formation Density Plot

$$F = \frac{.62}{\psi^{2.15}}$$

PURRUMBETE #1

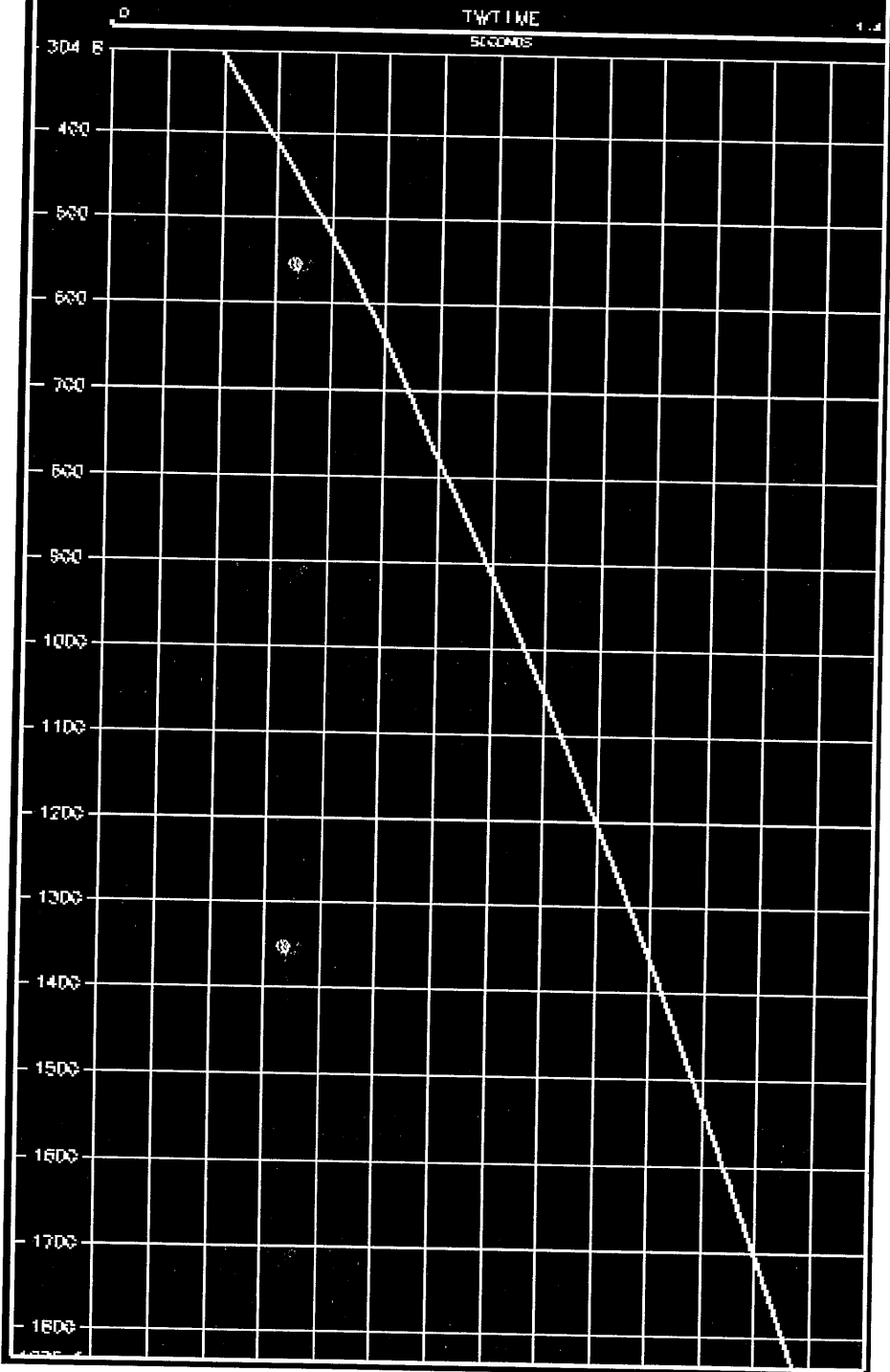
PURRUMBETE - 1



derived from sonic log
replacement velocity
= 1600 m/s

author C. Lavin
11-3-96

PURRUMBETE - 1

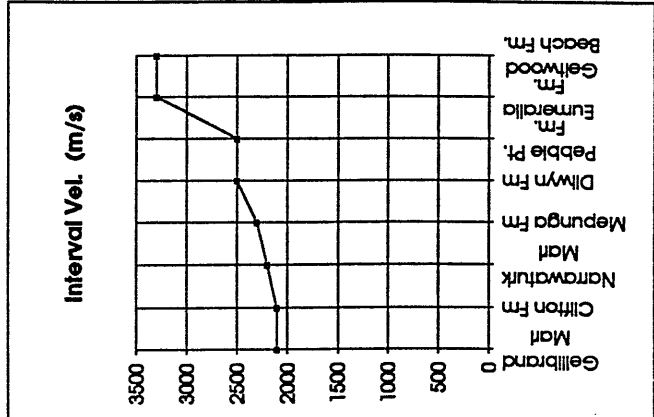
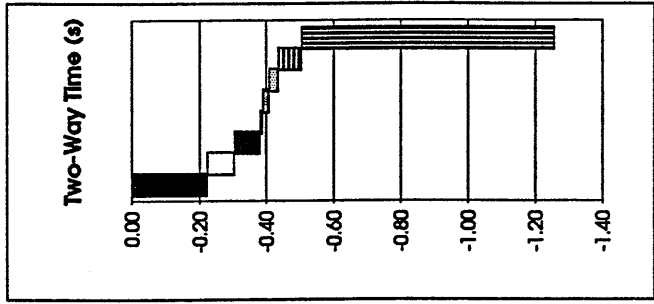
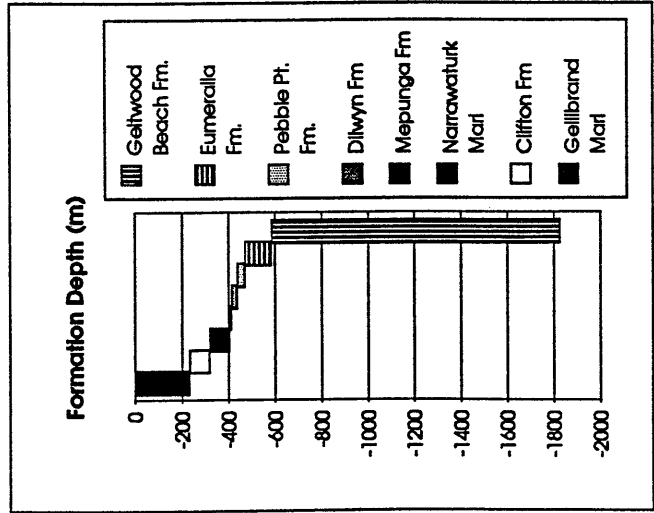


PURRUMBETE NO. 1

OTWAY BASIN

Sirat. log by - Interstate Oil 1968
 Lat: -38.36555 Long: 143.21944
 KB Elev. (m ASL) 148 Gnd. Elev. 145

Age	Unit	Remarks	Depth	Thickness Int. Vel. (m/s)	T-time (s)	2*T-time (s)	TWT Fm. top (s)
Miocene	Gellibrand Marl	Hexlesbury Gp.	-3	2100	-0.11	-0.22	0.00
Miocene	Clifton Fm		-238	2100	-0.04	-0.08	-0.22
Eocene	Narrawaturk Marl	Niranda Gp.	-323	2200	-0.04	-0.08	-0.30
	Mepunga Fm		-408	2300	0.00	-0.01	-0.39
Paleoc-Eocene	Dilwyn Fm	Wangerip Gp.	-418	2500	-0.01	-0.02	-0.39
	Pebble Pt. Fm.		-442	2500	-0.01	-0.03	-0.41
E.CRET.	Eumeralla Fm.	Ohway Gp.	-476	3300	-0.03	-0.07	-0.44
	Gellwood Beach Fm.		-590	3300	-0.38	-0.75	-0.51
		TD	-1830		-0.63		-1.26



SEISMIC INTERP

ENCLOSURES

PE907111

This is an enclosure indicator page.
The enclosure PE907111 is enclosed within the
container PE907110 at this location in this
document.

The enclosure PE907111 has the following characteristics:

ITEM_BARCODE = PE907111
CONTAINER_BARCODE = PE907110
 NAME = Structural Map
 BASIN = OTWAY
 PERMIT = PEP/6
 TYPE = SEISMIC
 SUBTYPE = HRZN_CNTR_MAP
DESCRIPTION = Port Campbell Embayment , Otway Basin
 Structural Map showing the approximate
 Basement configuration prior to
 drilling Purumbete-1 (enclosure from
 WCR) for Purumbete-1
REMARKS =
DATE_CREATED = 31/10/68
DATE_RECEIVED =
 W_NO = W523
 WELL_NAME = PURUMBETE-1
CONTRACTOR =
CLIENT_OP_CO = INTERSTATE OIL LTD

(Inserted by DNRE - Vic Govt Mines Dept)

PE907112

This is an enclosure indicator page.
The enclosure PE907112 is enclosed within the
container PE907110 at this location in this
document.

The enclosure PE907112 has the following characteristics:

ITEM_BARCODE = PE907112
CONTAINER_BARCODE = PE907110
 NAME = Correlation Section
 BASIN = OTWAY
 PERMIT = PEP/6
 TYPE = WELL
 SUBTYPE = WELL_CORRELATION
DESCRIPTION = Correlation Section, Purrrumbete-1 to
 Fergusons Hill-1 (enclosure from WCR)
 for Purrrumbete-1
REMARKS =
DATE_CREATED = 30/11/68
DATE_RECEIVED =
 W_NO = W523
 WELL_NAME = PURRUMBETE-1
CONTRACTOR =
CLIENT_OP_CO = INTERSTATE OIL LTD

(Inserted by DNRE - Vic Govt Mines Dept)

PE907113

This is an enclosure indicator page.
The enclosure PE907113 is enclosed within the
container PE907110 at this location in this
document.

The enclosure PE907113 has the following characteristics:

ITEM_BARCODE = PE907113
CONTAINER_BARCODE = PE907110
 NAME = Correlation Section
 BASIN = OTWAY
 PERMIT = PEP/6
 TYPE = WELL
 SUBTYPE = WELL_CORRELATION
DESCRIPTION = Correlation Section, Garvoc-1 to
 Purrumbete-1 (enclosure from WCR) for
 Purrumbete-1
REMARKS =
DATE_CREATED = 30/11/68
DATE_RECEIVED =
 W_NO = W523
 WELL_NAME = PURRUMBETE-1
CONTRACTOR =
CLIENT_OP_CO = INTERSTATE OIL LTD

(Inserted by DNRE - Vic Govt Mines Dept)

PE907114

This is an enclosure indicator page.
The enclosure PE907114 is enclosed within the
container PE907110 at this location in this
document.

The enclosure PE907114 has the following characteristics:

ITEM_BARCODE = PE907114
CONTAINER_BARCODE = PE907110
NAME = Reflection Var Section
BASIN = OTWAY
PERMIT = PEP/6
TYPE = SEISMIC
SUBTYPE = SECTION
DESCRIPTION = Reflection Var Section, Line 181, SP
3419-3459, Before Drilling, (enclosure
from WCR) for Purumbete-1
REMARKS =
DATE_CREATED = 30/04/68
DATE_RECEIVED =
W_NO = W523
WELL_NAME = PURUMBETE-1
CONTRACTOR =
CLIENT_OP_CO = INTERSTATE OIL LTD

(Inserted by DNRE - Vic Govt Mines Dept)

PE907115

This is an enclosure indicator page.
The enclosure PE907115 is enclosed within the
container PE907110 at this location in this
document.

The enclosure PE907115 has the following characteristics:

ITEM_BARCODE = PE907115
CONTAINER_BARCODE = PE907110
 NAME = Reflection Var Section
 BASIN = OTWAY
 PERMIT = PEP/6
 TYPE = SEISMIC
 SUBTYPE = SECTION
 DESCRIPTION = Reflection Var Section, Line 181, SP
 3419-3459, After Drilling, (enclosure
 from WCR) for Purumbete-1
 REMARKS =
 DATE_CREATED = 30/04/68
 DATE_RECEIVED =
 W_NO = W523
 WELL_NAME = PURUMBETE-1
 CONTRACTOR =
 CLIENT_OP_CO = INTERSTATE OIL LTD

(Inserted by DNRE - Vic Govt Mines Dept)

PE605023

This is an enclosure indicator page.
The enclosure PE605023 is enclosed within the
container PE907110 at this location in this
document.

The enclosure PE605023 has the following characteristics:

ITEM_BARCODE = PE605023
CONTAINER_BARCODE = PE907110
NAME = Well Log
BASIN = OTWAY
PERMIT = PEP/6
TYPE = WELL
SUBTYPE = WELL_LOG
DESCRIPTION = Well Log, SP-GR-LLS-LLD, (enclosure
from WCR) for Purumbete-1
REMARKS =
DATE_CREATED =
DATE_RECEIVED =
W_NO = W523
WELL_NAME = PURUMBETE-1
CONTRACTOR =
CLIENT_OP_CO = INTERSTATE OIL LTD

(Inserted by DNRE - Vic Govt Mines Dept)

PE605024

This is an enclosure indicator page.
The enclosure PE605024 is enclosed within the
container PE907110 at this location in this
document.

The enclosure PE605024 has the following characteristics:

ITEM_BARCODE = PE605024
CONTAINER_BARCODE = PE907110
NAME = Composite Well Log
BASIN = OTWAY
PERMIT = PEP/6
TYPE = WELL
SUBTYPE = COMPOSITE_LOG
DESCRIPTION = Composite Well Log, Sheet 2 of 2,
(enclosure from WCR) for Purrrumbete-1
REMARKS =
DATE_CREATED = 1/08/68
DATE_RECEIVED =
W_NO = W523
WELL_NAME = PURRUMBETE-1
CONTRACTOR =
CLIENT_OP_CO = INTERSTATE OIL LTD

(Inserted by DNRE - Vic Govt Mines Dept)

PE605025

This is an enclosure indicator page.
The enclosure PE605025 is enclosed within the
container PE907110 at this location in this
document.

The enclosure PE605025 has the following characteristics:

ITEM_BARCODE = PE605025
CONTAINER_BARCODE = PE907110
NAME = Composite Well Log
BASIN = OTWAY
PERMIT = PEP/6
TYPE = WELL
SUBTYPE = COMPOSITE_LOG
DESCRIPTION = Composite Well Log, Sheet 1 of 2,
(enclosure from WCR) for Purumbete-1
REMARKS =
DATE_CREATED = 1/08/68
DATE_RECEIVED =
W_NO = W523
WELL_NAME = PURUMBETE-1
CONTRACTOR =
CLIENT_OP_CO = INTERSTATE OIL LTD

(Inserted by DNRE - Vic Govt Mines Dept)