SHELL DEVELOPMENT

(AUSTRALIA)

PTY. LTD.

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PECTEN NOS. 1 AND 1A, OFFSHORE VICTORIA

WELL COMPLETION REPORT

by

Shell Development (Australia) Pty. Ltd.

Melbourne
October, 1967.

CONTENTS

APPENDICES

PCTN1_1A/A00429/P4

I. SUMMARY

PECTEN - 1A

(a) Drilling

The Pecten structure was probed with the Sedco 135E semi-submersible rig in floating position for the operator, Shell Development (Australia) Pty. Ltd.

Positioning the Sedco unit over the location proved to be troublesome as reflected by the time spent between leaving Portland on 20th January, 1967, where the unit had been outfitting since its arrival from Japan and the spudding in date of Pecten-1 on 26th March. Efforts to anchor conventionally were given up after 20 individual anchor setting trials. Jet tests with a bit failed to penetrate the sea crust and a 15 ft core cut from the sea bed revealed a top surface of smooth hard rock overlying soft sediments. An alternative location on the same structure was tried with similar results.

With the knowledge that good anchoring ground was present underneath the 2 to 3 ft thick hard crust covering the area, experiments were carried out with explosives to blast holes of sufficient magnitude in which the anchors could be placed. This rapidly proved to be impractical, both from the point of view of the amount of explosive required and of the time necessary to place each anchor individually in its respective hole.

All efforts were then concentrated on the drilling in of specially designed and locally manufactured anchor piles. These consisted of a joint of 20 inch casing reinforced over the upper 8 to 10 feet. A chain, later connected to the Sedco's anchors, was attached to each pile by means of a clamp, free to rotate some 2 feet below the top of the pile.

Six of these piles were found to be sufficient to hold the unit in position and drilling started on 26th March.

The first hole had to be abandoned at 887 ft bdf due to mechanical trouble just before cementing the 20 inch casing. The unit was moved 50 feet to the South and a new hole - Pecten 1A - was spudded on 12th April. Drilling proceeded uneventfully to a total depth of 9,352 ft bdf, reached on 4th June.

One sand only, in the WAARRE formation of the Upper Cretaceous, was drillstem tested through perforations in the $9\frac{5}{8}$ inch casing and yielded a maximum amount of 145,000 cuft of gas per day together with 615 barrels per day of salt water.

The well was plugged back and abandoned as a dry hole on 11th June, 1967, and after rigging down and de-anchoring, the unit left for NERITA location on 14th June, 1967.

(b) Geological

Pecten-1,1A was the first well to be drilled offshore in the Otway Basin. The well was located on the culmination of a seismically defined anticlinal structure with a closed area of approximately 28 square miles and a vertical closure of 150 to 350 feet.

The sequence penetrated consisted of carbonates of the Oligocene - Miocene Heytesbury group to 1880 feet; interbedded sands, marls and ferruginous sands of the Upper Eocene Nirranda group to 2630 feet; sands, silts and clays of the Paleocene Wangerrip group to 3894 feet; sands, siltstones and clays of the Upper Cretaceous Sherbrook group to 5892 feet and sandstones, siltstones and shales of the Lower Cretaceous Otway group to total depth at 9352 feet.

Good quality reservoir rocks were present in the Tertiary and Upper Cretaceous sequences but no significant quantities of hydrocarbons were encountered.

However, the results of the well have made an important contribution to stratigraphical knowledge in this part of the Otway Basin. While the sequence penetrated is broadly similar to that onshore, significant changes in thickness and facies have taken place and the several stratigraphic breaks have been confirmed and more precisely defined.

II. INTRODUCTION

Pecten No.1-1A is the first offshore exploration well drilled in the Otway Basin in southwestern Victoria. It was drilled as a test well on a seismically defined structure with an area of closure of approximately 28 square miles and vertical closure of up to 350 feet, nine miles offshore in the Port Campbell embayment (Encl.1).

The Jurassic-Tertiary Otway Basin trends approximately east-west across south-western Victoria into South Australia, extending offshore onto the continental shelf. During the Lower Cretaceous (and possibly upper Jurassic) immature, fluviatile sandstones, siltstones and shales of the Otway group were deposited in the east-west trending trough. At the end of the Lower Cretaceous the Otway group was extensively faulted and gently folded and the tectonism produced several sub-basins and embayments in place of the original single trough. Upper Cretaceous and Tertiary sediments were deposited in these sub-basins during several transgressive-regressive cycles above the eroded surface of the Otway group. Sedimentation was strongly influenced during this time by structure. The Upper Cretaceous and Lower Tertiary sediments contain mature sandstones and sands with interbedded siltstones and clays. The uppermost strata in the sequence are Eocene-Miocene carbonates deposited during a widespread transgression over the whole basin.

Several major rock units are recognised in the Otway Basin, each being bounded by an unconformity. These units, from base to top, are the Otway, Sherbrook, Wangerrip, Nirranda and Heytesbury groups. Prior to drilling the well, the Eocene Nirranda group, Paleocene Wangerrip group, and sands in the Upper Cretaceous Sherbrook group were regarded as containing potential reservoirs.

Fault controlled structures predominate in the Otway Basin and most of the anticlinal features appear to be broad gentle folds associated with basement highs. Pecten-1A was drilled on such a structure in the offshore area of the Port Campbell embayment as a test of the hydrocarbon bearing potential of the Tertiary and Upper Cretaceous sequence in which reservoir rocks were known from onshore wells. The main target was the Waarre formation, the basal unit of the Sherbrook group. The well was intended also to penetrate the Otway group sufficiently to assess the prospects which were expected to be limited by absence of porosity and permeability.

The section penetrated was generally as predicted, but no significant quantities of hydrocarbons were encountered and the well was plugged and abandoned at a total depth of 9352 feet.

III. WELL HISTORY

1. General Data

(a)	Well name and number:	Pecten No.1 - 1A.
(b)	Name and address of Operator:	Shell Development (Aust.) Pty. Ltd., 155 William Street, Melbourne, Victoria, 3000.
(c)	Name and address of tenement holder:	1. Frome-Broken Hill Co. Pty. Ltd., 31 Queen Street, Melbourne, Victoria, 3000. Subject to a farm-in agreement dated 13th July 1965 with Shell Development (Aust.) Pty. Ltd., 155 William Street, Melbourne, Victoria, 3000.
(d)	Petroleum tenement:	Authority to prospect PEP 22 Otway Basin, offshore Victoria. Shell Development is acting as operator on behalf of itself and Frome-Broken Hill Co. Pty. Ltd. The operating agreement dated 29th June, 1965, between Frome-Broken Hill Co. Pty. Ltd. and Shell Development (Aust.) Pty. Ltd. was approved by the Minister for Mines, Victoria, on 13th July, 1965.
(e)	District:	Otway Basin, offshore Victoria.
(f)	Location:	I. Geographical Co-ordinates Long. 142° 39' 56" E Lat. 38° 40' 41" S II. Mercator ATM (Zone 6) 558514 yards East 230870 yards North
(g)	Elevation: Reference for depth: Derrick floor elevation:	Seabed 205 feet below MSL. Derrick floor. 112 feet above MSL.

		Pecten I		Pecten 1A
(h)	Total Depth:	887	,	9,352 (ft bdf)
(i)	Date drilling commenced:	26/3/67	,	12/4/67
(j)	Date total depth reached:	3/4/67	,	4/6/67
(k)	Date well abandoned:	11/4/67	,	11/6/67
(l)	Date rig was released:	-	,	14/6/67
(m)	Drilling time to total depth:	9	,	54 (days)

(n) Status of well:

Pecten I: Abandoned (mechanical reasons) with cement plug from 865 ft to 317 ft, with 1950 sacks construction cement.

Pecten 1A: Abandoned as a dry hole with the following plugs:-

Bridge Plug No.1 at 6135 ft. Baker Model 'N' size 6AA inside $9\frac{5}{8}$" casing.

Cement Plug No.1 6100-5100 ft with 200 sacks construction cement.

Bridge Plug No.2 at 615 feet. Baker Model 'N' size 6AA inside $9\frac{5}{8}$" casing.

Cement Plug No.2 595-327 feet with 100 sacks construction cement. Vetco type temporary and permanent guide base left on seabottom.

(o) Estimated Total Cost — Pecten 1 $294,000

Pecten 1A $2,259,650 (below 889 ft.)

2. Drilling Data

(a) Name and address of Drilling Contractor: Southeastern Drilling, Inc., 4400 First National Bank Building, Dallas, Texas, 75202, USA.

In Australia: 143 Percy Street, Portland, Victoria, 3305.

(b) Drilling Plant: Plant owned by Southeastern Drilling, Inc., of U.S.A.

Drawworks: Make: Oilwell
Type: E-3000 (elect.driven drawworks)

Power Units (Engines & Generators)

No.	Make	Model
3 (on skids)	Electro-Motive Division	SR-16"W

The skid mounted units comprised the following:

I. Engines

No.	Make	Model	HP
3	GM	16-645	2200 @ 857 RPM each

II. Generators

Power Unit No.I

One 1500 KW DC generator
Two D-79 DC generators 553 KW each

Power Unit No. II and III

One 1500 KW-DC generator
One D-79-DC generator 553 KW
One 750 KW AC alternator

Auxiliary Units

One Cat. D-353 engine driven 250 KW, AC alternator

Horse Power

Available to Drawworks - 1600 HP.

Drill Pipe

Size (ins.)	:	5 Range - 2
Tool Joint (ins.)	:	6-$\frac{3}{8}$ - OD
Connection type	:	5" XH
Weight lb/ft	:	19.5
Grade	:	E S-135
Length (ft.)	:	12,000

Drill Collars

Size O.D.(ins.)	:	9$\frac{1}{2}$	8	6$\frac{1}{2}$
I.D.(ins.)	:	2-13/16	2-13/16	2-13/16
Connection (type)	:	7$\frac{5}{8}$API	6$\frac{5}{8}$API	No. API 46 (4" IF)

		Reg.	Reg.	
Weight lbs/ft	:	220	150	92
Number	:	6	30	40

Core Barrel

Make	:	Christensen
Model	:	250-P
Length	:	$6\frac{3}{4}$ x 4 x 60'
Number	:	One

(c) Mast: Make: Lee C. Moore
Type: Cantilever offshore mast-welded type.
Gross Capacity: 1,333,000 lbs.
Static hook capacity: 1,000,000 lbs.

(d) Slush Pumps:

No.	Make	Type	Size
2	Oilwell	1700-P	7" x 18"
2	Mission	Centri-fugal	5 x 6R

All electrically driven (see Power Units above)

(e) Blowout Preventer Stacks:

1. 20" (Nom.) BOP's - comprising the following from top to bottom:-

(i) One inverted Vetco H-4 - $20\frac{3}{4}$" hydraulic connector.
(ii) One Vetco 24" breach lock flex joint for a maximum of 9 degrees deflection.
(iii) One hydril MSP 2000 psi.
(iv) One Cameron 20" nominal drilling spool with one studded 3-1/16" 10,000 lbs test outlet.
(v) One Vetco H-4 - $20\frac{3}{4}$" hydraulic connector.

2. 13" BOP's comprising the following from top to bottom

(i) One inverted Vetco H-4 - $13\frac{5}{8}$" hydraulic connector.
(ii) One Vetco 16" breach lock flex joint for a maximum of 9 degrees deflection.
(iii) One Hydril GK-5000 psi W.P.
(iv) Two Double Cameron U-type preventors with ram locks, each with 2 studded outlets 10,000 psi test, 3-1/16" ID.
(v) One Vetco H-4 - $13\frac{5}{8}$" hydraulic connector.

(f) Hole size and depth (bdf):

Pecten I	Pecten 1A
36 inch to 532 feet	36 inch to 386 feet
26 inch to 887 feet	26 inch to 864 feet
- -	$17\frac{1}{2}$ inch to 2186 feet
- -	$12\frac{1}{4}$ inch to 6263 feet
- -	$8\frac{1}{2}$ inch to 9352 feet

(g) Casing and Cementing Details:

	Pecten I	Pecten IA			
Size (inch)	30	30	20	13-$\frac{3}{8}$	9$\frac{5}{8}$
Weight (lbs/ft)	310	310	94	61/72	43.5/47
Grade	-	-	J55	J55/N80	N80
Range	-	-	3	3	2
Setting Depth (bdf)	522	378	849	2164	6245
Shoe/Collar	Float	Float/-	Float/-	Guide/Diff. fill up	Diff. fill up (both)
Plugs	None	None	None	Top & Bottom	Top & bottom
Centralisers	None	None	None	3	12
Cement (sacks)	1200	650	1410	1350	1900
TOC annulus	Seabed	Seabed	Seabed	Seabed	2320 (CBL)
Method used	Displacement	Displ-acement	Displ-acement	Plugs	Plugs

(h) Drilling Fluid:

PECTEN I was spudded with sea water. From the 30 inch casing shoe, fresh bentonite mud was used to TD at 887 ft bdf. At this depth, where the 20 inch casing was to be set, the mud was replaced by sea water to check for eventual entry of gas in the hole prior to pulling the marine riser.

PECTEN IA was spudded in with sea water and sea water was used for drilling (without marine riser) to 864 feet, where the 20" casing was set. Before running 30" and 20" casing 66 lbs/cuft Bentonite mud was spotted in the hole.

Spersene - XP20 inhibited mud was used below the 20" casing. The treatment was increased with depth and CMC was added to obtain the required low water loss.

The following are the average weekly characteristics of the mud used in Pecten IA:-

Week No.	Weight lbs/cuft	Viscosity MF Sec.	Filtrate cc/30 min.	Sand %	Silt %	pH	Cl' ppm
1	66	35	30	NA	NA	NA	NA
2	69	50	7.5	NA	1.5	9.3	NA
3	70	50	4.8	0.7	3.0	10	1800
4	72	46	4.5	1.5	3.0	9.3	3200
5	73	40	5.0	0.5	2.0	9.8	1800
6	72	40	5.0	0.6	2.0	9.8	1500
7	73	45	5.0	0.5	3.2	9.8	1400
8	79	46	5.0	0.8	3.0	10.0	1600
9	79	46	5.3	0.5	2.0	10.0	1200

(i) Water Supply:

Fresh water for drinking and industrial purposes was transported from Portland's main water supply system to the drilling barge on the two work boats. Both boats have a fresh water storage capacity of approximately 250 tons each.

(j) Perforation and Shooting Record:

Casing Size (ins.O.D.)	Interval Perforated	Type of Charges	Number of shots/ft.	Size of Charge shot(diam.ins.)	Method Used
$9\frac{5}{8}$"	5852'-5834'	Unijet	4	$2\frac{1}{8}$	Shaped charges
$9\frac{5}{8}$	5822'-5810'	Unijet	4	$2\frac{1}{8}$	Shaped charges

(k) Plugging back and Squeeze Cementation Jobs:

PECTEN I

A cement plug was placed from 865 ft to 317 ft bdf with 1950 sacks of construction cement, 118 lbs/cuft.

The plug was not tested but the top of cement was checked by the divers and found at 343 ft bdf.

PECTEN IA

Abandonment plugs as agreed by the Victorian Mines Department were as follows:-

	Bridge Plug No. 1	Bridge Plug No. 2
Type of Plug :	Baker Model 'N'	Baker Model 'N'
Size :	6AA	6AA
Depth Set :	6135 ft bdf	615 ft bdf
Method used :	Set on wireline	Set on wireline
Plug Tested :	YES (See DST No. 1)	No

	Cement Plug No. 1	Cement Plug No. 2
Length and type of plug:	1000' Construction Cement	268' Construction Cement
Number of sacks used for the job:	200	100
Depth interval of plug feet bdf:	6100 - 5100	595 - 327
Method used and squeeze pressure:	812' open ended $2\text{-}\frac{7}{8}$" stinger 5" Drillpipe	Open ended $2\text{-}\frac{7}{8}$" tubing
Amount of cement squeezed away:	None	None
Plug tested:	No	No

(l) Fishing Operations:

At 7687' a cone of a $8\frac{1}{2}$" bit was lost in the hole. The junk was drilled satisfactorily with a $8\frac{1}{2}$" OWC-J bit.

(m) Side-tracked hole. None

3. Logging and Testing

(a) Ditch cuttings: Samples were collected in Pecten IA from 864 ft on, at ten feet intervals during drilling and at five feet intervals during coring. All samples were taken from the shale shaker. Time lag checks were made at frequent intervals. The ditch cutting samples were washed, dried and split into portions, which were placed in separate marked envelopes. Complete sets of these samples are stored in the Core Laboratories of the Victorian Mines Department, the Core and Cuttings Library BMR, and in the Geological Laboratory, Shell Development (Australia) Pty. Ltd., Melbourne.

(b) Coring:

Four cores were cut in Pecten IA using a Christensen Tungsten Corehead (Type C14) or Diamond Core Head (Type C8).

Core No.	Interval Cored (ft)	Feet Cut	Recovery	Recovery %
1	1890 - 1915	25	2'2"	9
2	5104 - 5114	10	None	0
3	5708 - 5714	6	6'	100
4	5907 - 5937	30	29'	96

The cores were slabbed longitudinally into 3 parts; one quarter of the core is stored by the Secretary of Mines, Victoria, one quarter by the BMR and one half by Shell Development (Australia) Pty. Ltd.

(c) Side Wall Cores:

Prior to running and cementing the $9\frac{5}{8}$" casing and after reaching total depth, Schlumberger shot a total of 120 side wall cores. 104 Side wall cores were recovered, of which 80 were accepted by the wellsite geologist.

Listed below are the depths at which these side wall cores were taken:

Depth (ft)	Remarks	Depth (ft)	Remarks
2460		2720	
2550		3180	
2590	Non accepted	3230	
2632		3280	
2660		3338	
2690		3362	
3450		6565	Misfire
3456		6606	Misfire
3618		6946	Misfire
3695		7030	Misfire
3735		7105	
3797		7166	
3833		7175	Misfire
3883		7194	
3908		7204	
4022		7240	Misfire
4044		7276	
4176		7297	
4248		7305	Misfire
4295		7330	
4403		7360	
4493	Bullet lost	7393	Misfire
4493		7399	
4598		7424	
4618		7440	Misfire
4685		7490	
4720	Bullet lost	7552	
4785		7650	
4785		7715	
4816		7812	
4840	Bullet lost	7920	
4880	Bullet lost	8120	
4888	Bullet lost	8206	
4964		8330	
4985		8395	
5030		8428	Empty
5078		8506	
5128	Bullet lost	8520	Non accepted
5182		8532	
5260	Bullet lost	8546	
5300	Bullet lost	8572	
5300		8605	Non accepted
5398		8630	Non accepted
5528	Bullet lost	8670	Non accepted

Depth (ft)	Remarks	Depth (ft)	Remarks
5528	Empty	8682	Non accepted
5650		8712	Non accepted
5735		8735	
5813	Bullet lost	8743	
5827		8836	Empty
5880		8873	Non accepted
5920		8915	Non accepted
5977		8932	
6013		8962	Non accepted
6155		9018	Non accepted
6352	Misfire	9027	Non accepted
6487	Misfire	9210	Non accepted
9038	Non accepted	9235	Non accepted
9055		9271	
9092	Non accepted	9305	
9109			
9132			

(d) Electric and Other Logging - Summary:

The several types and runs of Schlumberger logs recorded in Pecten 1A are listed in Appendix I and presented graphically in Appendix IA, the caluclations carried out at the levels of interest are presented in Appendix II.

The conclusions of general interest are summarized below:

(i) Interval 2,200 - 2,650 ft bdf : rather clean sand, porosities in the 20 - 30% range; fresh water bearing (ca 3,000 ppm NaCl).

(ii) Interval 2,730 - 3,150 ft bdf : still rather clean sands, but a slight increase in shaliness with depth is noticeable; porosities from 25 to 30%, fresh water bearing; (ca 3,000 ppm NaCl).

(iii) Interval 3,450 - 3,800 ft bdf, fresh water bearing sands (ca 4,000 ppm NaCl) of average (18 to 25%) porosity with several dense streaks.

(iv) Interval 3,900 - 5,900 ft bdf. The Upper Cretaceous consists of silty/shaly sands with porosities ranging from 18 to 25% and high (> 70%) water saturation throughout (ca 20,000 ppm NaCl). salty water

(v) Interval 5,900 - 9,352 ft bdf. The Lower Cretaceous consists of sandy/shaly siltstones of very low (≤ 10%) porosity with high saturation of moderately saline water (ca 7,500 ppm NaCl).

(e) Penetration Rate Log:

A Penetration Rate Log (drilling time log) is included in the Composite Well Log (Encl.3) and in the Well History Chart (Encl.4).

(f) Deviation Surveys:

A total of 26 drift surveys were carried out in this hole (Append.III). The Totco Double Recorder for measuring drift up to 8^{o} was used.

(g) Temperature Surveys: None.

(h) Gas Log:

A continuous mud gas recorder and a gas chromatograph were used to record and analyse gas shows from the mud. The Mud Gas Log is included in the Composite Well Log (Encl.3).

(i) Formation Testing:

Halliburton Oil Well Testing Co. conducted all tests carried out in this well, using Halliburton's open hole/through casing testing assemblies. Details and results of the tests are listed below:

BASIC

D.S.T. No. : 1. (to test inflow through Baker model "N" Bridge Plug set at 6135' in $9\frac{5}{8}$" casing above $8\frac{1}{2}$" open hole.)

D.S.T. No. : 2.

Interval : 5810' x 5822' and 5834' - 5852'.

Test attempted in: $9\frac{5}{8}$" cased hole.

Equipment used: Halliburton's Hydrospring Tester with RTTS packer.

Test Result : -

Remarks : Test not carried out due to not having enough daylight time.

D.S.T. No. : 3.

Interval Tested: 5810' - 5822' and 5834' - 5852'.

Test carried out in: $9\frac{5}{8}$" cased hole.

Equipment used: Halliburton's Hydrospring Tester, with RTTS packer.

Test Result : Well produced gas and formation water (for details see Appendix IV).
The estimated open flow potential is of the order of 2,500 bbl/d, i.e. a Productivity Index of ca 1 bbl/d/psi.
The water and gas analyses are given in Appendix V and VI respectively.

(j) Production Testing: None.

LOT

- None at 13 3/8" shoe
- 1.68 SG FIT at 9 5/8" shoe.

IV. GEOLOGY

1. History of Exploration

The search for petroleum has been carried out in the Otway Basin for many years and several companies hold exploration permits granted by the Victorian and South Australian Governments. The work of these companies, supported by the B.M.R. and State Mines Departments has contributed greatly to an understanding of the basin and its petroleum prospects. A number of hydrocarbon indications have been reported but as yet no commercial accumulation has been found.

In addition to surface and subsurface geological work, aeromagnetic and gravity surveys have been carried out in various parts of the basin and an extensive seismic coverage exists both onshore and offshore. Up to May 1967 a total of 21 petroleum exploration wells had been drilled in the Otway Basin, 10 of which had been drilled by Frome-Broken Hill, mainly in the Port Campbell area. Port Campbell-1 produced gas at a rate of 4.25 mmcfd and small quantities of oil emulsion were produced with gas-cut salt water from Port Campbell-4. Minor gas flows were encountered in several other wells in the basin and Caroline-1 produced commercial quantities of carbon dioxide.

Following a Farm-in Agreement date 13th July, 1965, Shell Development (Australia) Pty.Ltd. became the operator in Petroleum Exploration Permits 5, 6 and 22 with the right to earn a 50% interest for a total expenditure of $A 4,000,000 including seismic and drilling obligations. During 1966 land seismic surveys were completed in the Yambuk, Portland and Nelson areas and two marine seismic surveys were carried out in PEP.22.

A large structural high had been located offshore from Flaxmans-1 by marine seismic work carried out by Frome-Broken Hill. The Pecten feature was delineated during the first marine seismic survey carried out by Shell Development and structural closure was confirmed by digital lines shot during the latter part of 1966. A location on the culmination of the structure was chosen for the first offshore test in the Otway Basin.

2. Summary of regional geology

(a) Stratigraphy

The Otway Basin is a ? Jurassic to late Tertiary basin trending east-west across south-western Victoria into South Australia almost at right angles to the major trend in the underlying basement rocks, which are probably Palaeozoic metasediments deposited in the Tasman Geosyncline. The ? Jurassic-Lower Cretaceous sediments were deposited in a single large trough, but post-Lower Cretaceous sedimentation was largely controlled by fault tectonics and took place in several distinct sub-basins or embayments separated by fault-bounded structurally high areas. Facies variations are numerous in the sequence and as a result stratigraphic interpretations are many and complicated. For the purposes of the present exploration five major rock units are recognised. The upper four groups vary in thickness, show much variation in facies, and almost certainly are at least locally diachronous, but each is bounded by an unconformity about which there is little controversy.

The ? Jurassic-Cretaceous Otway group consists of a fairly monotonous sequence of fluviatile deposits of sandstones, siltstones and shales. The sediments are first cycle, immature sediments and contain a high proportion of altered volcanic and feldspathic debris. It is considered that the sediment came from both northern and southern sources. Basal conglomerate and clean quartz sands have been found in the Otway group, mainly towards the northern margin of the basin. Correlations of several sandy members within the Otway group have been attempted, but only a broad lithological subdivision into two (sometimes three) units is possible.

Following the deposition of the Otway group, block faulting resulted in the division of the basin into several sub-basins; the Gambier sub-basin, the Tyrendarra and Port Campbell embayments and the Torquay and Port Phillip sub-basins. The latter two in particular appear to have remained completely separate from the rest of the Otway Basin during the Upper Cretaceous and lower Tertiary. In the Port Campbell embayment several transgressive - regressive cycles are recorded in the post-Otway group sequence.

The Otway group is unconformably overlain by the Sherbrook group, a transgressive - regressive sequence known only in the subsurface. The partly marine basal sands (the Waarre formation) are very variable in thickness and locally contain a high clay content. Although equivalents may occur to the west, the Waarre formation is apparently restricted to the Port Campbell embayment. Grain size distribution indicates a south-eastern source for the unit, and isopach maps suggest it was deposited on an irregular topographic surface. The sediments are largely unconsolidated and vary from coarse sand through fine grained sand to clay with minor siltstone and carbonaceous layers. The overlying Flaxmans formation consists of glauconitic siltstones with dense to slightly porous, clean or ferruginous quartz sands. It is also variable in thickness and marks a transition from the Waarre formation to the main transgressive unit in the Upper Cretaceous, the Belfast Mudstone.

The Belfast Mudstone is a thick sequence of glauconitic siltstone and shale with lenticular glauconitic sands. The thickness of the formation varies considerably and over structural highs the formation thins and appears to consist of silt and sandstone, with only minor shale. It represents the period of greatest transgression and is overlain by the Paaratte formation which consists of fine grained glauconitic quartz sand and sandstone with interbeds of glauconitic shale, clay, siltstone and minor dolomite. This formation is transitional between the Belfast Mudstone and the predominantly continental Curdies formation. It also varies in thickness and probably thins over structurally high areas.

The Curdies formation consists of carbonaceous shale, siltstones and sandstones representing the final regressive phase of the Upper Cretaceous depositional cycle. Deposition as in the underlying units appears to be structurally controlled, and the environment of deposition appears to have been mostly paralic, although in Pecten-1A parts of the formation are marine.

The overlying Paleocene Wangerrip group consists of paralic sediments with shallow marine incursions. The lithologies are siltstone and clayey sand overlying a conglomeratic basal sand unit of variable thickness.

The Wangerrip group is overlain with major disconformity by the Upper Eocene Nirranda group. This is a mixed lithological unit, composed of an initial coarse grained sand member (Mepunga formation), overlain abruptly by interbedded marls, limestones, clays and minor sands (Narrawaturk Marl). (See section 4 for further discussion).

The Nirranda group is overlain conformably or with minor disconformity by the Heytesbury group, which consists of a carbonate sequence deposited during the most recent and most widespread transgression in the Otway Basin. The lower part of the group is comprised of marls and minor limestones, and the upper part is predominantly limestone.

(b) Structural Geology

The Otway Basin developed after extensive east-west downwarping and the largely continental Otway group was deposited in the resulting trough. Fault tectonics predominate in the post-Lower Cretaceous structure of the Otway Basin and the folds present are generally large gentle structures, many of which appear to result from draping of sediments over structural highs. The major faulting took place from the end of the Lower Cretaceous into the Upper Cretaceous, and differential faulting divided the basin into sub-basins and embayments separated by structurally high areas. Trends of the resulting major

structures are north-east - south-west in the eastern part of the basin and northwest - southeast in the western part. The Otway group sediments were folded and eroded during these movements. Phases of uneven downwarping followed in the region and the complex transgressive - regressive Upper Cretaceous and Tertiary sequences were deposited. Very mild deformation continued from the Upper Cretaceous into the Tertiary to produce minor faults and warping effects in the Tertiary strata.

Within the Port Campbell embayment there are several broad structural highs on which a number of closed features have been indicated by seismic results. The largest of these, delineated by marine seismic was tested by drilling Pecten 1A. Thinning of the contoured seismic intervals over the crest of this structure suggests that it was a positive feature during the Upper Cretaceous and Lower Tertiary. The seismic results show only a small closure in the underlying Otway group and suggest that the culmination, if any, in this unit is well to the south of the younger structure.

3. Stratigraphic Table : Pecten 1A

Age	Rock Unit	Top (Ft.below R.T.)	Thickness (Ft.)
Pleistocene ?	Thin leached Crust (K/A)		
Oligo-Miocene	Heytesbury group	Seabed	1563
	Limestone unit	"	
	Marl unit	1250	1250
Upper Eocene	Nirranda group	1880	750
	Narrawaturk Marl	1880	270
	Mepunga formation	2150	480
Paleocene	Wangerrip group	2630	1264
	Dilwyn formation	2630	838
	Pebble Point formation	3468	426
Upper Cretaceous	Sherbrook group	3894	1998
	Curdies formation	3894	819
	Paaratte formation	4713	561
	Belfast Mudstone	5274	432
	Flaxmans formation	5706	104
	Waarre formation	5810	82
Lower Cretaceous	Otway group	5892	3458 +
	Unit 1	5892	1563
	Unit 2	7455	1895 +
		T.D. 9352	

4. Stratigraphy

(a) General

Prior to drilling Pecten 1A, the Mesozoic-Tertiary sequence in the Otway Basin had been divided for preliminary exploration purposes into four major rock units (Ref. 2) and the somewhat confusing formational nomenclature was largely disregarded pending the results of further drilling.

The stratigraphy of the basin has since been well documented by the B.M.R. (Ref. 3). Drilling results now allow a detailed subdivision of the sequence encountered in Pecten 1A, which is largely in accordance with that described by the B.M.R. for the rest of the basin.

Apart from a hard, thin limestone layer of probably Pleistocene age at the sea bed, the sequence drilled down to 1880 feet consisted of Oligocene-Miocene limestones and marls belonging to the Heytesbury group. Except for the recognition of an upper limestone unit (down to 1250 feet) and a lower marl unit, no further subdivision has been attempted at this stage. The two units can be correlated with equivalents from onshore wells in the Port Campbell embayment. (Encl. 5).

Two important time breaks within the Tertiary sequence of Pecten 1A occur at 1880 feet and 2630 feet (Appendix VIII). The interval between, formerly included partly in the Heytesbury group and partly in the Wangerrip group, is now defined as the Nirranda group.

The name "Nirranda group" was first used by Bock and Glennie (Ref. 4) to designate the interval between the Heytesbury and Wangerrip groups in bores Nirranda-3 and Mepunga-10. This interval contains a lower transgressive sand unit (Mepunga formation) and an overlying variable marl unit (Narrawaturk Marl), corresponding to sub-unit Bc_2, "limonitic sandstone and conglomerate" and "marl with limonite and glauconite" described by the B.M.R. (Ref. 3). Carter (Ref. 5) showed the outcropping portions of the Nirranda group (Browns Creek Clays, Castle Cove Limestone and possibly the Lower Glen Aire Clays of earlier authors) to be of Eocene age. Leslie (Ref. 1) briefly referred to the Nirranda group as the "Browns Creek Group" which, although an older and more widely known name, is too readily confused with the Browns Creek Clays which comprise only part of the unit under discussion.

It is now considered that the evidence from Pecten 1A warrants a formal definition of the Nirranda group. The type section is nominated in the well-sampled, conformable sequence in Narrawaturk-2 bore as the interval 1830 feet to 2330 feet. The group contains two formations (after Bock andGlennie); the Mepunga formation (2200 - 2330 feet), consisting of coarse grained, well sorted limonitic or

glauconitic quartz sandstone, with dolomitic cement and dolomite stringers in places, and the Narrawaturk Marl (1830 - 2200 feet), consisting of interbedded shaly marl, limestone, sandy limestone and clay.

The lower limit of the group is a basinwide Middle to Lower Eocene disconformity. Wherever sampled, the Mepunga sands have been found to overly Upper Paleocene carbonaceous silts and sands of the Wangerrip group. The upper contact of the group was cored in the designated type section, revealing a well defined dipping contact with the sandy, ferruginous limestone of the Clifton formation conformably overlying the Narrawaturk Marl, without an appreciable time break between the two. Where the Clifton formation is of Middle to Upper Oligocene age, or is absent (as in Pecten-1A), a significant disconformity marks the top of the Nirranda group. Almost certainly all formations within the Nirranda group are diachronous, the known age ranging from the Middle-Upper Eocene boundary to Lower Oligocene. Stratigraphic studies now in progress are expected to clarify the relationships of the several outcropping formations (Browns Creek Clays, Castle Cove Limestone, Point Ronald Clay) and subsurface strata which fall within this group.

In Pecten-1A the top of the Nirranda group is marked by a slight increase in shaliness shown by the gamma ray log below the disconformity at 1880 feet. The Narrawaturk Marl is a dark grey clay at the base grading upwards into lighter greenish grey shaly marl with thin limestone beds. The Mepunga formation is highly ferruginous, especially in the upper part.

The sequence between 2630 feet and 3894 feet is assigned to the Wangerrip group and is of Paleocene age. The two formations recognised in Pecten-1A are correlated with units Db (Dilwyn formation) and Dd (Pebble Point formation) described by the B.M.R. (Ref. 3).

The Dilwyn formation consists of interbedded sand, silt and lignitic silt and contains a thick homogeneous silt member which is considered to correspond to the Rivernook member described by Baker (Ref. 6). The Rivernook member occurs 100 feet above the base of the formation, in the interval 3150 - 3372 feet, and is clearly distinguishable both on lithology and wireline logs (Encl. 3). A thinner silt unit near the top of the formation is correlated with the Trochocyathus member of the onshore area. The Dilwyn formation in Pecten-1A is disconformably overlain by friable quartz sands of the Mepunga formation at 2630 feet.

In the basal part of the Dilwyn formation there is a transition from interbedded sands and silts to massive, friable conglomeratic quartz sandstone. The top of the Pebble Point formation is placed at the top of the first thick sand body at 3468 feet.

The Sherbrook group of Upper Cretaceous age occupies the interval between 3894 feet and 5892 feet in Pecten-1A. It is considerably thinner than in Flaxmans-1, particularly in the lower part, and the sands are in general dirtier due to an increase in shale content. Time stratigraphy (Appendix VIII) illustrates clearly that the several formations that make up the group are facies units of one major transgressive - regressive depositional cycle. On palynological evidence (Appendix Xc.) the Cretaceous/Tertiary boundary probably lies between 3833 feet and 3908 feet. The interval 3657 - 3894 feet consists largely of silty to sandy clay. The top of the Sherbrook group is taken at the base of this interval at a ferruginous sand layer which shows a slight change in gamma ray response at this depth.

The Curdies formation consists of quartz sandstone with shale interbeds grading down into shale with sandstone interbeds. By comparison with Flaxmans-1 the unit is of similar lithology but slightly thicker in Pecten-1A.

Pending the results of a detailed petrological study now in progress, the top of the Paaratte formation is taken at the top of a

sequence of blocky, slightly shaly quartz sandstones containing abundant green pellets, with shale and siltstone interbeds. By comparison with Flaxmans-1 the Paaratte formation in Pecten-1A is somewhat thinner but has a considerably higher sand percentage.

The underlying Belfast Mudstone (5274 - 5706 feet) is clearly defined both on lithology and wireline logs. In Pecten-1A the unit is a siltstone rather than a glauconitic shale and the thickness is considerably reduced from that encountered in Flaxmans-1.

The Flaxmans formation is much more silty and less clearly defined than in onshore wells. It is reduced in thickness from Flaxmans-1, has a considerably lower sand percentage and the sands have a higher clay content.

The Waarre formation is readily defined in Pecten-1A, particularly on electric and gamma ray logs, as the relatively massive sand with minor shale interbeds in the interval 5810 - 5892 feet. The unit is considerably thinner than in Flaxmans-1 and the overall sand percentage is much reduced. The sands are more shaly with lower porosity and permeability than found in onshore wells. On the grounds of lithology and distribution the formation is included in the Sherbrook group rather than at the top of the underlying Otway group according to the scheme adopted by the B.M.R. (Ref. 3).

The top of the Otway group at 5892 feet is marked by a change from relatively quartz rich sands to sub-lithic and lithic sandstones and this lithological change is strongly reflected in the wireline logs. The sediments penetrated in the Otway group are similar lithologically and petrographically to sections in onshore wells in the Port Campbell Embayment and the same two-fold subdivision is evident in Pecten-1A. The upper part (Unit 1 (Ref. 7)) is more sandy with some thick sandstone bodies while the lower part, down to total depth, consists of a rapid alternation of sandstone, siltstone and shale. Correlation with Flaxmans-1 (Encl. 5) shows that over 2300 feet of Unit 1 is missing in Pecten-1A, confirming the magnitude of the angular unconformity indicated by seismic results between the Otway and Sherbrook groups and demonstrating the validity of separating the Waarre formation from the Otway group.

(b) Lithological Description

In Pecten-1A samples were obtained from below the 20 inch casing shoe at 849 feet. Description of the interval 550 - 849 feet is taken from Pecten-1.

(i) Heytesbury group (Oligocene - Miocene)

550'-560' Lime wackestone, light grey, bioclastic, fine grained, subangular, poorly consolidated, glauconitic, clay and calcite cement.

560'-830' Lime wackestone, marly, grading into marl, light grey, fine-grained, silty, glauconitic, fossiliferous, grading into lime packstone, interbedded with marl, light grey, silty and sandy, glauconitic, grading into calcareous marl, fossiliferous.

830'-1250' Lime packstone, grading into grainstone and wackestone, white to beige-grey, bioclastic, fine grained, marl and calcite matrix, glauconitic, slightly pyritic and silty, contains foraminifera and bryozoa. Locally crystalline. Locally interbedded with marl, grey, fossiliferous.

1250'-1744' Marl, grey to green, very fossiliferous, containing streaks of lime packstone, white to grey, bioclastic, slightly glauconitic.

1744'-1810' Lime packstone, white to grey, bioclastic, plus streaks of marl, grey to green, very fossiliferous.

1810'-1880' Marl, grey to green, very fossiliferous, containing streaks of lime packstone, as above.

(ii) Nirranda group (Upper Eocene)

Narrawaturk Marl

1880'-2150' Interbedded Marl, grey green to dark grey, fossiliferous, clayey soft, and minor lime packstone, white to beige-grey, bioclastic, fine grained, grading into lime wackestone.

Mepunga formation

2150'-2630' Quartz sandstone, red and limonitic between 2150' and 2250', changing to white below 2250' fine to very coarse-grained, well sorted, well rounded, moderate to low sphericity, friable (occurring as loose grains in the samples) plus streaks of glauconitic crystalline dolomite in the interval 2375'-2402', consisting of glauconite grains in a crystalline dolomitic matrix, and thin beds of clay, light to dark brown, soft.

(iii) Wangerrip group (Paleocene)

Dilwyn formation

2650'-2732' Silt, dark brown, lignitic, clayey, soft, grading into brown silty clay.

2732'-3151' Quartz sandstone, fine to very coarse grained, well sorted, subrounded to rounded, poorly consolidated, interbedded with clay, light grey-green, silty, soft, and silt, as above

3150'-3372' Silt as above, grading into clayey sand, fine grained, dark brown, lignitic. (=Rivernook member).

3372'-3468' Quartz sandstone, as above, interbedded with silt, silty clay and dolomite as above.

Pebble Point formation

3468'-3894' Quartz sandstone, as above, but massive, thick-bedded and pebbly, plus interbeds of silt and silty clay as above.

(iv) Sherbrook group (Upper Cretaceous)

Curdies formation

3894'-4353' Quartz sandstone, dense to very slightly porous, white, fine to medium grained, silty, clayey, well sorted, partly consolidated with pyrite matrix, micaceous, glauconitic, carbonaceous in the lower parts, interbedded with clay, light grey-green, silty soft, and silt, locally siltstone, medium to dark green-grey, sandy, glauconitic, micaceous, grading into silty sandstone. Trace of coal in upper part.

4353'-4713' Shale, dark green, sandy, glauconitic, micaceous, grading into sandstone, containing minor interbeds of glauconitic sandstone, shaly, with orange dolomitic matrix.

Paaratte formation

4713'-4993' Quartz sandstone, slightly porous, light grey, very fine-grained, well sorted, carbonaceous, micaceous, pyritic, glauconitic, friable, grades into siltstone, interbedded with shale, dark green-grey, sandy, silty, glauconitic, fossiliferous grading into siltstone, clay, silty, sandy, glauconitic, micaceous, soft, siltstone, light grey to yellow green, clayey, sandy glauconitic, micaceous, soft, grades into sand and traces of dolomite, crystalline and glauconitic.

4993'-5274' Clay, as above, interbedded with silt, light grey to yellow green, clayey, sandy, soft, micaceous, plus traces of dolomite, as above.

Belfast Mudstone

5274'-5706' Siltstone, dark green to dark brown, glauconitic, sandy, shaly, grades into sandstone, silty, glauconitic, locally pyritic and carbonaceous, interbedded with minor quartz sandstone, white to green, very fine-grained, well sorted, unconsolidated, very glauconitic, locally clayey.

Flaxmans formation

5706'-5810' Siltstone, light to medium grey, shaly, sandy glauconitic, laminated, carbonaceous, interbedded with quartz sandstone, dense, white to light grey, very fine-grained, well sorted, slightly dolomitic, silt and clay cement.

Waarre formation

5810'-5892' Quartz sandstone, dense, fine-grained, well sorted, clay matrix, silty, carbonaceous, interbedded with clay, light grey, silty, sandy, soft and minor quartz sandstone, medium to coarse-grained, sorted, subangular to subrounded, unconsolidated.

(v) Otway group (Lower Cretaceous)

Unit 1

5892'-7455' Sublithic-Subfeldspathic sandstone, dense, light green to grey, fine-grained, sorted, subangular to rounded, green clay matrix, interbedded with siltstone, light grey, carbonaceous, firm, and minor claystone, light grey-green, locally pyritic, firm to hard, locally silty, plus traces of coal.

Unit 2

7455'-9352' Interbedded sublithic sandstone, siltstone and claystone as above, with traces of coal.

5. Structure

The structure tested by drilling Pecten-1A is a broad northeast-southwest trending anticline in the offshore part of the Port Campbell embayment. It is part of a structurally high trend which extends onshore through Flaxmans-1 and Nirranda-6.

The well was crestally located on the main structural closure at the level of seismic horizon 'C', taken to be approximately coincident with the main prospective (Waarre formation) interval. At this level seismic data indicated a closed area of about 28 square miles and a vertical closure of 350 feet. Closure is present at all levels up to the top of the Nirranda group where vertical closure had decreased to 150 feet. Evidence of structural growth is shown by thinning of the contoured seismic intervals over the crest of the structure, particularly in the lower part of the Sherbrook group. Seismic results showed also a striking angular unconformity between the Otway and Sherbrook groups with marked truncation of Otway group sediments taking place southwards from Flaxmans-1.

The results of Pecten-1A have confirmed the structural picture interpreted from seismic data and there can be little doubt that the well was drilled on a closed anticlinal feature. Dipmeter results above and below top Otway group confirm the marked discordance at this unconformity Dips within the Otway group are uniformly towards the northeast which confirms the seismic picture of structure below the base Sherbrook group unconformity.

6. Relevance to Occurrence of Petroleum

No hydrocarbon indications were noted from cuttings, cores or sidewall samples. Below 4000 feet traces of gas were recorded from the mud returns by gas detector with peaks over the intervals 4680-4860 feet, 5810-5870 feet, 6590-6620 feet, 7040-7450 feet and 7890-8560 feet. Two porous sands in the Waarre formation (5810-5822 feet and 5834-5852 feet) were tested but yielded only formation water and minor quantities of gas.

Petrophysical evaluation (Appendix II) of the section drilled in Pecten-1A shows all sands to be water bearing with water saturations never less than 70%.

Logs show also that the section is freshwater flushed down into the Curdies formation with freshwater influence as deep as $\pm$ 4400 feet. By comparison the base of freshwater influence in Flaxmans-1 is at $\pm$ 4800 feet. Therefore it seems likely that over most of the offshore Port Campbell embayment in PEP22 the good reservoirs of the Wangerrip and Nirranda groups will have been affected by freshwater flushing.

However, sands of reasonable reservoir properties were encountered in the Paaratte and Waarre formations but, although drilled in what must still be regarded as a good trap, failed to contain appreciable accumulations of hydrocarbons. Although gas detector readings in the Otway group were often quite strong the sands were too tight throughout to be regarded as potential reservoirs.

7. Porosity and Permeability of Sediments Penetrated

Porosities were calculated from the sonic and formation density logs and estimated visually in ditch cuttings. Porosity and permeability measurements were made on several sidewall cores and on plugs from Core No.4.

In sands of the Nirranda and Wangerrip groups porosities range from 20% to 30% with a slight decrease with depth due to increasing shaliness. Porosities in rocks of the Sherbrook group are mainly in the range 17-25% and permeability measurements in the Paaratte formation gave 19 and 30 millidarcies. Porosities in the Otway group were below 12% and decrease with depth; permeabilities zero to 1.2 millidarcies.

In general these results are similar to those of the sequence in adjacent onshore wells, although a slight reduction in porosity and permeability occurs in rocks of the Wangerrip and Sherbrook groups due to an increase in shaliness. The Waarre formation in particular contains less sand and is of lower porosity than in the nearest wells onshore.

Results from the Otway group confirm the generally poor reservoir potential of this unit.

8. Contribution to Geological Concepts Resulting from Drilling

As well as providing a valuable point of stratigraphic control in the offshore area of the Otway Basin the results of Pecten-1A have made a significant contribution to an understanding of the palaeogeography of the Port Campbell embayment. The more important factors are summarized as follows:-

(a) The 3,458 feet of Otway group penetrated confirmed the uniformity of these sediments and demonstrated once more the complete absence of porosity and permeability in sandstones of the unit. The identification of zeolites from the Otway group in Pecten-1A, together with the occurrence of zeolites in Flaxmans-1 (Ref.8), is strong evidence for regional zeolitisation of the Otway group.

(b) Correlation with Flaxmans-1 shows a considerable thickness ($\pm$ 2,300 feet) of the upper part of the Otway group to be missing in Pecten-1A, thus confirming the magnitude of the basal Sherbrook group angular unconformity indicated by seismic data. The presence of this unconformity strongly supports the inclusion of the Waarre formation as the basal unit of the Sherbrook group.

(c) Time stratigraphic studies have shown the several formations of the Sherbrook group to be facies units of one major transgressive-regressive depositional cycle. The presence of a thin Belfast Mudstone section of open marine nature during a time interval represented in onshore wells by a restricted environment suggests a barrier to the open sea (possibly a line of barrier bar sands) across part of the Port Campbell embayment. The location of Pecten-1A at greater distance from sediment source is indicated by the fact that the sands throughout the Sherbrook group section are noticeably dirtier.

(d) Erosion of Permian rocks is indicated by the presence of reworked spores of Permian age throughout the Cretaceous sequence (Appendix Xa) and reworked Lower Cretaceous spores in the Curdies and Paaratte formations suggest that Otway group sediments, probably from the Otway horst, were being eroded at this time.

(e) Marked disconformities occur in the Tertiary sequence of Pecten-1A, between the Upper Paleocene and Lower-Middle Eocene and between the Upper Eocene and Middle Oligocene. The interval between these disconformities is formally defined as the Nirranda group, comprising the Mepunga formation and the overlying Narrawaturk Marl.

(f) Before drilling the Pecten structure was considered to have been a positive structural element throughout much of its history. This has been confirmed by the marked thinning of many units, by the deposition of paralic sands during marine deposition in adjacent parts of the basin and by the number of stratigraphic breaks in the sequence.

V. REFERENCES

Ref.No.1 Leslie, R.B., 1965. Petroleum Exploration in the Otway Basin. Proc. VIIIth Commonwealth Mineral and Met. Congr., 5: 203-216

Ref.No.2 Shell Development (Australia) Pty. Ltd. 1966 Application for Petroleum Seach Subsidy for the proposed offshore deep test Pecten No.1. Port Campbell Embayment, Otway Basin. Unpublished.

Ref.No.3 Condon, M.A. Williams, L.W., et al. A preliminary review of the Otway Basin. B.M.R. Rec. 1966/170.

Ref.No.4 Bock, P.E., and Glenie, R.C., 1965. Late Cretaceous and Tertiary Depositional Cycles in South-Western Victoria. Proc. Royal Society of Victoria, Vol. 79, part 1, 153-163.

Ref.No.5 Carter, A.N., 1958. Tertiary Foraminifera from the Aire District, Victoria. Geol. Surv. Vic. Bull.55.

Ref.No.6 Baker, G., 1953. The relationship of Cyclammina bearing sediments to the Older Tertiary deposits south-east of Princetown, Victoria. Mem.nat.Mus. Vic. 18: 125-134.

Ref.No.7 Cundill, J.R., 1966. Otway Basin Study. Cundill, Meyers & Associates, (Unpubl. report for Shell Development (Australia) Pty. Ltd.).

Ref.No.8 Baker, G., and McAndrew, J., 1961. Zeolite-bearing sedimentary rock from the Mesozoic portion of Flaxmans No.1 Borehole, Western Victoria. C.S.I.R.O. Mineragraphic Investigations Rept. No.850.

APPENDIX I

LIST OF SCHLUMBERGER LOGS

RUN IN PECTEN 1A

LOG	RUN NO.	DATE - 1967	INTERVAL LOGGED	SCALE (ins.per 100 ft.)
IES/SP	1	21st April	2184 - 849	1, 5
	2	10th May	6261 - 2164	1, 5
	3	26th May	8387 - 6246	1, 5
	4	4th June	9352 - 8200	1, 5
Sonic/C	1	21st April	2166 - 849	1, 5
	2	10th May	6250 - 2164	1, 5
BSGRC	3	26th May	8378 - 6246	1, 5
	4	4th June	9338 - 8200	1, 5
GR/N	1	21st April	2192 - 849	1, 5
N	2	4th June	9353 - 5700	
GR	2	11th May	6261 - 2164	1, 5
GR/CCL	(5)	6th June	6130 - 5710	- 5
FDC	1	11th May	6258 - 2164	1, 5
	2	26th May	8386 - 6246	1, 5
	3	4th June	9352 - 8290	1, 5
MLC	1	10th May	6261 - 2164	1, 5
MLLC	1	5th June	9352 - 6246	1, 5
CBL	1	10th May	2164 - 310	1, 5
CBL	2	26th May	6246 - 2100	1, 5

APPENDIX II

PETROPHYSICAL EVALUATION PECTEN-1A

by

Shell Development (Australia) Pty. Ltd.

PECTEN 1A

R_w and S_w Estimate

Depth	SP	Ec	Rw	ø	M	F	Ro	R
(ft bdf)	(mv)	(mv) @77°F	(Ω m) @ 77°F/ @ BHT	(%) on FDC			(Ω m)	(Ω @
2,497	-	-	1.75/.94	25	1.8	11	11	10
2,742	-	-	1.75/.94	24	1.8	13	12	18
2,842	-	-	1.75/.94	26	1.8	11	10	15
3,505	-	-	1.40/.75	23	1.8	14	10	17
3,557	-	-	1.40/.75	24	1.8	13	10	18
4,082	30	18	.73/.38	20	1.8	18	6.8	3
4,317	33	20	.70/.36	25	1.8	11	4.0	2
4,820	52	37	.38/.21	29	1.8	9	1.9	1
4,970	60	53	.22/.12	19	1.8	9	1.1	1
5,264	61	54	.21/.11	23	1.8	14	1.5	1
5,715	34	21	.66/.34	20	1.8	18	6.1	3
5,816	65	49	.25/.14	22	1.8	15	2.1	3
5,860	60	44	.30/.16	21	1.8	16.5	2.6	4

PECTEN 1A

R_w and S_w Estimate

Depth	SP	Ec	Rw	ø	M	F	Ro	R_{il}	I	n	Sw	Remarks
(ft bdf)	(mv)	(mv) @77°F	(Ω m) @ 77°F/ @ BHT	(%) on FDC			(Ω m)	(Ω m) @ BHT			(%)	
2,497	-	-	1.75/.94	25	1.8	11	11	10	1	1.6	100	Rw estimated from Resistivity/Porosity plot. SP not developed enough for reliable determination.
2,742	-	-	1.75/.94	24	1.8	13	12	18	1.5	1.6	75	
2,842	-	-	1.75/.94	26	1.8	11	10	15	1.5	1.6	75	
3,505	-	-	1.40/.75	23	1.8	14	10	17	1.7	1.6	70	
3,557	-	-	1.40/.75	24	1.8	13	10	18.5	1.8	1.6	70	
4,082	30	18	.73/.38	20	1.8	18	6.8	3.8	< 1 (?)	1.6	100	
4,317	33	20	.70/.36	25	1.8	11	4.0	2.2	< 1 (?)	1.6	100	
4,820	52	37	.38/.21	29	1.8	9	1.9	1.2	< 1 (?)	1.6	100	
4,970	60	53	.22/.12	19	1.8	9	1.1	1.0	ca 1	1.6	100	
5,264	61	54	.21/.11	23	1.8	14	1.5	1.8	1.2	1.6	90	
5,715	34	21	.66/.34	20	1.8	18	6.1	3.0	< 1 (?)	1.6	100	
5,816	65	49	.25/.14	22	1.8	15	2.1	3.5	1.7	1.6	70	
5,860	60	44	.30/.16	21	1.8	16.5	2.6	4.0	1.5	1.6	75	

PCTN1-1A/900429/P27

Depth	SP	Ec	Rw	Ø	M	F	Ro	R_{il}	I	n	Sw	Remarks
LOWER CRETACEOUS (OTWAY)												
7,980	16	6	.83/.35	12	2.0	69	24	16	<1	1.6	100	
8,508	17	5 (?)	/.3	10	2.0	100	30	25	<1	1.6	100	Rw determined from SP not too reliable.
8,660	15	3 (?)	/.3	9	2.0	122	36.6	37	1	1.6	100	True Rw probably somewhat lower.
8,841	13	(?)	/.3	8	2.0	155	46.5	50	1.1	1.6	95	
8,934	10	(?)	/.3	6	2.0	275	82.5	93	1.1	1.6	95	

DEVIATION SURVEYS RECORD - PECTEN IA

Depth (ft.)	Deviation (°)
830	0
1850	¼
2160	½
3290	2
3853	1½
4340	1
5060	¼
5430	1
5698	1½
5900	1½
6240	1½
6525	1
6800	1¼
7000	1
7230	2
7430	2
7690	2½
7783	2¾
7968	2¾
8180	2
8541	4
8645	3
8759	4
8810	2
8900	3
9000	3½

PE900430

This is an enclosure indicator page.
The enclosure PE900430 is enclosure within the container PE900429 at this location in this document.

The enclosure PE900430 has the following characteristics:

ITEM_BARCODE	=	PE900430
CON TAINER_BARCODE	=	PE900429
NAME	=	Drill stem test results
BASIN	=	OTWAY
PERMIT	=	PEP 22
TYPE	=	WELL
SUBTYPE	=	DIAGRAM
DESCRIPTION	=	Drill stem test results
DATE_CREATED	=	
DATE_RECEIVED	=	
W_NO	=	W502/505
WELL_NAME	=	Pecten 1A
CONTRATOR	=	
CLIENT_OP_CO	=	Shell

APPENDIX V

WATER ANALYSIS

WELL : PECTEN NO. 1A.

FORMATION TEST : No. 1 through perforations 5810' - 5822; 5834' - 5852.

SAMPLING : Samples taken from string and separator, on 8th June, 1967.

IONS AND OTHER CHARACTERISTICS \ SAMPLE	FLUID TAKEN FROM STRING HEAD AT 14.20		FLUID TAKEN FROM STRING HEAD AT 15.20		FLUID TAKEN FROM STRING HEAD AT 16.36		FLUID TAKEN FROM SEPARATOR AT 16.50		FLUID TAKEN FROM SEPARATOR AT 17.40	
pH at 22°C	7.10		6.90		6.95		5.90		6.50	
CONDUCTIVITY IN mhos/cm AT 22°C	0.0308		0.0301		0.0308		0.0304		0.0316	
INSOLUBLE SOLIDS AT 22°C IN % w/w OWEN DRY	1.71		0.647		0.365		0.266		0.254	
	p.p.m.	m.e./l.	p.p.m.	m.e./l.	p.p.m.	m.e./l.	p.p.m.	m.e./l.	p.p.m.	m.e./l.
CO_3 =	NIL	--	NIL	--	NIL	--	NIL	--	NIL	--
HCO_3 -	790	13.0	700	11.5	670	11.0	610	10.0	655	10.7
C1-	12110	341.6	12320	347.5	12270	346.1	12320	347.5	12350	348.4
SO_4 =	220	4.6	195	4.1	185	3.9	155	3.2	180	3.7
SiO_2 =	125	4.2	155	5.2	30	1.0	40	1.3	15	0.50
PO_4 ≡	N.Dc.	--	NDc.	--	N.Dc.	--	N.Dc.	--	N.Dc.	--
ANIONS TOTAL	13245	363.4	13370	370.3	13155	362.0	13125	362.0	13200	363.3
Na^+	4965	216.0	5015	218.1	4950	215.3	4965	216.0	5050	219.7
K^+	177	4.53	167	4.27	168	4.30	167	4.27	160	4.09
Li^+	1.0	0.14	1.0	0.14	1.0	0.14	1.0	0.14	1.0	0.14
Ca^{2+}	2805	140.0	2905	145.0	2880	143.7	2870	143.2	2900	144.7
Mg^{2+}	81	6.7	91	7.5	97	8.0	86	7.1	92	7.6
Sr^{2+}	121	2.71	120	2.74	121	2.76	121	2.76	119	2.72
CATIONS TOTAL	8150	370.1	8299	277.7	8317	374.2	8210	373.5	8322	378.9
IONS TOTAL AT 22°C	21395		21669		21472		21335		21522	
SOLUBLE SOLIDS AT 22°C	22110	--	22120		22020		21890		22040	

COMMENT : It is evident that samples taken before and at 16.50 hrs. are contaminated by drilling fluids. The degree of contamination decreases progressively with increase in sampling time.

NOTE : Samples were received in steel bottles.

N.Dc. - Not detected.

Analysis by : J. Puchel (Bureau of Mineral Resources - Canberra).

Date : 20th July, 1967.

APPENDIX VI

GAS ANALYSIS

(BY GAS CHROMATOGRAPHY)

WELL: PECTEN NO. 1A.

FORMATION TEST: No. 1 through perforations
5810' - 5822'; 5834' - 5852'

SAMPLING: Samples taken from the Separator on 8th June, 1967. and at times shown in the respective columns below.

COMPONENT (% Mol) \ SAMPLE	Choke: 24/64 : 16.00 Hours Temp., 50°F. Press: 165 P.S.I.	Choke: 16/64 : 16.45 Hours Temp., 60°F Press: 165 P.S.I.	Choke: 8/64 : 17.30 Hours Temp., 57°F Press: 165 P.S.I.
H_2	N.Dc.	0.002*	N.Dc.
He	0.005*	0.005*	0.005*
O_2 + Ar	0.16	0.75	0.18
N_2	1.03	1.35	1.61
CO	N.Dc.	N.Dc.	N.Dc.
CO_2	0.04	0.05	0.02
METHANE	96.3	96.0	95.7
ETHANE	1.85	1.90	1.84
PROPANE	0.41	0.45	0.44
ISOBUTANE	0.064	0.067	0.065
BUTANE	0.067	0.071	0.071
ISOPENTANE	0.024	0.026	0.028
PENTANE	0.017	0.018	0.018
2-METHYLPENTANE	0.007	0.010	0.009
3-METHYLPENTANE	0.005	0.003	0.005
HEXANE	0.005	0.007	0.010
C_7 AND HIGHER	TRACE	TRACE	TRACE
H_2S	N.Dc.	N.Dc.	N.Dc.

NOTES:
1. N.Dc. - NOT DETECTED.
2. COMPOSITION OF GASES IS QUOTED FOR THE SAMPLES ON HAND AND AT THE TIME OF TESTING ONLY.
3. ( )* APPROX. ESTIMATION ONLY.
4. DATE OF ANALYSIS 10TH JULY, 1967.
5. ANALYSIS BY: J. PUCHEL (BUREAU OF MINERAL RESOURCES - CANBERRA.)

APPENDIX VII

CORE AND SIDEWALL CORE DESCRIPTIONS

PECTEN 1A

by Shell Development (Australia) Pty. Ltd.

DESCRIPTION OF CORES

Core No. 1 — 1890 feet to 1915 feet. Cored 25 feet, recovered 2'2" (9%).

Marl, grey to slightly greenish, containing thin layers approximately every ½ inch, rich in test debris, and some small inclusions of dark grey clay and brown marl. Bioclastic debris and clayey inclusions more abundant in lower 10 inches.

Core No. 2 — 5104 to 5114 feet. No recovery, but siltstone adhering to corehead.

Siltstone, dark brown, sandy, shaly, micaceous, plus silt, dark green, glauconitic, soft, plastic.

Core No. 3 — 5708 to 5714 feet. Cored 6 feet, recovered 6 feet (100%).

Quartz sandstone, dense, light grey, fine to very fine-grained, moderately well sorted, moderate to high sphericity, subrounded to rounded, abundant silt matrix, glauconitic, slightly micaceous and carbonaceous, locally dolomitic, pebbly. Several pink, fossiliferous calcareous concretions occur in the lower part of the core. Churning of sediment by burrowing organisms throughout.

Core No. 4 — 5907 to 5936 feet. Cored 29 feet, recovered 29 feet (100%).

Sublithic sandstone, dense, light grey to green, fine to medium-grained, moderately well sorted, low to moderate sphericity, green clay cement, contains quartz, feldspar and some mica, lithics are mostly green, dark grey or pink and volcanic. The sandstone contains carbonaceous plant remains, is massive, well bedded, cross-bedded and laminated, and locally contains silty layers and very fine-grained sandstone layers. Some calcareous concretions also occur.

DESCRIPTION OF SIDEWALL CORES

2460 feet	Quartz sand, porosity probably mostly destroyed by sampling, medium to coarse, sorted, angular to subrounded, matrix of yellow silty clay, some lithic grains.
2550 feet	Quartz sand, porosity as above, medium to coarse, well sorted, subangular to subrounded, small amount of light grey silty clay matrix, rare lithic grains.
2590 feet	Quartz sand, slightly porous, fine to coarse grained, poorly sorted, angular to rounded, pyritic, silty.
2632 feet	Siltstone, dark brown, shaly, carbonaceous, ferruginous, slightly micaceous, traces of coal with thin streaks of clean white quartz siltstone.
2660 feet	Siltstone and silty shale. Interlaminated streaks of siltstone, white, quartzose lithic, angular, well sorted, no matrix or cement, very porous, and silty shale, dark brown, carbonaceous, ferruginous.
2690 feet	Siltstone and silty shale as above.
2720 feet	Siltstone and silty shale as above, 65% silty shale.
3180 feet	Siltstone, brown, ferruginous, carbonaceous, slightly pyritic, shaly, locally sandy.
3230 feet	Shale, slightly silty, carbonaceous, dark brown, with rare silty streaks.
3280 feet	Shale, dark brown, carbonaceous, silty.
3338 feet	Shale, as at 3280 feet, micaceous.
3362 feet	Shale, dark brown, micaceous, with thin light grey silt lenses.
3450 feet	Silt, rounded quartz grains in matrix of hard black carbonaceous silt.
3456 feet	Silt, as at 3450 feet.
3618 feet	Quartz sandstone, very porous, white, medium grained, angular, well sorted, pebbly, with minor silty streaks.
3695 feet	Siltstone, sandy, locally carbonaceous, pyritic.
3735 feet	Lithic sandstone, slightly porous, light grey, medium grained, moderately sorted, subangular, silty clayey matrix, glauconitic.
3797 feet	Quartz sandstone, locally porous, grey fine grained, well sorted, angular, locally with patchy dark grey clay matrix, lithic, glauconitic.
3833 feet	Quartz sandstone, locally porous, fine grained, well sorted, locally with streaks of carbonaceous matrix, lithic, micaceous, very glauconitic.
3883 feet	Siltstone, dark grey, micaceous, with thin lenses of clean white fine grained sand.
3908 feet	Quartz sandstone, dense, grey, fine grained, sorted, dirty, abundant silty clay matrix, lithic, glauconitic.
4022 feet	Silty shale, dark grey, micaceous, carbonaceous, pyritic, glauconitic, compact.
4044 feet	Silty shale, as at 4022 feet, very glauconitic.
4176 feet	Shale, dark grey, compact, pyrite, slightly glauconitic.

4248 feet	Shale, black, very fine grained, carbonaceous, contains rare rounded sand grains.
4295 feet	Glauconitic sandstone, dense, dark green, with rounded quartz grains set in a very abundant matrix of green glauconitic clay.
4403 feet	Siltstone, dark grey, micaceous, slightly glauconitic, fossiliferous.
4493 feet	Siltstone, grey, slightly micaceous.
4598 feet	Siltstone, grey, contains quartz sand grains, slightly glauconitic, fossiliferous.
4618 feet	Shale, grey, micaceous, slightly carbonaceous, pyritic, fossiliferous.
4785 feet	Shaly siltstone, dark grey, micaceous, slightly carbonaceous, with streaks of clean white siltstone, fossiliferous.
4816 feet	Quartz sand, slightly porous, grey, fine grained, moderately sorted, angular, silty matrix, slightly lithic.
4964 feet	Quartz sand, dense, yellowish, fine grained, poorly sorted, angular to subrounded, abundant yellowish silt matrix, slightly lithic, rare mica flakes, slightly phosphatic, glauconitic.
4985 feet	Quartz sandstone, dense, light grey-green, moderately well sorted, angular to subangular, silt matrix, very glauconitic.
5030 feet	Siltstone, dark grey, shaly in patches, slightly glauconitic.
5078 feet	Shaly siltstone, carbonaceous, micaceous, locally glauconitic.
5182 feet	Shale, dark grey, dense, massive, trace of mica and pyrite.
5300 feet	Shale, dark grey, slightly micaceous.
5398 feet	Shale, dark grey, slightly glauconitic and micaceous.
5650 feet	Shale, dark grey-green, glauconitic (30% glauconite pellets).
5735 feet	Silty shale, dark grey, slightly micaceous, with thin glauconitic siltstone streaks.
5827 feet	Clay, dark grey, sandy with nests and thin streaks of fine to medium grained sandstone, feldspathic to sublithic, with clayey matrix, carbonaceous.
5880 feet	Quartz sand, porous, fine to coarse grained, moderate sorting, poorly consolidated, clean.
5920 feet	Siltstone, grey, slightly micaceous, clayey.
5977 feet	Clay, dark grey, slightly silty and sandy, with thin coal streaks.
6013 feet	Clay, dark grey, slightly micaceous.
6155 feet	Clay, grey, slightly silty and micaceous, occasional lignite specks.

7105 feet	Lithic sandstone, dense, medium grey, medium grained, sorted, angular to subrounded, low to moderate sphericity, greenish white clay cement, feldspathic, quartzose, slightly carbonaceous.
7166 feet	Sublithic sandstone, dense, medium grey-green, fine to medium grained, poorly sorted, angular to subrounded, low to moderate sphericity, greenish white clay cement, feldspathic, quartzose, slightly micaceous and carbonaceous.
7194 feet	Lithic sandstone, as at 7105 feet.
7204 feet	Sublithic sandstone, dense, as at 7166 feet.
7276 feet	Siltstone, light grey, sandy, micaceous, grades into quartz sandstone, dense, very fine grained, well sorted, subrounded to rounded, feldspathic, lithic, silty.
7297 feet	Lithic sandstone, dense, medium grey, fine to medium grained, poorly sorted, angular to subrounded, greenish white clay cement, feldspathic, quartzose, slightly micaceous.
7330 feet	Sublithic sandstone, as at 7166 feet.
7360 feet	Sublithic sandstone, as above, with coal fragments.
7399 feet	Lithic sandstone, as at 7105 feet.
7424 feet	Lithic sandstone, as at 7297 feet.
7490 feet	Siltstone, light grey, laminated, slightly carbonaceous and micaceous, clayey.
7552 feet	Siltstone, light grey, sandy, slightly carbonaceous, clayey.
7650 feet	Lithic sandstone, as at 7297 feet.
7715 feet	Siltstone, as at 7552 feet.
7812 feet	Sublithic sandstone, dense, light grey, very fine grained, well sorted, subrounded to rounded, silty, clay matrix, quartzose, feldspathic, carbonaceous, grades into siltstone.
7920 feet	Claystone, medium grey, carbonaceous, slightly silty.
8120 feet	Sublithic siltstone, as at 7812 feet.
8206 feet	Siltstone, light grey, with thin carbonaceous streaks, plus thin laminae of very fine grained silty sandstone.
8330 feet	Claystone, medium grey, silty, sandy.
8395 feet	Sublithic sandstone, as at 7166 feet.
8506 feet	Sublithic sandstone, dense, light grey, very fine grained, well sorted, moderate sphericity, light grey cement, quartzose, clayey.
8520 feet	Sublithic to quartz sandstone, dense, light grey, very fine to fine grained, moderately sorted, moderate to low sphericity, light grey clay matrix, feldspathic, clayey.
8532 feet	Lithic sandstone, dense, light grey-green, medium grained, well sorted, moderate sphericity, light grey clay cement, feldspathic, slightly micaceous and carbonaceous.

8546 feet	Claystone, light grey.
8572 feet	Lithic sandstone, as at 8532 feet.
8605 feet	Lithic sandstone, dense, light grey, very fine to fine grained, moderately sorted, moderate to low sphericity, light grey clay cement, quartzose, feldspathic, slightly carbonaceous.
8630 feet	Siltstone, medium grey, with thin carbonaceous streaks.
8670 feet	Sublithic sandstone, as at 8506 feet.
8682 feet	Siltstone, light to medium grey, clayey, firm.
8712 feet	Sublithic sandstone, as at 8532 feet, fine to medium grained, angular to subrounded, slightly micaceous.
8735 feet	Lithic sandstone, dense, light grey-green, fine to medium grained, moderately sorted, angular to subrounded, moderate to low sphericity, clay cement, with green claystone laminae, feldspathic, quartzose.
8743 feet	Claystone, light grey.
8843 feet	Siltstone, light grey with faint brown streaks.
8873 feet	Claystone, light grey with faint brown streaks, slightly silty.
8915 feet	Lithic sandstone, as at 8735 feet, with no claystone laminae.
8932 feet	Lithic sandstone, as above.
8966 feet	Siltstone, grey, sandy, much clayey matrix, coal streaks.
9018 feet	Sublithic sandstone, as at 8506 feet, poorly sorted, with carbonaceous streaks.
9027 feet	Sublithic sandstone, as at 8532 feet.
9038 feet	Lithic sandstone, as at 8915 feet, carbonaceous, with carbonaceous streaks.
9055 feet	Lithic sandstone, as at 8605 feet.
9092 feet	Sublithic sandstone, dense, light grey, medium to coarse grained, moderately sorted, angular to subangular, low sphericity, abundant white clay matrix, feldspathic, slightly micaceous.
9109 feet	Lithic sandstone, as at 8735 feet.
9132 feet	Sublithic sandstone, dense, light grey, very fine grained, well sorted, subrounded to rounded, silty, clay cement, feldspathic, carbonaceous, grades into siltstone.
9210 feet	Claystone, light grey with faint brown streaks.
9235 feet	Sublithic sandstone, dense, light grey, medium grained, well sorted, angular to subangular, moderate sphericity, abundant white clay matrix, feldspathic, slightly carbonaceous.
9271 feet	Lithic sandstone, as at 8735 feet, grain boundaries indistinct.
9305 feet	Sublithic sandstone, as at 9235 feet, fine to medium grained, micaceous, with coal fragments.

APPENDIX VIII

THE FORAMINIFERAL SEQUENCE, PECTEN 1A WELL

by

S.D.A. Geological Laboratory

CONTENTS

1. Note on the zonation scheme

The biostratigraphic scheme of Taylor (1966) (Ref.1) for the Gippsland, Bass and Otway basins, was used in this investigation. The scheme contains a series of 30 alphabetical zonules spanning the Upper Cretaceous and Tertiary, and is based on the extinction, rather than the initial appearance, of index species. This enables a well to be zoned entirely on cuttings, despite downhole contamination, providing the in situ faunas are moderately abundant. The local subdivision is necessarily less detailed than the Shell zonation schemes based on tropical faunas, because the local temperate and cold water faunas are impoverished in both species and individuals.

2. Sample Detail

Faunal determination of three conventional cores, sidewall cores and cuttings was carried out from the first returns at 600' (in the initial hole, Pecten-1) down to the top of the Otway group at 5892' in Pecten-1A. Cutting samples were checked at approximately fifty foot intervals, and more closely where good faunas were found. Distribution of faunas was recorded quantitatively in the Upper Cretaceous, and qualitatively in the Tertiary intervals. No detailed examination was made of the interval 600 - 1700 feet.

3. Faunal Sequence

Pecten - 1A penetrated a superficial layer of Pleistocene beach rock, and drilled through an unknown thickness of Middle and Upper Miocene limestone, before the first casing was set at 850 feet. (Information from Pecten-1, suggested that the Middle/Lower Miocene boundary was somewhat above 550 feet.)

From the first returns of Pecten-1A at 864 feet down to 1300 feet, Lower Miocene limestones were penetrated. Precise zonule boundaries were not defined. (see Text Fig.1).

Between 1300 feet and 1870 feet the planktonic fauna was dominated by Globigerina ampliapertura, G. euapertura, Globorotalia opima and G. obesa, indicating an Oligocene (Zonule I) age. Miocene contamination over this interval was heavy. No detailed analysis of the cuttings above 1700' was made, but the fauna suggested that both Zonules I_1 and I_2 were present.

No indications of the Lower Oligocene Zonule J were found, and a minor timebreak, corresponding to Hiatus III in the rest of the basin, is indicated at or above about 1880 feet. (Ref.No.2.)

At 1880 feet the end-members of the Eocene Globigerina linaperta lineage first appear in the cuttings, and by core No.1 (1892-1915 feet) the fauna of the uppermost Eocene Zonule K is well developed. Core No.1 is a bedded marly clay with an abundant shallow water benthonic fauna, and moderately abundant planktonics, indicating shallow open marine conditions. The fauna includes: Globigerina linaperta, Globigerina ampliapertura, G. euapertura, Globorotalia opima, G. obesa, Globoquadrina larmeui, Bolivina pontis, B. anastomosa, Cibicides perforatus, and Cerobertina kakahoica.

A rich Zonule K planktonic and benthonic fauna continues down to 2150 feet. Here the lithological change from a marly clay to a sand is not immediately apparent, due to caving. This uppermost Eocene fauna between about 1900 feet and 2150 feet includes Globigerina linaperta (the index fossil of the zonule), Globigerina ampliapertura, Globorotalia opima, and Chiloguembelina cubensis.

Between about 2300 feet and 2630 feet the sandy sequence contains very few in situ foraminifera. Rare Eocene benthonic species similar to those in the overlying clay occur at 2470-80 feet. Diagnostic in situ planktonics are absent, and hence no definite age can be ascribed to this interval, but it is probably Upper Eocene.

The first appearance of Paleocene faunas is at 2700 feet. A very sparse calcareous fauna contains Globorotalia chapmani which indicates Zonule R, the middle zone of the Upper Paleocene. Faunas in sidewall cores between 2800 feet and 3200 feet are confined almost entirely to the arenaceous genus Haplophragmoides. At 3200 feet a rich calcareous fauna diagnostic of Zonules S and T appears; it is correlated with the Middle - Upper Paleocene Rivernook member. The fauna is dominated by Vaginulina longiforma, Praebulimina quadrata, Kolesnikovella angusta, and Anomalinoides praespissiformis. In the absence of diagnostic planktonics, Zonules S and T cannot be separated. The horizon is at least 80' thick (proved from 3200' to a sidewall core at 3280'). At 3338' a sidewall core contains a paralic Haplophragmoides paupera fauna, which continues, with very rare calcareous specimens, down to about 3456'. There is no evidence of the presence of the Middle Paleocene Zonule U (the fauna usually associated with the Pebble Point formation).

From 3456' to the topmost Cretaceous fauna at 4022', sidewall samples are barren of foraminifera, although heavy Zonule S contamination occurs down into the Cretaceous. The distribution of Upper Cretaceous faunas is controlled by facies. However, within this framework two faunal zones are distinguishable; these correspond to Taylor's zonules XA and XB. (Ref. No.3.) The boundaries of these zonules in Pecten-1A are determined solely by facies changes; the boundary between XA and XB is therefore not a time plane. The nearest approximation to time planes that can be established are the correlations of two marine ingressions in Zonule A with two similar ingressions in Zonule A of Flaxmans-1.

The Upper Cretaceous sequence commences at or slightly above 4022 feet, where an arenaceous fauna of Haplophragmoides sp. A, H. sp. B, and H. sp. C of Taylor, with Haplophragmoides spp. and Dorothia filiformis, is definitive. Other species, including Ammobaculites subcretacea, A. goodlandensis, Bathysiphon sp., Hyperammina elongata, and Textularia spp. are less frequent components of this fauna, which occurs sporadically from 4022 feet to 5300 feet. This interval corresponds to the maximum limits of Zonule XA.

Two shaley horizons containing calcareous faunas occur in this interval. The upper horizon, sampled by a sidewall core at 4022 feet in the Curdies formation, includes Hoeglundina supracretacea, Alabamina australis, Gyrodinoides nitida, Valvulineria lenticula, Stilostomella alexanderi, Lenticula sp. and Nodosaria sp. Although several of the species are long ranging, the total fauna (including arenaceous species) is indicative of XA. These two shale stringers correlate with similar shales of XA age in Flaxmans 1.

At 5300 feet, coincident with the top of the dark shales of the Belfast Mudstone, the first appearance of new arenaceous species was recorded. As this is associated with a wave of calcareous species, it would appear that the distribution of this fauna is facies controlled, and that the upper boundary of the zonule in a time sense is not represented in this well. The fauna of the interval 5300-5800 feet is moderately diverse in species (by the standards of the local Upper Cretaceous) in contrast to the small number of species found in the dominantly paralic interval 4022-5300 feet. Fairly common in this "Belfast Mudstone" interval are the following species: Valvulineria erugata, Stensoina praeexsculpta, Gavelinopsis cenomenica, Cibicides ribbingi, Pallaimorphina heliciformis, and the planktonic Hedbergella trochoidea; while species also present in higher intervals such as Hoeglundina supracretacea, Valvulineria lenticula, Alabamina australis, Gyrodinoides nitida and Ceratobulimina kremnoides increase markedly in abundance below 5300 feet.

Species such as Textularia cf. trilobita, Gavelinopsis cenomenica and Colomia austrotrochus would appear to indicate a Zonule XB age (=Turonian) for this interval. However, true T. trilobita, one of the index fossils for the zone, was found only in the deepest sample (5760 feet). Above this, an evolutionary series of slight variants changes perceptibly towards a different species by the time the form T. cf. trilobita disappears at 5300 feet due to a facies change.

For this reason, and because the palynological data indicated correlation with the base of Taylor's Zonule XA rather than with XB, it is proposed to regard the time interval represented by the deposition of the Belfast Mudstone, as a transition zone between XA and XB. Its age would be approximately Coniacian.

Between 5600 feet and 5760 feet (basal "Belfast Mudstone" - top of Flaxmans formation) the fauna again becomes very sparse with mainly arenaceous species. An isolated interval between 5760 feet and 5800 feet again contains calcareous foraminifera. A true XB fauna, represented by rare Textularia trilobita, with other species as above, was found in this interval. Palynological data confirmed the Turonian age of this sample. Below 5800 feet (the base of the Flaxmans formation) no faunas were found.

4. Biostratigraphic Interpretation

The Upper Cretaceous foraminiferal sequence commences in Pecten -1A at approximately 5800 feet within the interval correlated with the Flaxmans formation. Foraminifera have not been previously reported from this interval. Taylor (Ref.No.3) suggested that Upper Cretaceous marine sedimentation began in a coastal trough between Port Campbell-2 and Flaxmans-1 in Turonian times with the deposition of the basal Belfast Mudstone. Marine sedimentation probably commenced slightly later in Pecten-1A with the deposition of the Flaxmans formation but still within the Turonian.

The Belfast Mudstone in Pecten-1A evidently represents an interval of time between the Turonian (XB Zonule) and the Santonian (XA Zonule). This gap, corresponding approximately to the Coniacian, or part thereof, has not been recognized previously in any well with the possible exception of Sherbrook-1. The interval is designated "XA - XB transition" on a combination of containing persistent, if sparse, planktonic foraminifera, throughout most of the interval. It suggests a restriction of part of the Port Campbell Embayment to open marine conditions during the deposition of the Belfast Mudstone.

In Flaxmans-1 and Port Campbell-2 Belfast Mudstone deposition continued into Zonule XA (Senonian; probably Santonian) times; but in Pecten-1A shale/silt deposition ended earlier, still within XB - XA transition zone. The lower parts of the Paaratte formation in Pecten-1A are time equivalents (and therefore lateral facies variations) of the upper part of the Belfast Mudstone in Port Campbell-1 and 2. This facies variation from "barred basin" (restricted marine) and open marine in the centre of the Port Campbell embayment, to "marginal marine" (=paralic) conditions on the edges of the embayment was described by Taylor (Ref.No.3) and is supported by the results from Pecten-1A.

In summary, Pecten-1A location is interpreted as becoming part of a marine Cretaceous depositional trough in very late Turonian times (with the deposition of the Flaxmans formation). Deposition of the Belfast Mudstone apparently occurred between XA and XB times, that is, during the Coniacian, in a fairly open marine environment. Deposition of the Paaratte must have commenced near the end of Coniacian times, and paralic sedimentation been initiated earlier in Pecten than elsewhere. Deposition of the Paaratte continued on the (now) high Pecten structure in Santonian times, while the deposition of the Belfast Mudstone continued in the deepest part of the trough.

Two marine ingressions represented by shales containing Zonule XA calcareous faunas were recognized in Pecten-1A at 5150 feet interbedded in the Paaratte formation and at 4044 feet interbedded in the Curdies formation. These are correlated with tongues of the Belfast Mudstone.

The top of the Cretaceous foraminiferal sequence in Pecten-1A is at about 4022 feet within marine and paralic equivalents of the Curdies formation. Since the Cretaceous extends at least as high as 3908' (on palynological data; see Appendix No.X) with rare microplankton still present, the top of the foraminiferal sequence may not represent the top of the marine sequence. Sedimentation may have continued without a marked break from Cretaceous to Tertiary times.

Earliest (?)Tertiary deposits are in moderately glauconitic but non-foraminiferal silts and sands. A marginal marine environment is suggested for the interval 4000-3450 feet, but the reasons for the absence of foraminifera over this interval are unknown.

Poor Haplophragmoides faunas between 3450 feet and 3300 feet suggests the development of paralic conditions with limited access to the sea in Middle Paleocene times. Between 3300 feet and 3200 feet a major marine transgression of Upper Paleocene age occurs. It is represented by dark shales correlated with the Rivernook member of the Dilwyn formation. The fauna suggests a slightly shallower facies than for the outcropping Rivernook memberin the Princetown area.

Following this a return to paralic conditions over the interval 3200 - 2750 feet is again evident. Sporadic Haplophragmoides spp., indicative of marsh to lagoonal conditions, are the only faunas found.

At 2700 feet a brief marine ingression is represented by a dark shale with a sparse planktonic and benthonic fauna. It is correlated with the Trochocyathus member of the Dilwyn formation. No diagnostic Paleocene foraminiferal faunas were found above this interval.

In outcrops in the Princetown area five Paleocene marine ingressions (or minor transgressive/regressive cycles) have been recognized; (i.e. Pebble Point shell bed, Rivernook member, Turritella "Bed", Trochocyathus "Bed", and Princetown member ingressions.) In Pecten-1A only two (Rivernook member and Trochocyathus member) have been recognized on faunal evidence. This suggests that the Pecten structure was elevated above the level of all but the most severe Paleocene marine ingressions.

A change from carbonaceous silts to clean sands at 2630 feet marks a basin-wide disconformity covering the Lower and Middle Eocene. In Pecten-1A the sands between 2630 feet and 2150 feet appear to be largely non-marine. Foraminiferal faunas are absent for most of the interval, and the sands are strongly limonitic and have a dolomitic cement in the upper parts. Correlates of these (Mepunga) sands in Flaxmans-1 and in outcrop at Brown's Creek are marine, and contain glauconite and a rich Upper Eocene foraminiferal fauna. Marine sedimentation in Pecten-1A was not initiated until the uppermost zone of the Eocene. Thus Pecten-1A had been above sea level earlier (in the uppermost Paleocene = "Princetown fauna" times) and had been re-covered by the sea much later (in Zonule K times), than onshore areas of the Port Campbell embayment. The time gap in this regional regressive/transgressive cycle is increased by the high structural position of Pecten.

The resumption of marine sedimentation occurs fairly abruptly with the deposition of a marly clay, correlated with the Narrawaturk Marl, in uppermost Eocene (Zonule K) times. The rich and diverse benthonic fauna of core No.1 suggests a moderately shallow environment; the lithology (bedded clayey marl), a fairly quiet depositional site disturbed only occasionally by turbulence.

At approximately 1880' a paleontological hiatus (the absence of Lower Oligocene Zonule J) was detected. This minor hiatus is the regressive/initial transgressive phase separating Nirranda group sediments from the Heytesbury group, and is developed in a number of wells in the Port Campbell embayment. This minor hiatus again reflects the high position of the Pecten structure.

Open marine, moderately deep water marl deposition resumed in Middle Oligocene (Zonule I) times. It gradually altered to limestone formation and continued without apparent break until Middle or Upper Miocene times. The Oligocene - Miocene sequence in the well was not examined in detail.

5. Note on the seafloor cores

Cores at the site penetrated up to 30' of two types of fine-grained moderately deep water limestones. No age could be confidently assigned to them, other than to say that they are probably Upper Miocene and Pliocene in age. The planktonic faunas of this stratigraphic interval are as yet little known in Victoria. Overlying these limestones was a very thin crust (1' thick) of Pleistocene beach or dune limestone, confirming a fall in Pleistocene sea level of over 200'.

REFERENCES

Ref. No. 1 Taylor, D.J. 1966: Geological Survey of Victoria, unpublished report. (to be published).

Ref. No. 2 Taylor, D.J. 1967: Geological Survey of Victoria, unpublished report. (to be published).

Ref. No. 3 Taylor, D.J. 1964: Foraminifera and the Stratigraphy of the Western Victorian Cretaceous Sediments: Proceedings of the Royal Society of Victoria, Vol.77, part 2, p.535-602.

APPENDIX IX

PALYNOLOGICAL EXAMINATION OF TERTIARY SAMPLES FROM WELL PECTEN 1A, OTWAY BASIN, AUSTRALIA

by

J. Muller, B.I.P.M., The Hague

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ENCLOSURES

1. Palynological Percentage Distribution Chart, Well Pecten 1A.
2. Lower Tertiary Correlation, Otway Basin.

PALYNOLOGICAL EXAMINATION OF TERTIARY SAMPLES FROM WELL PECTEN 1A, OTWAY BASIN, AUSTRALIA

by

J. Muller

SUMMARY

Results of a palynological examination of 11 samples from well Pecten 1A are correlated with the section described on land from the nearby Princetown area. Three correlative horizons appear to be of value for future work.

1. Introduction

Sample material available consisted of 10 sidewall samples of fair to good quality and one core. Plant microfossil content proved to be poor to fair. The majority of the 102 types distinguished could be referred to published species or genera. Nomenclature of these species is adopted mainly from HARRIS (1965). A type collection has been assembled in which 91 species are represented by one or more single grain preparations. All samples were counted and the results are presented as percentages on the accompanying distribution chart (Encl.1).

2. Discussion of Results

The microfloral succession as exhibited on the distribution chart is characterized by striking variations. Since the number of samples is rather small, it is difficult to know how far local environmental changes are responsible for these changes. However, by reference to the microfloral succession described by HARRIS (1965) from the nearby Princetown area, it proved possible to recognize three correlative horizons of probably time-stratigraphic value. In the following the succession encountered in Pecten 1A will be discussed from older to younger.

The sidewall samples at 4022' and 3695' have a similar microflora, characterized by the dominance of Po3.20 (Triorites edwardsii), Po3.21 (Triorites crassipora) and by the absence of many types which are common in the younger samples. Microplankton is present in low percentages and is composed exclusively of two species of Deflandrea. This microflora of this interval corresponds closely with the Triorites edwardsii assemblage zone of HARRIS. Its age is given by HARRIS as Middle Paleocene, but, since the lower limit of the zone has not been defined and the main marker species, Triorites edwardsii, is known to range down into the Upper Cretaceous, the possibility that the interval 3695'-4022' is wholly or partly of Cretaceous age has to be considered. The main evidence against an Upper Cretaceous age is the absence of characteristic Cretaceous microplankton species. It would therefore seem reasonable to correlate both samples with the lower part of the Wangerrip group (Pebble Point Formation and lower part of Dilwyn clay).

The sidewall sample at 3456' shows a dominance of winged Conifer grains as well as an abundance of microplankton, mainly Hystrichosphaerids. It is possible that this reflects a change in facies and the sample cannot be assigned to a zone.

The sidewall samples at 3362' and 3338' show again a markedly different microfloral composition. Po3.19 (Triorites harrisii), Po5.69 (Malvacipollis diversus), Pco.39 (Nothofagidites emarcida) and Pcs.41 (Myrtaceidites parvus) are dominant, while microplankton is absent. Both Po3.20 (Triorites edwardsii) and Pcs.60 (Duplopollis orthoteichus) are also absent and this makes the interval hard to place in HARRIS' succession. He recognizes a Triorites edwardsii - Duplopollis orthoteichus concurrent range zone, but the characteristic overlap in the range of these marker species has not been observed in Pecten 1A. However, the presence of Po5.69 (Malvacipollis diversus) and Pcs.41

(Myrtaceidites parvus) renders it more likely that the samples under discussion can be correlated with this transitional zone, rather than with the Triorites edwardsii zone. In this connection it must be emphasized that the pollen content of this interval is poor and that additional counting may very well reveal the presence of the marker species.

The sidewall samples from 3280'-2632' show continuous presence of Pcs.60 (Duplopollis orthoteichus) in addition to the regular presence of Po2.52 (Banksieidites minimus), Po3.92 (Proteacidites ornatus), Po3.61 (Proteacidites dilwynensis), Pcs.51 (Myrtaceidites tenuis), Pcs.45 (Duplopollis major). Microplankton occurs regularly and Hystrichosphaerids are dominant. This assemblage is characteristic for the Duplopollis orthoteichus assemblage zone as defined by HARRIS who considers the zone to be of Upper Paleocene age. This interval is therefore correlatable with the upper part of the Dilwyn clay above the Turritella bed (cf. HARRIS, fig.2). Of special interest is the occurrence of 2% Po3.47 (Proteacidites pachypolus) in the sample at 2632'. This species was originally taken by COOKSON (1954) as index species for "Microflora C". HARRIS, however, would limit its value for correlation to a very broad usage and indicates a range from Upper Paleocene - Upper Eocene. It is therefore striking that, both in Pecten-1A and in the land section studied by HARRIS, the species is restricted to the uppermost part of the Wangerrip group and it would appear that its base occurrence is a valuable correlative horizon of considerable time-stratigraphic significance. In fact, correlation of the sidewall sample at 2632' in Pecten 1A with the Princetown member (HARRIS' sample S 218) is fairly certain on the occurrence of Proteacidites pachypolus alone.

The core at 1892', which is assigned to the Heytesbury group, carries, as would be expected, a different flora, mainly characterized by dominance of Pco.39 (Nothofagidites emarcida), Po3.19 (Triorites harrisii) and Hystrichosphaerids. This assemblage cannot at present be assigned to a floral zone due to lack of information on the younger succession.

The resulting correlation is presented on Enclosure 2. Top Cretaceous is defined in the Princetown area by the contact between Otway group and Wangerrip group and in Pecten 1A by the contact between Curdies formation (Sherbrook group) and Wangerrip group. In the latter well top Curdies had been indicated at 3972' on geological evidence, but palynological data would suggest a slightly lower position, below 4022'. Top Triorites edwardsii zone can not, unfortunately, be accurately placed in either section because of large sample gaps. Base Duplopollis orthoteichus zone and base Proteacidites pachypolus on the other hand are well defined stratigraphically. From the correlation shown it would appear that the interval top Cretaceous - base Duplopollis orthoteichus zone is of approximately equal thickness in both sections, while the interval base Duplopollis orthoteichus zone - base Proteacidites pachypolus is much thicker in Pecten-1A than in the Princetown area.

3. Conclusion

A fair measure of agreement exists between the floral succession in the Tertiary of Pecten-1A and on land in the Princetown area. The main correlative horizons which are of value for future work are top Triorites edwardsii zone, base Duplopollis orthoteichus zone and base Proteacidites pachypolus. For more detailed studies an average sampling distance of 50' for sidewall cores is recommended.

4. References:

COOKSON, I.C., 1954 : The occurrence of an older Tertiary microflora in Western Australia.
Austr. J. Sci., 17 (1).

HARRIS, W.K., 1965 : Basal Tertiary microfloras from the Princetown area, Victoria, Australia.
Palaeontographica, B, 115.

PALYNOLOGICAL REPORT ON SHELL PECTEN 1A WELL, 4044 FEET - 9305 FEET

by

Dr. M.E. Dettmann

Text Figures

Table 1 : Preservation and zonal attribution of plant microfossil assemblages in sidewall cores of Shell Pecten 1A well, 4044 feet - 9305 feet.

Table 2 : Vertical ranges of selected spore and pollen species.

Enclosure

1. Distribution of Microflora, Lowermost Tertiary and Cretaceous, Pecten 1A.

PALYNOLOGICAL REPORT ON SHELL PECTEN 1-A WELL,

4044 FEET - 9305 FEET

by

Dr. M.E. Dettmann

The present account includes the documentation and evaluation of microfloral data obtained from sediments in Pecten 1-A well between 4044 feet and 9305 feet. From within this interval 38 sidewall cores were processed and all yielded plant matter that includes spores, pollen grains, wood, and cuticular fragments; microplankton were also extracted from several samples between 4044 feet and 5920 feet.

The microfloral yield of the individual samples is documented in Table 1, which also incorporates preservation details of the various types of plant microfossils constituting the microfloral assemblages. The quality of preservation was determined on residues which had been subjected to treatment with cold hydrofluoric acid followed by mineral separation with zinc bromide. Residues from samples at and below 7204 feet required no further treatment for the specific determination of the spore-pollen types present in the microfloras. However, residues of samples between 4044 feet and 6155 feet were given additional treatment with Schulze solution for $\frac{1}{2}$-1 hour followed by $\frac{1}{2}$% ammonium hydroxide before specific analyses were carried out.

The spore-pollen-microplankton content of all samples is documented below, and the ages of the individual assemblages are discussed. Thus, the present account incorporates data presented in a previous report (Dettmann 1967) on samples between 4044 feet and 4493 feet. As outlined below, the microfloral evidence clearly indicates that the entire section examined is of Cretaceous age, ranging from Aptian or older to Senonian and later. Moreover, several distinct microfloral assemblages are recognizable within the section, thus enabling correlation of the sediments with the spore-pollen and microplankton zones delineated by Dettmann and Playford (1968a) and Evans (1966) respectively in Cretaceous sequences of the Otway Basin and of other basins in eastern Australia.

DISCUSSION AND AGE OF MICROFLORAL ASSEMBLAGES

A. 4044 feet - 5078 feet

4044 feet

The following species of well preserved spores, pollen, and microplankton are represented in the residue:

Spores:
- *Cyathidites australis* Couper
- *C. minor* Couper
- *Camarozonosporites amplus* (Stanley)
- *C. ohaiensis* (Couper)
- *Gleicheniidites circinidites* (Cookson)
- *Kraeuselisporites pappliatus* Harris
- *Laevigatosporites ovatus* Wilson & Webster
- *L. major* (Cookson)
- *Lycopodiumsporites* sp.
- *Stereisporites antiquasporites* (Wilson & Webster)
- *S. viriosus* Dettmann & Playford

Pollen:
- *Dacrycarpites australiensis* Cookson & Pike
- *Nothofagidites senectus* Dettmann & Playford
- *Phyllocladidites mawsonii* Cookson
- *Polyporina fragilis* Harris
- *Proteacidites amolosexinus* Dettmann & Playford
- *P. cf. crassus* Cookson
- *P. subscabratus* Couper
- *Tricolpites lillei* Couper
- *T. pachyexinus* Couper
- *T. sabulosus* Dettmann & Playford
- *Triorites edwardsii* Cookson & Pike
- *aff. T. edwardsii* Cookson & Pike

Microplankton: Baltisphaeridium sp.
Epicephalopyxsis indentata Deflandre & Cookson
Hystrichosphaeridium cf. heteracanthum Deflandre & Cookson
? Trichodinium sp.
Remanié: Nuskoisporites sp. - Permian

4248 feet

Well preserved spores, pollen, and microplankton that constitute the following assemblage were extracted from the sample:

Spores: Cyathidites australis Couper
Camarozonosporites amplus (Stanley)
C. ohaiensis (Couper)
Gleicheniidites circinidites (Cookson)
Kraeuselisporites pappilatus Harris
Laevigatosporites major (Cookson)
L. ovatus Wilson & Webster
Lycopodiumsporites sp.
Ornamentifera sentosa Dettmann & Playford
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Dacrydiumites florinii Cookson & Pike
Microcachryidites antarcticus Cookson
Nothofagidites senectus Dettmann & Playford
Podocarpidites ellipticus Cookson
Podosporites microsaccatus Couper
Proteacidites amolesexinus Dettmann & Playford
P. scaboratus Couper
P. subscabratus Couper
Tricolpites pachyexinus Couper
T. sabulosus Dettmann & Playford
T. sp.
Triorites edwardsii Cookson & Pike
aff. T. edwardsii Cookson & Pike
Microplankton: Baltisphaeridium sp.
Deflandrea pellucida Cookson & Eisenack
Epicephalopyxsis indentata Deflandre & Cookson
? Odontochitina sp.
Palambages Form A Manum & Cookson

4403 feet

The following forms of well preserved spores, pollen, and microplankton were identified in the residue:

Spores: Cyathidites australis Couper
C. cf splendens Harris
Camarozonosporites ohaiensis (Couper)
Rouseisporites sp.
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Araucariacites australis Cookson
Dacrydiumites florinii Cookson & Pike
Microcachryidites antarcticus Cookson
Nothofagidites senectus Dettmann & Playford
Phyllocladidites mawsonii Cookson
Podocarpidites ellipticus Cookson
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
Tricolpites pachyexinus Couper
T. sabulosus Dettmann & Playford
Microplankton: Baltisphaeridium sp.
Remanié: Nuskoisporites sp. - Permian

4493 feet

Fair concentrations of well preserved spores, pollen, and microplankton were extracted from the sample. Species identified include:

Spores:
Cyathidites australis Couper
C. minor Couper
Ceratosporites sp.
Camarozonosporites amplus (Stanley)
C. ohaiensis (Couper)
Clavifera triplex (Bolkhovitina)
Densoisporites velatus Weyland & Kreiger
Gleicheniidites circinidites (Cookson)
Lycopodiumsporites sp.
Laevigatosporites major (Cookson)
Stereisporites antiquasporites (Wilson & Webster)
S. viriosus Dettmann & Playford

Pollen:
Dacrydiumites florinii Cookson & Pike
Microcachryidites antarcticus Cookson
Nothofagidites senectus Dettmann & Playford
Phyllocladidites mawsonii Cookson
Podocarpidites ellipticus Cookson
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
Tricolpites gillii Cookson
T. pachyexinus Couper
T. sabulosus Dettmann & Playford
T. sp.
Triorites edwardsii Cookson & Pike

Microplankton:
Deflandrea pellucida Cookson & Eisenack
D. cf. micracantha Cookson & Eisenack

Remanié:
Nuskoisporites sp. - Permian

4618 feet

The following assemblage of well preserved spores and pollen grains was extracted from the sample:

Spores:
Cyathidites australis Couper
Camarozonosporites amplus (Stanley)
C. ohaiensis (Couper)
Clavifera triplex (Bolkhovitina)
Gleicheniidites circinidites (Cookson)
Kraeuselisporites sp.
Laevigatosporites major (Cookson)
Lycopodiumsporites sp.
Neoraistrickia sp.
Stereisporites antiquasporites (Wilson & Webster)
S. viriosus Dettmann & Playford

Pollen:
Dacrydiumites florinii Cookson & Pike
Nothofagidites senectus Dettmann & Playford
Phyllocladidites mawsonii Cookson
Podocarpidites ellipticus Cookson
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
P. subscabratus Couper
Tricolpites gillii Cookson
T. pachyexinus Couper
T. sabulosus Dettmann & Playford
Triorites minor Couper

Remanié:
Nuskoisporites sp. - Permian

4685 feet

The following species of well preserved spores, pollen grains, and microplankton were extracted from the sample:

Spores:	Baculatisporites comaumensis (Cookson)
	Cyathidites australis Couper
	Camarozonosporites amplus (Stanley)
	Clavifera triplex (Bolkhovitina)
	Gleicheniidites circinidites (Cookson)
	Laevigatosporites ovatus Wilson & Webster
	Stereisporites antiquasporites (Wilson & Webster)
Pollen:	Araucariacites australis Cookson
	Classopollis cf. classoides Pflug
	Microcachryidites antarcticus Cookson
	Nothofagidites senectus Dettmann & Playford
	Phyllocladidites mawsonii Cookson
	Podocarpidites ellipticus Cookson
	Proteacidites amolosexinus Dettmann & Playford
	P. scaboratus Couper
	P. subscabratus Couper
	Tricolpites pachyexinus Couper
	T. sabulosus Dettmann & Playford
	Triorites minor Couper
Microplankton:	Xenikoon australis Cookson & Eisenack
Remanie:	Nuskoisporites sp. - Permian
	Dictyotosporites speciosus Cookson & Dettmann - Lower Cretaceous
	Murospora florida (Balme) - Lower Cretaceous

4785 feet

Well preserved spores and pollen grains identified in the sample comprise the following species:

Spores:	Baculatisporites comaumensis (Cookson)
	Cyathidites australis Couper
	Camarozonosporites amplus (Stanley)
	Gleicheniidites circinidites (Cookson)
	Laevigatosporites ovatus Wilson & Webster
	Lycopodiumsporites sp.
	Ornamentifera sentosa Dettmann & Playford
Pollen:	Araucariacites australis Cookson
	Microcachryidites antarcticus Cookson
	Nothofagidites senectus Dettmann & Playford
	Phyllocladidites mawsonii Cookson
	Podocarpidites ellipticus Cookson
	Proteacidites amolosexinus Dettmann & Playford
	P. scaboratus Couper
	P. subscabratus Couper
	Stephanoporopollenites obscurus Harris
	Tricolpites gillii Cookson
	T. pachyexinus Couper
	T. sabulosus Dettmann & Playford
Remanie:	Nuskoisporites sp. - Permian

5030 feet

The following well preserved spores, pollen grains, and microplankton were identified:

Spores:	Cyathidites australis Couper
	Camarozonosporites amplus (Stanley)
	Clavifera triplex (Bolkhovitina)
	Gleicheniidites circinidites (Cookson)
	Stereisporites viriosus Dettmann & Playford
Pollen:	Araucariacites australis Cookson
	Cycadopites nitidus (Balme)
	Microcachryidites antarcticus Cookson

Nothofagidites senectus Dettmann & Playford
Phyllocladidites mawsonii Cookson
Podosporites microsaccatus (Couper)
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
Stephanoporopollenites obscurus Harris
Tricolpites gillii Cookson
T. pannosus Dettmann & Playford
T. pachyexinus Couper
T. sabulosus Dettmann & Playford
Triorites minor Couper

Microplankton: Hystrichosphaeridium heteracanthum Deflandre & Cookson

5078 feet

Well preserved spores, pollen grains, and microplankton were extracted from the sample and constitute the following assemblage:

Spores:
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
Camarozonosporites ohaiensis (Couper)
Clavifera triplex (Bolkhovitina)
Gleicheniidites circinidites (Cookson)
Laevigatosporites major (Cookson)
L. ovatus Wilson & Webster
Ornamentifera sentosa Dettmann & Playford
Stereisporites antiquasporites (Wilson & Webster)

Pollen:
Araucariacites australis Cookson
Cycadopites nitidus (Balme)
Microcachryidites antarcticus Cookson
Phyllocladidites mawsonii Cookson
Podosporites microsaccatus (Couper)
Podocarpidites ellipticus Cookson
Proteacidites amolosexinus Dettmann & Playford
P. scaboratus Couper
P. subscabratus Couper
Tricolpites gillii Cookson
T. pachyexinus Couper
T. sabulosus Dettmann & Playford

Microplankton: Hystrichosphaeridium heteracanthum Deflandre & Cookson

Remanie:
Nuskoisporites sp. - Permian
Dictyotosporites speciosus Cookson & Dettmann - Lower Cretaceous
Murospora florida (Balme) - Lower Cretaceous

Spore-pollen assemblages extracted from samples between 4044 feet and 5078 feet in Pecten 1-A well are characterized by Nothofagidites senectus, Proteacidites amolosexinus, Tricolpites pachyexinus, T. gillii, and T. sabulosus and are conformable with the Nothofagidites Microflora of Dettmann & Playford (1968a). As outlined by these authors and in a previous report (Dettmann 1967) faunal and microfloral evidence indicates a Santonian to uppermost Cretaceous age for the Nothofagidites Microflora. Assemblages referable to the Nothofagidites Microflora occur in the nearby Flaxmans No.1 well between 4126 feet and 4714 feet; accordingly this sequence is correlated with Pecten 1-A well between 4044 feet and 5078 feet.

In both well sequences Triorites edwardsii commences its range in stratigraphically higher deposits than the first appearances of the Nothofagidites Microflora. Thus on the basis of T. Edwardsii horizons in Pecten 1-A well between 4044 feet and 4493 feet may be correlated with Flaxmans No.1 well between 4126 feet and 4316 feet. Within the latter well, the first appearance of T. edwardsii is associated with Taylor's (1964) foraminiferal Zonule A, and thus its lower age limit is within the Santonian.

Dettmann and Playford (1968a) have shown that their Nothofagidites Microflora occurs in sediments equivalent to Evans's (1966) Xenikoon australis and "Deflandrea pellucida" Zones (see Table 2). Microplankton associated with the Nothofagidites Microflora in Pecten 1-A well support this view, with Xenikoon australis represented in sediments at 4618 feet and Deflandrea pellucida and its associates occurring in deposits between 4044 feet and 4493 feet.

B. 5182 feet - 5650 feet

5182 feet

Reasonably well preserved spores and pollen grains extracted from the sample occur in minor proportions and include the following types:

Spores:
- Cyathidites australis Couper
- C. minor Couper
- Clavifera triplex (Bolkhovitina)
- Gleicheniidites circinidites (Cookson)
- Kraeuselisporites sp.
- Laevigatosporites ovatus Wilson & Webster
- Stereisporites antiquasporites (Wilson & Webster)

Pollen:
- Microcachryidites antarcticus Cookson
- Phyllocladidites mawsonii Cookson
- Podocarpidites ellipticus Cookson
- Proteacidites scaboratus Couper
- P. subscabratus Couper
- Stephanoporopollenites sp.
- Tricolpites pachyexinus Couper

5300 feet

Fairly well preserved spores, pollen grains, and microplankton were observed in the residue. The following forms were identified:

Spores:
- Balmeisporites glenelgensis Cookson & Dettmann
- Baculatisporites comaumensis (Cookson)
- Cyathidites minor Couper
- Clavifera triplex (Bolkhovitina)
- Gleicheniidites circinidites (Cookson)
- Lycopodiumsporites austroclavitidites (Cookson)
- Stereisporites antiquasporites (Wilson & Webster)

Pollen:
- Araucariacites australis Cookson
- Microcachryidites antarcticus Cookson
- Phyllocladidites mawsonii Cookson
- Podocarpidites ellipticus Cookson
- Podosporites microsaccatus (Couper)
- Proteacidites scaboratus Couper
- P. subscabratus Couper
- P. sp.
- Stephanoporopollenites obscurus Harris
- Tricolpites pachyexinus Couper
- T. sp.

Microplankton:
- Hystrichosphaeridium heteracanthum Deflandre & Cookson

5398 feet

A diverse assemblage of spores, pollen grains, and microplankton was extracted from the sample. Species present comprise:

Spores:
- Cyathidites australis Couper
- C. minor Couper
- Camarozonosporites ohaiensis (Couper)
- Clavifera triplex (Bolkhovitina)
- Cicatricosisporites sp.
- Gleicheniidites circinidites (Cookson)
- Laevigatosporites ovatus Wilson & Webster

	Ornamentifera sentosa Dettmann & Playford
	Rouseisporites sp.
	Stereisporites antiquasporites (Wilson & Webster)
Pollen:	Classopollis cf. classoides Pflug -
	Microcachryidites antarcticus Cookson
	Phyllocladidites mawsonii Cookson
	Podocarpidites cf. ellipticus Cookson
	Podosporites microsaccatus (Couper)
	Proteacidites scaboratus Couper
	P. subscabratus Couper
	Stephanoporopollenites obscurus Harris
	Tricolpites pachyexinus Couper
	T. pannosus Dettmann & Playford
	Triorites minor Couper
Microplankton:	Deflandrea sp.
	Hystrichosphaeridium heteracanthum Deflandre & Cookson

5650 feet

A sparse assemblage comprising the following species of spores, pollen grains, and microplankton was extracted from the sample:

Spores:	Cyathidites australis Couper
	Camarozonosporites amplus (Stanley)
	Gleicheniidites circinidites (Cookson)
	Kraeuselisporites sp.
	Stereisporites antiquasporites (Wilson & Webster)
Pollen:	Microcachryidites antarcticus Cookson
	Proteacidites scaboratus Couper
	Tricolpites pachyexinus Couper
Microplankton:	Deflandrea victoriensis Cookson & Manum
	Hexagonifera vermiculata Cookson & Eisenack
	Hystrichosphaeridium heteracanthum Deflandre & Cookson
	Odontochitina sp.

Deposits between 5182 feet and 5650 feet in Pecten 1-A well are assigned to the Tricolpites pachyexinus Zone of Dettmann and Playford (1968a). This zone is characterized at the base by the incoming of Tricolpites pachyexinus, Proteacidites scaboratus, and Camarozonosporites amplus and its upper limit is marked by the introduction of elements diagnostic of the Nothofagidites Microflora. The age of the zone is within the Senonian, since at the type section its base approximates to the base of Taylor's (1964) Zonule A and its upper limit is within the same zonule (Dettmann & Playford 1968a, b). The zone occurs in Flaxmans No.1 well between 4974 feet and 5970 feet and in Port Campbell No.2 well between 5340 feet and 5919 feet. These sequences may thus be correlated with Pecten 1-A well between 5182 feet and 5650 feet.

The Tricolpites pachyexinus Zone includes the Deflandrea cretacea and Nelsoniella aceras microplankton Zones of Evans (1966; - see Table 2 this report). Although the indices of Evan's zones were not recovered from Pecten 1-A well, the occurrence of Hexagonifera vermiculata and Deflandrea victoriensis (at 5650 feet) is significant, since both species are concomitant with the bases of the Tricolpites pachyexinus and Deflandrea cretacea Zones and complete their ranges at the base of the Nelsoniella aceras Zone (Dettmann and Playford 1968a, Evans 1966).

C. 5735 feet - 5827 feet

5735 feet

The following species of imperfectly preserved spores, pollen, and microplankton were extracted from the sample:

Spores:	Arcellites hexapartitus (Dijkstra)
	Appendicisporites distocarinatus Dettmann & Playford
	Baculatisporites comaumensis (Cookson)
	Balmeisporites glenelgensis Cookson & Dettmann
	Ceratosporites sp.
	Cicatricosisporites sp.
	Cyathidites australis Couper
	C. minor Couper
	Gleicheniidites cf. circinidites (Cookson)
	Kraeuselisporites jubatus Dettmann & Playford
	Laevigatosporites ovatus Wilson & Webster
	Lycopodiumsporites sp.
	Stercisporites antiquasporites (Wilson & Webster)
Pollen:	Araucariacites australis Cookson
	Microcachryidites antarcticus Cookson
	Phyllocladidites mawsonii Cookson
	Podocarpidites cf. ellipticus Cookson
	Stephanoporopollenites obscurus Harris
	Tricolpites pannosus Dettmann & Playford
	Triorites minor Couper
Microplankton:	Hystrichosphaeridium complex (White)
	H. heteracanthum Deflandre & Cookson

5827 feet

Spores, pollen grains, and microplankton extracted from the sample include the following reasonably preserved forms:

Spores:	Appendicisporites distocarinatus Dettmann & Playford
	Baculatisporites comaumensis (Cookson)
	Balmeisporites glenelgensis Cookson & Dettmann
	Cyathidites australis Couper
	C. minor Couper
	Gleicheniidites cf. circinidites (Cookson)
	Laevigatosporites major (Cookson)
	L. ovatus Wilson & Webster
	Stereisporites antiquasporites (Wilson & Webster)
Pollen:	Araucariacites australis Cookson
	Alisporites grandis (Cookson)
	Cycadopites nitidus (Balme)
	Microcachryidites antarcticus Cookson
	Podocarpidites cf. ellipticus Cookson
	Tricolpites pannosus Dettmann & Playford
Microplankton:	Gonyaulax sp.
	Hystrichosphaeridium cf. heteracanthum Deflandre & Cookson
	Odontochitina operculata Deflandre

The presence of Phyllocladidites mawsonii together with Appendicisporites distocarinatus would suggest assignment of the horizon at 5735 feet in Pecten 1-A well to the basal portion of the Clavifera triplex Zone or possibly to the upper part of the underlying Appendicisporites distocarinatus Zone. As defined by Dettmann and Playford (1968a), the former zone immediately underlies the Tricolpites pachyexinus Zone and is characterized at the base by the incoming of Clavifera triplex and Phyllocladidites mawsonii. The C. triplex Zone has been recognized in Flaxmans No.1 well between 6375 feet and 6636 feet and in Port Campbell No.2 well between 7093 feet and 7904 feet, and these sequences may be in part equivalent to the horizon at 5735 feet in Pecten 1-A well. In the former wells the C. triplex Zone includes horizons of Taylor's (1964) Zonule B and deposits immediately below this zonule. Thus the zone is dated as Turonian with possible extensions into the Cenomanian and Senonian. The C. triplex Zone incorporates upper horizons of Evans's (1966) Ascodinium parvum

Zone and the succeeding "unclassified gap" (see Table 2).

The deposit at 5827 feet in Pecten 1-A well yielded Appendicisporites distocarinatus and apparently lacks diagnostic elements of the Clavifera triplex Zone. Thus, the horizon is assigned to the Appendicisporites distocarinatus Zone, the age of which is considered on microfloral evidence to be Upper Albian - ?Cenomanian/Turonian (Dettmann and Playford 1968a). The zone occurs in Flaxmans No.1 well between 6832 feet and 6902 feet and in Port Campbell No.2 well between 8096 feet and 8418 feet; and is within Evans's (1966) Ascodinium parvum Zone (see Table 2) of which Odontochitina operculata is a component.

D. 5920 feet

Abundant spores and pollen grains and rare microplankton occur in the sample from 5920 feet. Species present include:

Spores:	Aequitriradites spinulosus (Cookson & Dettmann)
	Appendicisporites distocarinatus Dettmann & Playford
	Cyathidites australis Couper
	C. minor Couper
	Cicatricosisporites australiensis (Cookson)
	C. cuneiformis Pocock
	Crybelosporites striatus (Cookson & Dettmann)
	Coptospora paradoxa (Cookson & Dettmann)
	Foraminisporis asymmetricus (Cookson & Dettmann)
	F. dailyi (Cookson & Dettmann)
	Gleicheniidites cf. circinidites (Cookson)
	Kraeuselisporites jubatus Dettmann & Playford
	Leptolepidites verrucatus Couper -
	Lycopodiumsporites circolumenus Cookson & Dettmann
	L. sp.
	Rouseisporites reticulatus Pocock
	Stereisporites antiquasporites (Wilson & Webster)
Pollen:	Alisporites grandis (Cookson)
	Araucariacites australis Cookson
	Cycadopites nitidus (Balme)
	Classopollis cf. classoides Pflug
	Podosporites microsaccatus (Couper)
	Tricolpites pannosus Dettmann & Playford
Microplankton:	Ascodinium parvum (Cookson & Eisenack)

The association of Coptospora paradoxa and Tricolpites pannosus clearly demonstrates that the sediment at 5920 feet in Pecten 1-A well belongs to the Tricolpites pannosus Zone which Dettmann and Playford have shown to be of Upper Albian - ?Cenomanian age. The zone has been recognized in Port Campbell No.2 well between 8556 feet and 8624 feet but has not been certainly identified in Flaxmans No.1 well. It is however, widely distributed in the Otway Basin, being present for example in Eumeralla No.1 well at 3311-21 feet and Timboon No.5 bore at 3500-04 feet. (see Dettmann 1963a, 1964a).

The Tricolpites pannosus Zone includes (see Table 2) upper horizons of the Odontochitina operculata Zone and the lowest portion of the Ascodinium parvum Zone (Evans 1966). It is noteworthy, therefore, that Pecten 1-A well at 5920 feet yielded Ascodinium parvum, the index of the latter microplankton zone.

E. 5977 feet - 7920 feet

5977 feet

The following imperfectly preserved spores and pollen grains were extracted from the sample:

Spores:
- Aequitriradites spinulosus (Cookson & Dettmann)
- Baculatisporites comaumensis (Cookson)
- Cyathidites australis Couper
- C. minor Couper
- Coptospora paradoxa (Cookson & Dettmann)
- Crybelosporites striatus (Cookson & Dettmann)
- Laevigatosporites ovatus Wilson & Webster
- Rouseisporites reticulatus Pocock
- Stereisporites antiquasporites (Wilson & Webster)
- Trilites cf. tuberculiformis Cookson

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

6013 feet

Abundant, fair-poorly preserved spores and pollen grains were recovered from the sample. Species identified comprise:

Spores:
- Appendicisporites distocarinatus Dettmann & Playford
- Baculatisporites comaumensis (Cookson)
- Cyathidites australis Couper
- C. minor Couper
- C. punctatus (Delcourt & Sprumont)
- Cicatricosisporites hughesi Dettmann
- Contignisporites glebulentus Dettmann
- Crybelosporites striatus (Cookson & Dettmann)
- Gleicheniidites cf. circinidites (Cookson)
- Kraeuselisporites jubatus Dettmann & Playford
- Kuylisporites sp.
- Lycopodiumsporites austroclavatidites (Cookson)
- L. eminulus Dettmann
- Stereisporites antiquasporites (Wilson & Webster)
- Trilites cf. tuberculiformis Cookson

Pollen:
- Alisporites grandis (Cookson)
- Araucariacites australis Cookson
- Classopollis cf. classoides Pflug
- Microcachryidites antarcticus Cookson
- Podosporites microsaccatus (Couper)
- Velosporites triquetrus (Lantz)

6155 feet

The sample yielded a sparse assemblage of imperfectly preserved spores and pollen grains. Species identified include:

Spores:
- Aequitriradites spinulosus (Cookson & Dettmann)
- Baculatisporites comaumensis (Cookson)
- Ceratosporites equalis Cookson & Dettmann
- Cyathidites australis Couper
- C. minor Couper
- Coptospora paradoxa (Cookson & Dettmann)
- Gleicheniidites cf. circinidites (Cookson)
- Stereisporites antiquasporites (Wilson & Webster)

Pollen:
- Alisporites grandis (Cookson)
- Araucariacites australis Cookson
- Classopollis cf. classoides Pflug
- Cycadopites nitidus (Balme)
- Microcachryidites antarcticus Cookson

Remanie: Nuskoisporites sp. - Permian

7204 feet

The sparse assemblage identified in the residue is composed of the following forms:

Spores:
Cyathidites australis Couper
Cicatricosisporites australiensis (Cookson)
C. hughesi Dettmann
Crybelosporites striatus (Cookson & Dettmann)
Leptolepidites verrucatus Couper
Stereisporites antiquasporites (Wilson & Webster)

Pollen:
Alisporites grandis (Cookson)
Araucariacites australis Cookson

7276 feet

The following assemblage of poorly-fairly preserved spores and pollen grains was extracted from the sample:

Spores:
Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
Cicatricosisporites australiensis (Cookson)
C. hughesi Dettmann
Coptospora paradoxa (Cookson & Dettmann)
Gleicheniidites cf. circinidites (Cookson)
Klukisporites scaberis (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)

Pollen:
Alisporites grandis (Cookson)
Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

7399 feet

The microflora of the sample includes the following poorly preserved forms:

Spores:
Aequitriradites spinulosus (Cookson & Dettmann)
Cyathidites australis Couper
C. minor Couper
Cicatricosisporites australiensis (Cookson)
C. hughesi Dettmann
Coptospora paradoxa (Cookson & Dettmann)
Crybelosporites striatus (Cookson & Dettmann)
Foraminisporis asymmetricus (Cookson & Dettmann)
Kraeuselisporites majus (Cookson & Dettmann)
Laevigatosporites ovatus Wilson & Webster
Lycopodiumsporites austroclavatidites (Cookson)
Rouseisporites reticulatus Pocock

Pollen:
Araucariacites australis Cookson
Microcachryidites antarcticus Cookson

7490 feet

A sparse assemblage of poorly preserved spores and pollen grains was recovered from the sample. Species identified include:

Spores:
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. punctatus (Delcourt & Sprumont)
Cicatricosisporites australiensis (Cookson)
Contignisporites sp.
Crybelosporites striatus (Cookson & Dettmann)
Klukisporites scaberis (Cookson & Dettmann)
Leptolepidites major Couper
Lycopodiumsporites sp.
Rouseisporites sp.
Stereisporites antiquasporites (Wilson & Webster)

Pollen:
Alisporites grandis (Cookson)
Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson

7552 feet

The following sparse assemblage of poorly preserved spores and pollen grains was obtained from the sample:

Spores:
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
Ceratosporites equalis Cookson & Dettmann
Cicatricosisporites australiensis (Cookson)
Klukisporites scaberis (Cookson & Dettmann)

Pollen:
Alisporites grandis (Cookson)
Araucariacites australis Cookson
Microcachryidites antarcticus Cookson

7715 feet

Poorly preserved spores and pollen grains comprising the following assemblage were extracted from the sample:

Spores:
Acquitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
Cicatricosisporites australiensis (Cookson)
Klukisporites scaberis (Cookson & Dettmann)
Stereisporites antiquasporites (Wilson & Webster)

Pollen:
Alisporites similis (Balme)
Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Podocarpidites cf. ellipticus Cookson

7920 feet

A diverse assemblage of poorly preserved spores and pollen grains occurs in the sediment. Forms identified comprise:

Spores:
Aequitriradites spinulosus (Cookson & Dettmann)
Balmeisporites holodictyus Cookson & Dettmann
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. punctatus (Delcourt & Sprumont)
Cicatricosisporites australiensis (Cookson)
C. hughesi Dettmann
Coptospora paradoxa (Cookson & Dettmann)
Crybelosporites striatus (Cookson & Dettmann)
Foraminisporis asymmetricus (Cookson & Dettmann)
F. dailyi (Cookson & Dettmann)
Lycopodiumsporites sp.

Neoraistrickia truncata (Cookson)
Pilosisporites grandis Dettmann
Rouseisporites reticulatus Pocock
R. sp.
Stereisporites antiquasporites (Wilson & Webster)
Trilobosporites trioreticulosus Cookson & Dettmann

Pollen:
Araucariacites australis Cookson
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

Samples between 5977 feet and 7920 feet in Pecten 1-A well yielded assemblages containing Coptospora paradoxa in association with Trilobosporites trioreticulosus, Pilosisporites grandis, Kraeuselisporites majus, and Cicatricosisporites hughesi; tricolpate and triporate angiospermous grains are entirely lacking. Thus the sediments may be equated to the Upper Aptian - Upper Albian Coptospora paradoxa Zone of Dettmann and Playford (1968a). This zone has wide distribution in the Otway Basin and has been recognized in for example, Flaxmans No.1 well between 7200 feet and 9135 feet (cf. Dettmann 1964b) and in Penola No.1 well between 1200 and 2798 feet (Dettmann 1963b).

F. 8120 feet - 9132 feet

8120 feet

A sparse microflora composed of the following poorly preserved spores and pollen grains was extracted from the sample:

Spores:
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
Cicatricosisporites australiensis (Cookson)
Crybelosporites striatus (Cookson & Dettmann)
Lycopodiumsporites sp.
Rouseisporites sp.
Stereisporites antiquasporites (Wilson & Webster)

Pollen:
Alisporites grandis (Cookson)
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

8206 feet

The following poorly preserved species of spores and pollen grains were observed in the sample:

Spores:
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
Cicatricosisporites australiensis (Cookson)
Crybelosporites striatus (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)
L. sp.

Pollen:
Alisporites grandis (Cookson)
Araucariacites australis Cookson
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson

8333 feet

The sample yielded a poorly preserved microflora. Species identified include:

Spores:
Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
C. punctatus (Delcourt & Sprumont)
Cicatricosisporites australiensis (Cookson)

C. ludbrooki Dettmann
Crybelosporites striatus (Cookson & Dettmann)
Foraminisporis asymmetricus (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)
Rouseisporites reticulatus Pocock

Pollen:
Microcachryidites antarcticus Cookson
Podosporites microsaccatus (Couper)
Podocarpidites cf. ellipticus Cookson

8546 feet

Poorly preserved spores and pollen grains observed in the residue include the following forms:

Spores:
Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
C. punctatus (Delcourt & Sprumont)
Crybelosporites striatus (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)
Osmundacidites wellmanii Couper
Pilosisporites notensis Cookson & Dettmann
Stereisporites antiquasporites (Wilson & Webster)

Pollen:
Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

8630 feet

The sample yielded good concentrations of poorly preserved spores and pollen grains. Forms identified comprise:

Spores:
Balmeisporites holodictyus Cookson & Dettmann
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. punctatus (Delcourt & Sprumont)
Cicatricosisporites australiensis (Cookson)
Crybelosporites striatus (Cookson & Dettmann)
Foraminisporis asymmetricus (Cookson & Dettmann)
F. wonthaggiensis (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)
L. eminulus Dettmann
Rouseisporites sp.
Stereisporites antiquasporites (Wilson & Webster)

Pollen:
Alisporites grandis (Cookson)
Araucariacites australis Cookson
Microcachryidites antarcticus Cookson
Velosporites triquetrus (Lantz)

8670 feet

Poorly preserved spores and pollen grains extracted from the sample constitute the following microflora:

Spores:
Aequitriradites spinulosus (Cookson & Dettmann)
A. verrucosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Balmeisporites holodictyus Cookson & Dettmann
Cyathidites australis Couper
C. punctatus (Delcourt & Sprumont)
Foraminisporis wonthaggiensis (Cookson & Dettmann)
Rouseisporites reticulatus Pocock
R. sp.
Stereisporites antiquasporites (Wilson & Webster)

Pollen:
Araucariacites australis Cookson

Remanie:
Nuskoisporites sp. - Permian

8743 feet

An extremely sparse assemblage of spores and pollen grains was obtained from the sample. The following forms were identified:

Spores: Cyathidites minor Couper
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Podocarpidites cf. ellipticus Cookson

8873 feet

This sample yielded only a few fragmented and badly preserved spores and pollen grains. Forms identified include:

Spores: Cyathidites australis Couper
Lycopodiumsporites sp.
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Podocarpidites cf. ellipticus Cookson

8962 feet

Fragmented spores and pollen grains identified in the residue include the following forms:

Spores: Baculatisporites comaumensis (Cookson)
Balmeisporites sp.
Cyathidites australis Couper
C. minor Couper
Leptolepidites major Couper
Lycopodiumsporites sp.
Pollen: Podocarpidites cf. ellipticus Cookson

9132 feet

The sample provided a high yield of plant material that includes minor proportions of identifiable spore and pollen remnants. The following forms were identified:

Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
Crybelosporites striatus (Cookson & Dettmann)
?Dictyotosporites speciosus Cookson & Dettmann
Foraminisporis asymmetricus (Cookson & Dettmann)
Kraeuselisporites sp.
Stereisporites antiquasporites (Wilson & Webster)
Pollen: Microcachryidites antarcticus Cookson
Podocarpidites cf. ellipticus Cookson

Samples between 8120 feet and 9132 feet yielded poorly or badly preserved microfloral assemblages in which only a minor proportion of forms are identifiable at specific or generic level. Forms identified include Crybelosporites striatus and Pilosisporites notensis thus demonstrating the presence of the Coptospora paradoxa Zone or the Crybelosporites striatus Subzone of the Dictyotosporites speciosus Zone. Assignment to either of these zones is precluded by the apparent absence of identifiable Coptospora paradoxa and Dictyotosporites speciosus, although a single fragmentary specimen was doubtfully assigned to D. speciosus in the sample at 9132 feet. Nevertheless, the presence of Crybelosporites striatus in Pecten 1-A well between 8120 feet and 9132 feet indicates that the sediments are no older than the Upper Aptian (Dettmann and Playford 1968a) and suggest correlation with at least part of the section between 7200 feet and 11517 feet in Flaxmans No.1 well (see Dettmann 1964b).

G. 9210 feet - 9305 feet

9210 feet

Badly preserved fragments of spores and pollen grains were extracted from the sample. The following forms were identified:

Spores:
- Aequitriradites spinulosus (Cookson & Dettmann)
- Baculatisporites comaumensis (Cookson)
- Cicatricosisporites australiensis (Cookson)
- Klukisporites scaberis (Cookson & Dettmann)
- Leptolepidites verrucatus Couper
- Lycopodiumsporites austroclavatidites (Cookson)
- L. sp.
- Stereisporites antiquasporites (Wilson & Webster)

Pollen:
- Podocarpidites cf. ellipticus Cookson

9305 feet

Rare, badly preserved fragmentary remnants of the following spore and pollen forms were observed:

Spores:
- Cyathidites australis Couper
- Cicatricosisporites australiensis (Cookson)
- Lycopodiumsporites sp.

Sediments at 9210 feet and 9305 feet in Pecten 1-A well yielded badly preserved spore-pollen remnants, few of which are specifically or generically identifiable. Stratigraphically significant species include Aequitriradites spinulosus and Cicatricosisporites australiensis which demonstrate a Lower Cretaceous or, at the oldest an uppermost Jurassic age.

CONCLUSIONS

Sediments between 4044 feet and 7920 feet in Pecten 1-A well range in age from Lower Cretaceous (Upper Aptian - Albian) to uppermost Cretaceous (Senonian and later) on the basis of spore-pollen assemblages diagnostic of the following biostratigraphic units delineated by Dettmann and Playford (1968a):- the Nothofagidites Microflora; the Tricolpites pachyexinus Zone; the Clavifera triplex Zone; the Appendicisporites distocarinatus Zone; the Tricolpites pannosus Zone; and the Coptospora paradoxa Zone. Sediments at and below 8120 feet are of Lower Cretaceous age (Upper Aptian or older) but contain insufficient representation of identifiable species for their assignment to the spore-pollen zones of Dettmann and Playford (1968a).

Microplankton were obtained from the majority of samples investigated between 4044 feet and 5920 feet, and their presence indicates marine influences during late Albian and Upper Cretaceous times. The stratigraphical distribution of the suites identified within the section supports the age determinations based upon spore-pollen criteria and conforms with the microplankton zonal scheme delineated by Evans (1966).

Remanié spores and pollen of Permian age occur spasmodically throughout the entire section investigated; those of Lower Cretaceous age were observed in late Cretaceous sediments between 4685 feet and 5078 feet.

Exceptionally well preserved plant material was extracted from the youngest Upper Cretaceous horizons investigated, and the remainder of the Upper Cretaceous sequence yielded reasonably preserved microfloral assemblages. The Lower Cretaceous section, however, provided plant material which is less well preserved, ranging from fair to poor in the upper part of the section to extremely bad and fragmented in the lowest intervals.

REFERENCES

Dettmann, M.E. 1963a. Palynological report on non-marine Lower Cretaceous sediments intersected in F.B.H. Eumeralla No.1 and F.B.H. Pretty Hill No.1 wells. Unpubl. report submitted to Frome-Broken Hill Co. Pty. Ltd. 14/11/63.

Dettmann, M.E. 1963b. Upper Mesozoic microfloras from south-eastern Australia. Proc. Roy. Soc. Vict., 77, 1-148.

Dettmann, M.E. 1964a. Palynological report on core samples from Timboon No.5 bore. Unpubl. report submitted to Frome-Broken Hill Co. Pty. Ltd. 24/4/64.

Dettmann, M.E. 1964b. Palynological report on Cretaceous core samples from F.B.H. Flaxmans No.1 well. Unpubl. report submitted to Frome-Broken Hill Co. Pty. Ltd., 7/4/64.

Dettmann, M.E. 1967. Preliminary palynological report on Shell Pecten 1-A well. Unpubl. report submitted to Shell Development (Australia) Pty. Ltd., 27/6/67.

Dettmann, M.E. and Playford, G. 1968a. Palynology of the Australian Cretaceous - a review. A.N.U. Press, Canberra (in press).

Dettmann, M.E. and Playford, G. 1968b. Taxonomy of some Cretaceous spores and pollen grains from eastern Australia. Proc. Roy. Soc. Vict. (in press).

Evans, P.R. 1966. Mesozoic stratigraphic palynology of the Otway Basin. Rec. Bur. Min. Resour. Geol. Geophys. Aust. 1966/69 (unpubl.)

Taylor, D.J. 1964. Foraminifera and the stratigraphy of the western Victorian Cretaceous sediments. Proc. Roy. Soc. Vict. 77, 535-603.

30th August, 1967.

Mary E. Dettmann,
Department of Geology,
University of Queensland,
St. Lucia, Queensland.

EXPLANATION OF TABLE 1

Preservation and zonal attribution of plant microfossil assemblages in sidewall cores of Shell Pecten 1-A well, 4044 feet - 9305 feet.

Abbreviations:

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

A = abundant
C = common
S = sparse
B = barren

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

Y = yellow
Br = brown
Bl = black
Exc. = morphological details perfectly preserved
Good = morphological details well preserved
Fair = morphological details imperfectly preserved
Poor = morphological features poorly preserved
Bad = morphological features rarely determinable
Frag = microfossils fragmentary

Spore - Pollen Zones are those defined by Dettmann and Playford (1968a). Diagnostic features of the zones are given in the text and on Table 2.

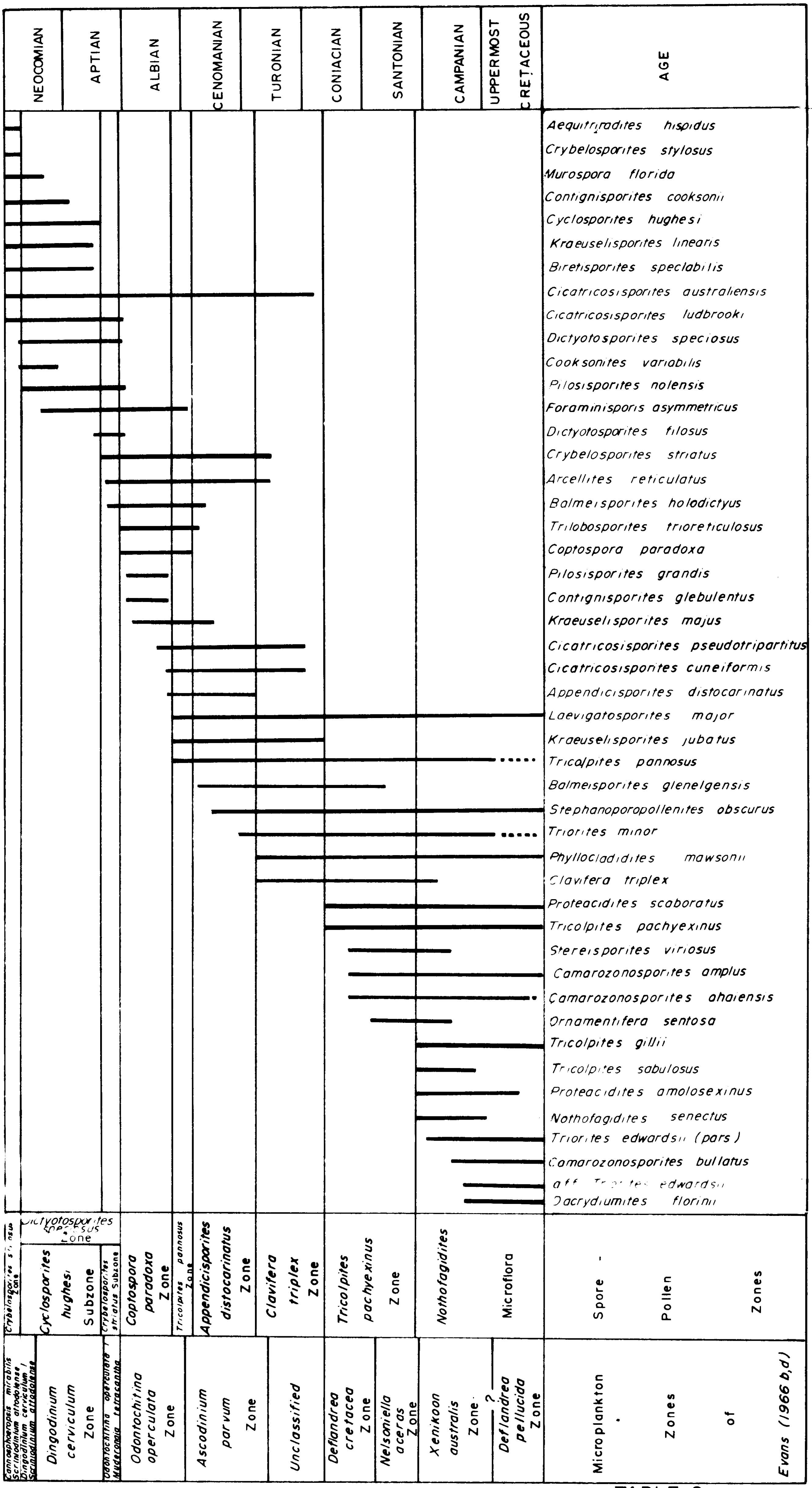
EXPLANATION OF TABLE 2

Vertical ranges of selected spore and pollen species within the zonal scheme defined by Dettmann and Playford (1968a) and with reference to the microplankton zones defined by Evans (1966). (Table taken from Dettmann and Playford 1968a).

Depth (feet)	Yield	Spore-Pollen		Microplankton		Wood		Cuticle		Spore-Pollen Zone
		Col.	Pres.	Col.	Pres.	Col.	Pres.	Col.	Pres.	
3618	A	"	good	Y	good	Br	fair	"	good	*Tricolporites edwardsi* Lowermost Tertiary – Uppermost Cretaceous
3695	S	"	"	"	"	"	"	"	"	
3735	C	"	"	"	"	"	"	"	"	
3797	A	"	"	"	"	"	"	"	"	
3833	A	"	"	"	"	"	"	"	"	
3908	A	"	"	"	"	"	"	"	"	*Nothofagidites*
4044	C	"	"	"	"	"	"	"	"	
4248	"	"	"	"	"	"	"	Y-Br	fair	
4403	"	"	good - fair	"	"	Br - Bl	"	"	"	
4493	"	"	"	"	"	"	"	"	"	
4618	"	"	"	–	"	"	"	"	"	
4685	"	"	"	Y	good - fair	"	"	"	"	
4785	"	Y-Br	fair	-	-	"	fair - poor	Br	fair - poor	
5030	"	"	"	Y	fair	"	"	Y - Br	"	
5078	"	"	"	"	"	"	"	"	"	
5182	S	"	"	-	-	"	"	"	"	*Tricolpites pachyexinus*
5300	"	"	"	Y	fair	"	"	"	"	
5398	C	"	"	"	"	"	"	"	"	
5650	S	"	"	"	"	"	"	"	"	
5735	"	"	fair - poor	"	"	"	"	"	"	*Clavifera triplex*
5827	"	"	fair	"	"	"	"	"	"	*Appendicisporites distocarinatus*
5920	C	"	fair - poor	"	"	"	"	"	"	*Tricolpites pannosus*
5977	"	"	"	-	-	"	"	"	poor	*Coptospora paradoxa*
6013	A	"	"	-	-	"	"	"	"	
6155	S	"	"	-	-	"	poor	"	"	
7204	"	"	"	-	-	"	"	"	fair - poor	
7276	C	"	"	-	-	"	"	"	"	
7399	"	"	poor	-	-	"	"	"	poor	
7490	S	Br	"	-	-	"	"	"	"	
7552	"	"	"	-	-	"	"	"	"	
7715	"	"	fair - poor	-	-	"	"	Br	"	
7920	A	"	poor	-	-	"	"	"	"	
8120	S	"	"	-	-	"	"	"	"	*Coptospora paradoxa* or *Crybelosporites striatus*
8206	C	"	"	-	-	"	"	"	"	
8333	"	"	"	-	-	"	"	"	"	
8546	"	"	"	-	-	Bl	"	"	"	
8630	A	"	"	-	-	"	"	"	bad	
8670	C	"	"	-	-	"	"	"	"	
8743	S	"	bad	-	-	"	bad	"	"	
8873	"	"	bad - frag	-	-	"	"	"	"	
8962	"	"	"	-	-	"	"			
9132	C	"	"	-	-	"	"	"	"	
9210	"	"	"	-	-	"	"	"	"	*Lower Cretaceous, ...der*
9305	S	"	"	-	-	"	"	"	"	

Drawing No 2034

TABLE I



Drawing No 2033

TABLE 2

PALYNOLOGICAL REPORT ON SHELL PECTEN 1A WELL, 3735 FEET AND 3908 FEET

by

Dr. M.E. Dettmann

In an attempt to locate the Cretaceous/Tertiary boundary in Shell Pecten 1A well, two samples were submitted by Shell Development (Australia) Pty. Ltd. from 3735 feet and 3908 feet. In a previous study Dettmann (1967a,b) indicated that samples between 4044 feet and 9305 feet are of Cretaceous age, ranging from the Lower Cretaceous (Upper Aptian or older) to the Upper Cretaceous (Senonian and later).

The samples investigated in the present study were processed according to the method outlined by Dettmann (1967b); i.e. they were first treated with cold hydrofluoric acid followed by mineral separation using zinc bromide. The residues were then examined and the preservation details of the contained microfossils recorded (Table 1). Specific analysis of the spores, pollen grains, and microplankton contained in the samples was carried out after the residues were subjected to additional treatment with Schulze solution for $\frac{1}{2}$ hour, followed by brief immersion in $\frac{1}{2}$% ammonium hydroxide.

Both samples yielded fair to good concentrations of well preserved spore-pollen-microplankton suites. As discussed below, the sample from 3908 feet is of uppermost Cretaceous age (Senonian or later) and that from 3735 feet is of latest Cretaceous or earliest Tertiary age.

MICROFLORAL CONTENT AND AGE OF SAMPLES

3735 feet

The following well preserved spores, pollen grains, and microplankton occur in the sediment:

Spores:	Cyathidites minor Couper
	Camarozonosporites amplus (Stanley)
	C. sp.
	Gleicheniidites circinidites (Cookson)
	Kraeuselisporites pappilatus Harris
	Stereisporites antiquasporites (Wilson & Webster)
Pollen:	Dacrydiumites balmei Cookson
	D. florinii Cookson & Pike
	Dilwynites tuberculatus Harris
	Liliacidites sp.
	Nothofagidites emarcidus (Cookson)
	N. senectus Dettmann & Playford
	Phyllocladidites mawsonii Cookson
	Podocarpidites ellipticus Cookson
	P. exiguus Harris
	Proteacidites cf. adenanthoides Cookson
	P. parvus Cookson
	P. cf. rectomarginus Cookson
	P. reticuloscabratus Harris
	P. subscabratus Couper
	P. scaboratus Couper
	Tricolpites gillii Cookson
	T. lillei Couper
	Triorites edwardsii Cookson & Pike
	aff. T. edwardsii
Microplankton:	Deflandrea bakeri Deflandre & Cookson
	D. pellucida Cookson & Eisenack
	Epicephalopyxis indentata Deflandre & Cookson
Remanié:	Aequitriradites spinulosus - Lower Cretaceous
	Nuskoisporites sp, - Permian

The spore-pollen suite shows certain characteristics of Dettmann and Playford's (1968) Senonian and later Nothofagidites Microflora and of Harris's (1965) Middle Paleocene Triorites edwardsii Assemblage. The presence of Nothofagidites senectus together with a single specimen of Tricolpites lillei is suggestive of a late Cretaceous age. However, several forms which are hitherto known as typically Tertiary in origin are also represented in the sample; these include Dacrydiumites balmei, Dilwynites tuberculatus, and the proteaceous types referred to Proteacidites parvus, P. reticuloscabratus, and P. cf. rectomarginus.

The microplankton suite includes Deflandrea pellucida which ranges from uppermost Cretaceous to Lower Tertiary (Evans 1966) and D. bakeri which is thought to be indicative of a Tertiary age.

Collectively, therefore, the microfloral evidence favours a lowermost Tertiary age, or possibly a horizon within the uppermost Cretaceous.

3908 feet

The well preserved microflora obtained from the sample includes abundant spores and pollen grains and rare microplankton. Species identified include:

Spores:	Cyathidites minor Couper
	C. splendens Harris
	Camarozonosporites amplus (Stanley)
	C. bullatus Harris
	Gleicheniidites circinidites (Cookson)
	Laevigatosporites major (Cookson)
	L. ovatus Wilson & Webster
	Lycopodiumsporites austroclavatidites (Cookson)
	Stereisporites antiquasporites (Wilson & Webster)
Pollen:	Cycadopites sp.
	Dacrydiumites florinii Cookson & Pike
	Microcachryidites antarcticus Cookson
	Nothofagidites senectus Dettmann & Playford
	Phyllocladidites mawsonii Cookson
	Polyporina fragilis Harris
	Podosporites microsaccatus (Couper)
	Podocarpidites exiguus Harris
	P. ellipticus Cookson
	Proteacidites amolosexinus Dettmann & Playford
	P. cf. adenanthoides Cookson
	P. scaboratus Couper
	P. subscabratus Couper
	Tricolpites gillii Cookson
	T. lillei Couper
	T. pachyexinus Couper
	T. sabulosus Dettmann & Playford
	Triorites edwardsii Cookson & Pike
	aff. T. edwardsii
Microplankton:	Deflandrea sp.
	cf. Eisenackia sp.
	Trichodinium sp.
Remanié:	Nuskoisporites sp. - Permian

The sample yielded a spore-pollen assemblage conformable with the Nothofagidites Microflora and is thus considered to be of uppermost Cretaceous age. The rare microplankton recovered appear to be undescribed forms.

REFERENCES

Dettmann, M.E. 1967a. Preliminary palynological report on Shell Pecten 1-A well. Unpubl. report submitted to Shell Development (Australia) Pty. Ltd. 27/6/67.

Dettmann, M.E. 1967b. Palynological report on Shell Pecten 1-A well, 4044 feet - 9305 feet. Unpubl. report submitted to Shell Development (Australia) Pty. Ltd. 30/8/67.

Dettmann, M.E. and Playford, G. 1968. Palynology of the Australian Cretaceous - a review. A.N.U. Press, Canberra (in press).

Evans, P.R. 1966. Mesozoic stratigraphic palynology of the Otway Basin. Rec. Bur. Min. Resour. Geol. Geophys. Aust. 1966/69 (unpubl.).

Harris, W.K. 1965. Basal Tertiary microfloras from the Princetown area, Victoria, Australia. Palaeontographica 115B, 75-106.

4th September, 1967.

Mary E. Dettmann,
Department of Geology,
University of Queensland,
St. Lucia, Queensland.

PALYNOLOGICAL REPORT ON PECTEN 1A WELL,

3618 FEET - 3833 FEET

by

Dr. M.E. Dettmann

In a further attempt to locate the Cretaceous/Tertiary boundary in Shell Pecten 1A well, five samples of sidewall cores from between 3618 feet and 3833 feet were submitted by Shell Development (Australia) Pty. Ltd. for palynological examination. The samples were treated according to the method outlined previously (Dettmann 1967c) and the preservation of the contained plant microfossils is documented in Table 1. The well preserved microfloras obtained from the four productive samples include abundant spores and pollen grains and rare microplankton and the species identified are documented below. Assessment of this data in the light of present knowledge on the distinction between Australian Cretaceous and Tertiary sediments by palynological means indicates that the horizon at 3618 feet is of Middle Paleocene age, whilst sediments between 3695 feet and 3833 feet cannot be more precisely dated than uppermost Cretaceous or earliest Tertiary.

MICROFLORAL CONTENT AND AGE OF SAMPLES

3618 feet, sidewall core 16

The well preserved microflora extracted from the sample includes abundant spores and pollen grains and rare microplankton. The following forms were identified:

Spores:	*Cyathidites australis* Couper
	C. splendens Harris
	Camarozonosporites amplus (Stanley)
	C. bullatus Harris
	Leavigatosporites major (Cookson)
	Stereisporites antiquasporites (Wilson & Webster)
	Trilites tuberculiformis Cookson
Pollen:	*Dacrydiumites balmei* Cookson
	D. ellipticus Harris
	Microcachryidites antarcticus Cookson
	Nothofagidites emarcidus (Cookson)
	Phyllocladidites mawsonii Cookson
	Podocarpidites ellipticus Cookson
	Podosporites microsaccatus (Couper)
	Proteacidites parvus Cookson
	P. reticuloscabratus Harris
	P. cf. *rectomarginus* Cookson
	P. subscabratus Couper
	P. sp.
	Tricolpites gillii Cookson
	Triorites edwardsii Cookson & Pike
	aff. *T. edwardsii* Cookson & Pike
	Triorites harrisii Couper
Microplankton:	*Baltisphaeridium* sp.
	Deflandrea bakeri Deflandre & Cookson

The microflora obtained from the sample lacks diagnostic components of Dettmann and Playford's (1968) *Nothofagidites* Microflora and exhibits close conformity with Harris's (1965) *Triorites edwardsii* Assemblage. On this basis an early Tertiary (Middle Paleocene) age is assigned to the sediment.

3695 feet

The sample, which had previously been washed for foraminiferal examination, yielded a small residue of plant microfossils. Species identified include the following forms of spores, pollen, and microplankton:

Spores:	Laevigatosporites ovatus Wilson & Webster
Pollen:	Nothofagidites emarcidus (Cookson)
	Phyllocladidites mawsonii Cookson
	Podocarpidites exiguus Harris
	Proteacidites parvus Cookson
	P. subscabratus Couper
	Triorites edwardsii Cookson & Pike
	aff. T. edwardsii Cookson & Pike
Microplankton:	Cyclonephelium retiintextum Cookson

With the exception of Proteacidites parvus, all forms identified in the sample are known from both late Cretaceous and early Tertiary deposits. Proteacidites parvus may be indicative of a Tertiary age (see Dettmann 1967 c).

3797 feet, sidewall core 13.

Abundant spores and pollen grains and rare microplankton occur in the sample. The following forms were identified:

Spores:	Baculatisporites comaumensis Cookson
	Cyathidites australis Couper
	Camarozonosporites amplus (Stanley)
	cf. Camarozonosporites sp.
	Ceratosporites sp.
	Gleicheniidites circinidites (Cookson)
	Laevigatosporites major (Cookson)
	L. ovatus Wilson & Webster
	Stereisporites antiquasporites (Wilson & Webster)
Pollen:	Dacrydiumites balmei Cookson
	D. ellipticus Harris
	Microcachryidites antarcticus Cookson
	Nothofagidites emarcidus (Cookson)
	N. senectus Dettmann & Playford
	Phyllocladidites mawsonii Cookson
	Podocarpidites ellipticus Cookson
	Podosporites microsaccatus (Couper)
	Polyporina fragilis Harris
	Proteacidites adenanthoides Cookson
	P. parvus Cookson
	P. scaboratus Couper
	P. subscabratus Couper
	P. sp.
	Tricolpites gillii Cookson
	T. cf. fissilis Couper
	T. pachyexinus Couper
	Triorites edwardsii Cookson & Pike
	aff. T. edwardsii Cookson & Pike
Microplankton:	Epicephalopyxsis indentata Deflandre & Cookson
Remanié	Nuskoisporites sp. - Permian
	Striatities sp. - Permian

The sample contains the first occurrences of Dacrydiumites balmei and D. ellipticus both of which are characteristic components of Harris's (1965) Middle Paleocene Triorites edwardsii Assemblage. It also yielded Tricolpites pachyexinus which, however, is suggestive of a late Cretaceous age (see Dettmann 1967a,b).

3833 feet, sidewall core 12

Two samples from this depth were examined. One had previously been washed for foraminiferal studies and no plant microfossils were observed in the palynological residue. The other sample yielded abundant plant material including the following species of well preserved spores, pollen, and microplankton:

Spores:	Baculatisporites comaumensis (Cookson)
	Cyathidites australis Couper
	C. splendens Harris
	Camarozonosporites amplus (Stanley)
	cf. Camarozonosporites sp.
	Densoisporites velatus Weyland & Krieger
	Leavigatosporites ovatus Wilson & Webster
	Lycopodiumsporites sp.
	Gleicheniidites circinidites (Cookson)
	Ornamentifera sentosa Dettmann & Playford
Pollen:	Araucariacites australis Cookson
	Dacrydiumites florinii Cookson & Pike
	Microcachryidites antarcticus Cookson
	Nothofagidites cf. brachyspinulosus (Cookson)
	N. emarcidus (Cookson)
	N. senectus Dettmann & Playford
	Phyllocladidites mawsonii Cookson
	Podocarpidites ellipticus Cookson
	Proteacidites amolosexinus Dettmann & Playford
	P. scaboratus Couper
	P. subscabratus Couper
	P. sp.
	Tricolpites pachyexinus Couper
	T. sabulosus Dettmann & Playford
	aff. Triorites edwardsii Cookson & Pike
Microplankton:	Deflandrea bakeri Deflandre & Cookson
	D. delineata Cookson & Eisenack
	D. pellucida Cookson & Eisenack
	Svarlbardella australina Cookson
Remanié:	Nuskoisporites sp. - Permian

The spore-pollen assemblage includes Nothofagidites senectus, Ornamentifera sentosa, Proteacidites amolosexinus, Tricolpites pachyexinus, and T. sabulosus and thus exhibits close conformity with the late Cretaceous Nothofagidites Microflora. The microplankton suite, however, includes several forms hitherto known only from Victorian Tertiary deposits. These include Deflandrea bakeri, D. delineata, and Svarlbardella australina, all of which are associated with Harris's (1965) Middle Paleocene Triorites edwardsii Assemblage in the basal (4ft. and 6ft. levels) of the Pebble Point Formation (see Cookson 1965, Cookson and Eisenack 1965). It should be emphazised, however, that the lower age limit of these microplankton species (and of Harris's Triorites edwardsii Assemblage) has not yet been fully determined. Thus, on present knowledge, the sediment at 3833 feet may be of late Cretaceous or earliest Tertiary age.

CONCLUSION

On microfloral evidence the Cretaceous/Tertiary boundary in Shell Pecten 1A well lies somewhere between 3908 feet and 3618 feet. Sediments at 3908 feet have been shown to be of uppermost Cretaceous age (Dettmann 1967c) and the horizon at 3618 feet is considered to be of Middle Paleocene age. Deposits examined from 3695 feet, 3797 feet, and 3833 feet contain microfloras that possess characteristics of Victorian uppermost Cretaceous microfloral assemblages and also include the first appearances of certain species that typify Victorian Lower Tertiary assemblages. The age of microfloras possessing these characteristics will undoubtedly be more precisely determined when they are recognised in sediments securely dated by means of marine faunas.

REFERENCES

Cookson, I.C. 1965. Microplankton from the Paleocene Pebble Point Formation, south-western Victoria. Proc. Roy. Soc. Vict., 78, 137-141

Cookson, I.C. and Eisenack, A. 1965. Microplankton from the Paleocene Pebble Point Formation, south-western Victoria. Proc. Roy. Soc.Vic., 79, 139-146

Dettmann, M.E. 1967a. Preliminary palynological report on Shell Pecten 1-A well. Unpubl. report submitted to Shell Development (Australia) Pty. Ltd., 27/6/67.

Dettmann, M.E. 1967b. Palynological report on Shell Pecten 1-A well, 4044 feet - 9305 feet. Unpubl. report submitted to Shell Development (Australia) Pty. Ltd. 30/8/67.

Dettmann, M.E. 1967c. Palynological report on Shell Pecten 1-A well, 3735 feet and 3908 feet. Unpubl. report submitted to Shell Development (Australia) Pty. Ltd. 4/9/67.

Dettmann, M.E. and Playford, G. 1968. Palynology of the Australian Cretaceous - a review. A.N.U. Press, Canberra (in press).

Harris, W.K. 1965. Basal Tertiary microfloras from the Princetown area, Victoria, Australia. Palaeontographica 115b, 75-106.

20th September, 1967.

Mary E. Dettmann,
Department of Geology,
University of Queensland,
St. Lucia, Queensland.

PE900431

This is an enclosure indicator page.
The enclosure PE900431 is enclosure within the
container PE900429 at this location in this document.

The enclosure PE900431 has the following characteristics:

ITEM_BARCODE	=	PE900431
CON TAINER_BARCODE	=	PE900429
NAME	=	Distribution of foraminifera
BASIN	=	OTWAY
PERMIT	=	PEP 22
TYPE	=	WELL
SUBTYPE	=	DIAGRAM
DESCRIPTION	=	Distribution of foraminifera
DATE_CREATED	=	
DATE_RECEIVED	=	
W_NO	=	W502/505
WELL_NAME	=	Pecten 1 & 1A
CONTRATOR	=	
CLIENT_OP_CO	=	Shell

PE900225

This is an enclosure indicator page.
The enclosure PE900225 is enclosed within the container PE900429 at this location in this document.

The enclosure PE900225 has the following characteristics:

ITEM_BARCODE	= PE900225
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1 & 1A Locality Map Showing Regional Geology, Enclosure 1
BASIN	= OTWAY
PERMIT	= PEP 22
TYPE	= GENERAL
SUBTYPE	= PROSPECT_MAP
DESCRIPTION	= Pecten 1 & 1A Locality Map Showing Regional Geology, Enclosure 1
REMARKS	=
DATE_CREATED	= 1/07/67
DATE_RECEIVED	= *
W_NO	= W502, W505
WELL_NAME	= Pecten 1 & 1A
CONTRACTOR	= Shell
CLIENT_OP_CO	= Shell

(Inserted by DNRE - Vic Govt Mines Dept)

PE900226

This is an enclosure indicator page.
The enclosure PE900226 is enclosed within the container PE900429 at this location in this document.

The enclosure PE900226 has the following characteristics:

ITEM_BARCODE	= PE900226
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Geological Section Before and After Drilling, Enclosure 2
BASIN	= OTWAY
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= CROSS_SECTION
DESCRIPTION	= Pecten 1A Geological Section Before and After Drilling, Enclosure 2
REMARKS	=
DATE_CREATED	= 1/07/67
DATE_RECEIVED	= *
W_NO	= W502, W505
WELL_NAME	= Pecten 1 & 1A
CONTRACTOR	= Shell
CLIENT_OP_CO	= Shell

(Inserted by DNRE - Vic Govt Mines Dept)

PE602797

This is an enclosure indicator page.
The enclosure PE602797 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602797 has the following characteristics:

ITEM_BARCODE	= PE602797
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Composite Well Log, Sheet 1 of 3
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= COMPOSITE_LOG
DESCRIPTION	= Pecten 1A Composite Well Log, Sheet 1 of 3, 0 - 2700ft, Enclosure 5
REMARKS	= *
DATE_CREATED	= 4/06/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Shell Development (Australia) Pty. Ltd.
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE905978

This is an enclosure indicator page.
The enclosure PE905978 is enclosure within the
container PE900429 at this location in this document.

The enclosure PE905978 has the following characteristics:

ITEM_BARCODE	=	PE905978
CONT AINER_BARCODE	=	PE900429
NAME	=	Well History Chart
BASIN	=	OTWAY
PERMIT	=	PEP 22
TYPE	=	WELL
SUBTYPE	=	DIAGRAM
DESCRIPTION	=	Well History Chart
DATE_CREATED	=	
DATE_RECEIVED	=	
W_NO	=	W502/505
WELL_NAME	=	Pecten 1A
CONTRATOR	=	
CLIENT_OP_CO	=	Shell

PE602798

This is an enclosure indicator page.
The enclosure PE602798 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602798 has the following characteristics:

ITEM_BARCODE	= PE602798
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Composite Well Log, Sheet 2 of 3
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= COMPOSITE_LOG
DESCRIPTION	= Pecten 1A Composite Well Log, Sheet 2 of 3, 2700 - 6600ft, Enclosure 5
REMARKS	= *
DATE_CREATED	= 4/06/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Shell Development (Australia) Pty. Ltd.
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602799

This is an enclosure indicator page.
The enclosure PE602799 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602799 has the following characteristics:

ITEM_BARCODE	= PE602799
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Composite Well Log, Sheet 3 of 3
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= COMPOSITE_LOG
DESCRIPTION	= Pecten 1A Composite Well Log, Sheet 3 of 3, 6600 - 9400ft, Enclosure 5
REMARKS	= *
DATE_CREATED	= 4/06/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Shell Development (Australia) Pty. Ltd.
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE900227

This is an enclosure indicator page.
The enclosure PE900227 is enclosed within the container PE900429 at this location in this document.

The enclosure PE900227 has the following characteristics:

ITEM_BARCODE	PE900227
CONTAINER_BARCODE	PE900429
NAME	Well Correlation Pecten 1A - Timboon 5, Enclosure 5
BASIN	OTWAY
PERMIT	PEP 22
TYPE	WELL
SUBTYPE	CROSS_SECTION
DESCRIPTION	Well Correlation Pecten 1A - Timboon 5, Enclosure 5
REMARKS	
DATE_CREATED	*
DATE_RECEIVED	*
W_NO	W502, W505
WELL_NAME	Pecten 1 & 1A
CONTRACTOR	Shell
CLIENT_OP_CO	Shell

(Inserted by DNRE - Vic Govt Mines Dept)

PE900236

This is an enclosure indicator page.
The enclosure PE900236 is enclosure within the
container PE900429 at this location in this document.

The enclosure PE900236 has the following characteristics:

ITEM_BARCODE	=	PE900236
CON TAINER_BARCODE	=	PE900429
NAME	=	Pecten 1 Master Log (Mud Log)
BASIN	=	OTWAY
PERMIT	=	PEP 22
TYPE	=	WELL
SUBTYPE	=	MUD_LOG
DESCRIPTION	=	Pecten 1 Master Log (Mud Log)
DATE_CREATED	=	
DATE_RECEIVED	=	
W_NO	=	W502/505
WELL_NAME	=	Pe cten 1
CONTRATOR	=	
CLIENT_OP_CO	=	Shell

PE602800

This is an enclosure indicator page.
The enclosure PE602800 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602800 has the following characteristics:

ITEM_BARCODE	= PE602800
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 1 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 1 of 14, 0 - 1000ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602801

This is an enclosure indicator page.
The enclosure PE602801 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602801 has the following characteristics:

ITEM_BARCODE	= PE602801
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 2 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 2 of 14, 1000 - 2000ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602802

This is an enclosure indicator page.
The enclosure PE602802 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602802 has the following characteristics:

ITEM_BARCODE	= PE602802
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 3 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 3 of 14, 2000 - 2200ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602803

This is an enclosure indicator page.
The enclosure PE602803 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602803 has the following characteristics:

ITEM_BARCODE	PE602803
CONTAINER_BARCODE	PE900429
NAME	Pecten 1A Master Log, Sheet 4 of 14
BASIN	Otway
PERMIT	PEP 22
TYPE	WELL
SUBTYPE	MUD_LOG
DESCRIPTION	Pecten 1A Master Log, Sheet 4 of 14, 2200 - 3000ft
REMARKS	*
DATE_CREATED	19/04/67
DATE_RECEIVED	*
W_NO	W502/505
WELL_NAME	Pecten 1A
CONTRACTOR	Geoservices
CLIENT_OP_CO	Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602804

This is an enclosure indicator page.
The enclosure PE602804 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602804 has the following characteristics:

ITEM_BARCODE	= PE602804
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 5 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 5 of 14, 3000 - 4000ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602805

This is an enclosure indicator page.
The enclosure PE602805 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602805 has the following characteristics:

ITEM_BARCODE	= PE602805
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 6 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 6 of 14, 4000 - 5000ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602806

This is an enclosure indicator page.
The enclosure PE602806 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602806 has the following characteristics:

ITEM_BARCODE	= PE602806
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 7 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 7 of 14, 5000 - 6000ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602807

This is an enclosure indicator page.
The enclosure PE602807 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602807 has the following characteristics:

ITEM_BARCODE	= PE602807
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 8 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 8 of 14, 6000 - 6250ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602808

This is an enclosure indicator page.
The enclosure PE602808 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602808 has the following characteristics:

ITEM_BARCODE	= PE602808
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 9 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 9 of 14, 6250 - 6900ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602809

This is an enclosure indicator page.
The enclosure PE602809 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602809 has the following characteristics:

ITEM_BARCODE	= PE602809
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 10 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 10 of 14, 6500 - 7000ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602810

This is an enclosure indicator page.
The enclosure PE602810 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602810 has the following characteristics:

ITEM_BARCODE	= PE602810
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 11 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 11 of 14, 7000 - 8000ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602811

This is an enclosure indicator page.
The enclosure PE602811 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602811 has the following characteristics:

ITEM_BARCODE	= PE602811
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 12 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 12 of 14, 8000 - 8200ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602811

This is an enclosure indicator page.
The enclosure PE602811 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602811 has the following characteristics:

ITEM_BARCODE	= PE602811
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 12 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 12 of 14, 8000 - 8200ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602812

This is an enclosure indicator page.
The enclosure PE602812 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602812 has the following characteristics:

ITEM_BARCODE	= PE602812
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 13 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 13 of 14, 8200 - 9000ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602813

This is an enclosure indicator page.
The enclosure PE602813 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602813 has the following characteristics:

ITEM_BARCODE	= PE602813
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Master Log, Sheet 14 of 14
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Master Log, Sheet 14 of 14, 9000 - 9400ft
REMARKS	= *
DATE_CREATED	= 19/04/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602814

This is an enclosure indicator page.
The enclosure PE602814 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602814 has the following characteristics:

ITEM_BARCODE	= PE602814
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Chromatolog, sheet 1 of 10
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Chromatolog, sheet 1 of 10, 8300 - 9000ft, 1:600
REMARKS	= new barcode PE900237 replaced with PE602814
DATE_CREATED	= 24/05/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602815

This is an enclosure indicator page.
The enclosure PE602815 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602815 has the following characteristics:

ITEM_BARCODE	= PE602815
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Chromatolog, sheet 2 of 10
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Chromatolog, sheet 2 of 10, 9000 - 9350ft, 1:600
REMARKS	= new barcode PE900238 replaced with PE602815
DATE_CREATED	= 24/05/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602816

This is an enclosure indicator page.
The enclosure PE602816 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602816 has the following characteristics:

ITEM_BARCODE	PE602816
CONTAINER_BARCODE	PE900429
NAME	Pecten 1A Chromatolog, sheet 3 of 10
BASIN	Otway
PERMIT	PEP 22
TYPE	WELL
SUBTYPE	MUD_LOG
DESCRIPTION	Pecten 1A Chromatolog, sheet 3 of 10, 3000 - 4000ft, 1:1200
REMARKS	new barcode PE900239 replaced with PE602816
DATE_CREATED	24/05/67
DATE_RECEIVED	*
W_NO	W502/505
WELL_NAME	Pecten 1A
CONTRACTOR	Geoservices
CLIENT_OP_CO	Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602817

This is an enclosure indicator page.
The enclosure PE602817 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602817 has the following characteristics:

ITEM_BARCODE	= PE602817
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Chromatolog, sheet 4 of 10
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Chromatolog, sheet 4 of 10, 4000 - 5000ft, 1:1200
REMARKS	= new barcode PE900240 replaced with PE602817
DATE_CREATED	= 24/05/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602818

This is an enclosure indicator page.
The enclosure PE602818 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602818 has the following characteristics:

ITEM_BARCODE	= PE602818
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Chromatolog, sheet 5 of 10
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Chromatolog, sheet 5 of 10, 5000 - 6000ft, 1:1200
REMARKS	= new barcode PE900241 replaced with PE602818
DATE_CREATED	= 24/05/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602819

This is an enclosure indicator page.
The enclosure PE602819 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602819 has the following characteristics:

ITEM_BARCODE	= PE602819
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Chromatolog, sheet 6 of 10
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Chromatolog, sheet 6 of 10, 6000 - 7000ft, 1:1200
REMARKS	= new barcode PE900242 replaced with PE602819
DATE_CREATED	= 24/05/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602820

This is an enclosure indicator page.
The enclosure PE602820 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602820 has the following characteristics:

ITEM_BARCODE	= PE602820
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Chromatolog, sheet 7 of 10
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Chromatolog, sheet 7 of 10, 7000 - 8000ft, 1:1200
REMARKS	= new barcode PE900243 replaced with PE602820
DATE_CREATED	= 24/05/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602821

This is an enclosure indicator page.
The enclosure PE602821 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602821 has the following characteristics:

ITEM_BARCODE	= PE602821
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Chromatolog, sheet 8 of 10
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Chromatolog, sheet 8 of 10, 8000 - 8200ft, 1:1200
REMARKS	= new barcode PE900244 replaced with PE602821
DATE_CREATED	= 24/05/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602822

This is an enclosure indicator page.
The enclosure PE602822 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602822 has the following characteristics:

ITEM_BARCODE	= PE602822
CONTAINER_BARCODE	= PE900429
NAME	= Pecten 1A Chromatolog, sheet 9 of 10
BASIN	= Otway
PERMIT	= PEP 22
TYPE	= WELL
SUBTYPE	= MUD_LOG
DESCRIPTION	= Pecten 1A Chromatolog, sheet 9 of 10, 8000 - 9000ft, 1:1200
REMARKS	= new barcode PE900245 replaced with PE602822
DATE_CREATED	= 1/06/67
DATE_RECEIVED	= *
W_NO	= W502/505
WELL_NAME	= Pecten 1A
CONTRACTOR	= Geoservices
CLIENT_OP_CO	= Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)

PE602823

This is an enclosure indicator page.
The enclosure PE602823 is enclosed within the container PE900429 at this location in this document.

The enclosure PE602823 has the following characteristics:

ITEM_BARCODE	PE602823
CONTAINER_BARCODE	PE900429
NAME	Pecten 1A Chromatolog, sheet 10 of 10
BASIN	Otway
PERMIT	PEP 22
TYPE	WELL
SUBTYPE	MUD_LOG
DESCRIPTION	Pecten 1A Chromatolog, sheet 10 of 10, 9000 - 9350ft, 1:1200
REMARKS	new barcode PE900246 replaced with PE602823
DATE_CREATED	3/06/67
DATE_RECEIVED	*
W_NO	W502/505
WELL_NAME	Pecten 1A
CONTRACTOR	Geoservices
CLIENT_OP_CO	Shell Development (Australia) Pty. Ltd.

(Inserted by DNRE - Vic Govt Mines Dept)