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MICROPLANKTON AND MICROFLORAL
CORRELATION OF VICTORIAN WESTERN
DISTRICT DEEP BORES AT THE
STAGE OF SAMPLING REACHED ON

24.2.60

Microplankton and Microfloral Correlation of Victorian
Western District Deep Bores at the Stage of Sampling
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A deep drilling programme in the Western District was commenced by the Mines Department in November 1957, with the spudding in of Portland No. 2 hole.

This and a following series of holes were drilled in a investigation of underground water resources to supplement surface supplies.

Portland No. 2 was followed by Portland No. 3, Belfast (Port Fairy) No. 4 and Timboon No. 5. Previous to this a deep hole had been drilled at Nelson, near the South Australian border.

Corings from all these holes have resulted in a wealth of new geological material, and Departmental Geologists have been working on many aspects of the intersected sediments. The Mesozoic sediments in particular, have been the subject of much discussion of late, and the need for study of these has been intensified by the recent discovery of natural gas at Port Campbell by Frome Broken Hill Co. Pty.Ltd.

This report is primarily concerned with correlations between all these areas, based on contained microfloras and microplankton.

The work on each bore is described below, and at this stage recognition must be made of the work on microfossil Systematics of Dr. Isobel Cookson of the Melbourne University who pioneered this study in Victoria.

It is also to be noted that preparations were made from cores only, as screen samples, which are available in the uncored sections are regarded as likely to contain sufficient contamination from higher horizons to render any results unreliable.

Nelson Bore

Locality: P.Glenelg (see map below)

Spudded in

Depth - 7305'

Surface Level - 10'

Bore No. 1.

No thorough Departmental palynological investigation was made on material from the Nelson Bore, but as it is still (10.2.60) the deepest hold drilled in Western Victoria a summary of published work is necessary to facilitate a broad correlation with later bores.

Age determinations have been made on lithological and palaeontological grounds by Boutakoff and Sprigg, Crespin, and Cookson, among others, and it is on Cookson's (or collaborators) work that the geological column and discussion below is based.

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Tertiary pollens and microplanktonic organisms are found in sediments to 4250' and apparently to 4500' whilst short time range Upper Cretaceous microplankton and spores (not so limited in time range) are listed from three horizons below this depth.

The actual Mesozoic-Cainozoic contact at 4500' however appears to have been established on lithological evidence the reliability of which could be questioned in the light of more recent Departmental drilling experience.

List of Microfossils in Nelson Bore as determined
by Dr. Cookson.

<u>Depth</u>	<u>Tertiary</u>
3874', 992'	Epicephalopyxis indentata Deflandre & Cookson
3874'	Deflandrea bakeri Deflandre & Cookson
730'	Hystriocholpoma cinctum Klumpp
	Triorites edwardsii
	<u>U.Cretaceous</u>
5782' & 6065'	Cicatricosisporites australiensis Cookson
5782-6192'	Hystriochosphaeridium complex (White) Deflandre
5782-6192'	" heteracanthum Cookson & Deflandrea
6192'	" tubiferum Deflandre (compared to H.complex by Deflandre & Cookson 1955)
5782'	Odontochitina cribropoda Deflandre & Cookson.
6233'	Odontochitina porifera, Cookson.
6233'	Gymnodinium nelsonense, Cookson.
6233, 6065, 5304'	Deflandrea cretacea, Cookson.
6233', 5304'	Tricolpites gillii
6485'-7'	Balmesporites glenelgensis Cookson & Dettman.

Portland No. 2 Bore.

Locality: P. Portland
Spudded in: November 1957
Depth: 4719½' Surface Level: 110'

This, the first of the holes drilled by the Emsco Rotary Rig bottomed at 4719½'. Samplings were very limited, but were sufficient at the time of drilling to enable a satisfactory assessment of the sediments intersected. Slides 586-607 in the Mines Department palaeontological laboratories may be described as follows:-

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Depth	Depth Difference	Slide Nos.	Micro - Fossil		Age
			Plantae	Plankton	
3078'5" - 3088'2½"	337'7½"	597-9	Cellular/debris		Tertiary
3425'10" 3437'3"	1005'7"	595-6	Tricolporites prolata, Cookson.		
4442'10" - 4459'10"	213'2"	593-4	B a r r e n		Upper Cretaceous marine?
4673'	2'	586-92	Triorites pollen, Multicelled fungal spores.	Hystri- osphaeridium sp.	
4675'	7'10"	600-3	Monosulcites minima Cookson.		
4682'10"	28'2"	607	Deflandrea sp. cf. cretacea.		
4711' - 4719'5"		604-6	Barren		

Dating of the samples is made difficult by the paucity of microfossils, but sufficient diagnostic forms are present to establish a Tertiary age to at least 3437' and probably to 4673'

At this latter depth Hystriosphæridium species co-exist with multicelled fungal spores more characteristic of Victorian Tertiary sediments.

However, in this same zone of marine sedimentation a damaged Deflandrea species comparable to D.cretacea Cookson, was isolated, which is indicative of the Upper Cretaceous. Hence in the geological column sediments below 4673' have been recorded on a query basis prior to further sampling which is proceeding.

Portland No. 3 Bore.

Locality: P. Portland.

Spudded in:

Depth: 5638' Surface Level: 16'

Lack of time has enabled preparation of only one sample from Portland No. 3 Bore.

At 5278' - 5286'6" a microplanktonic organism comparable with the genus Palaeoglenodinium Deflandre and Cookson, was isolated. If classification within this genus is confirmed this horizon probably falls into a zone of marine Upper Cretaceous sediments, the vertical extent of which must be established by further sampling.

cont.....4/-

Belfast No. 4 Bore.

Locality : P. Belfast, Township Port Fairy

Spudded in: 3.4.59

Depth : 5521'6" Surface Level:

On the completion of drilling at Portland the Emsco Rig was moved to Port Fairy, where three shallow holes had been drilled many years previously. A full quantitative and qualitative microfossil study was envisaged, but arrival of core from later holes for urgent palaeontological determination prevented this. However it would still be the most comprehensively sampled, of all the Western District deep bores. The slides examined are described below. From these hundred odd slides many microfossils have been isolated and individually mounted.

Belfast 4 Samplings.

D e p t h	Depth Difference	Slide Nos.	Micro-Fossils		Age
			Plantae	Plankton	
3777'-3787'		779-84	Proteacidites parvus Cookson & Proteacidites sp. Di & Tri winged Podocarpaceae,	Gyathidites sp.	Tert- iary.
4492'	6"	622-5		Hystri- chos- phaeridium heteracan- thum Deflandrea cretacea Cookson		Marine
4492'6"	2'	615-7	Proteacidites sp. rather barren)		
4494'6"	1'	612-4	Trisaccate Podocarpaceae Lycopodium-sporites austrorivulidites, Cookson. Trisaccites(non micro- terus)		Upper
4495'6"	1"	618-21	Proteacidites sp.			Cret- aceous
4496'6"	152'6"	608-11	Deflandrea cretacea Dinoflagellates.		
4649' - 4649'2"	4"	677-9	Hystri- chos- phaeridium of. polytrichum Valensi Hystri- chos- phaeridium sp. Hystri- chos- heteracanthum Defl. & Cookson		
4649'6" - 4549'10"	8"	703-6	Hystri- chos- phaeridium n.s. 1 & 2		
4650'6"	1'4"	674-6	Fromea cf. amphora Eisenback 1938. Hystri- chos- phaeridium n.s.		
4650'8"					
4652'	2'2"	660-7	Many Hystri- chos- phaeridium s.p		
4654'2" - 4654'6"	410'6"	707-12			

D e p t h	Depth Difference	Slide Nos.	Micro - Fossils		Age
			Plantae	Plankton	
5065' - 5072		685	Barren		} <i>Pre</i> <u>Predominantly Non-marine Upper Cretaceous</u>
5343'	27'	642-6	Cyathidites sp.		
5346'	6"	647-51	}		
5346'6"	3'6"	715-7			
5350'	1'	632-5	Few isolated		
5351'	1'	713-4	fern spores.		
5352'	6"	680-1	}		
5352'6"	6"	721			
5353'	4"	722			
5353'4"-5353'9"	9"	718-20			
5354'6"	150'	629-31		Cicatricosisporites australiensis Cookson	
5504'	6'	682-4			
5510'-5520'	-	636-41			
5520'	1'6"	656-9			
5521'6"		652-5			

A glance at the geological column for this bore shows that the Tertiary/Cretaceous boundary has not been defined. Samplings originally taken indicated on lithological grounds that this boundary would be well covered, but subsequent microfossils examination has revealed thicker Cretaceous sediments than expected.

From 4492 - 4654 feet marine sediments contain characteristic Upper Cretaceous microplankton as listed, as well as a number of new forms.

A large number of specimens of the genus *Hystrichosphaeridium* are new to Australia, and specific identifications of these is proceeding.

Lack of continuous corings prevented determination of the full vertical extent of this zone, but at 5065' samplings were barren. No indications of marine sedimentation were found below this depth and microfloras were generally depauperate, except at 5354' where a richer microflora was characterized by large numbers of *Cicatricosisporites australiensis* Cookson, a trilete spore characterized by narrow ridging of the exospore running parallel to the spore walls. This zone is very limited vertically. Barren sandstones and arkoses sampled below this horizon contain little other than a few fern spores with long (Mesozoic-Tertiary) time range indicating non marine conditions of sedimentation.

Port Campbell Bore.

Locality: P. Paaratte
 Spudded in:
 Depth: 5965'
 Bore No: Frome Broken Hill Co. Pty.Ltd.
 Pt. Campbell No. 1 Bore.

This bore excited much public interest when natural gas began to flow under pressure in late December 1959.

Core samples forwarded to this Department were examined (see Unpublished Reports, Vic. Mines Department 1959/70th and 94) but a thorough sampling schedule is only now under way, as work on the Belfast No. 4 bore held up the study of the Port Campbell material.

However, work has proceeded to the point where only Belfast No. 4 has been more thoroughly sampled.

Samplings have not yet been extensive enough to define the Tertiary-Cretaceous boundary, but this occurs above 4754' and below 3450'. See Table below.

Port Campbell.

Depth.	Depth Diff.	Slide Nos.	Micro - Fossils.		Age.
			Plantae	Plankton	
3450'660'	1294'	723-8			Tertiary
4754' - 6'	2'	754-6)	Proteacidites sp.	Deflandrea)	M
		)		cretacea)	a
		)		Cookson)	r
		)		cf. Fromea)	i
		)		sp. etc)	e
4756' - 8'	2'	751-3))	
4758' - 60'	2'	746-50))	
4760' - 2'	100'	744-5 )		)	U
4862' - 4'	2'	785-9)	Dinoflagellates, & Micro- Plankton with Genus Hystriosphæridium	)	P
4864' - 6'	152'	790-8) 828-31)	characteristic	)	e
5018' - 20'	2'	799-804 )		)	r
5020' - 2'	-	805-10 )		)	a
5021'	5'	881-5 )		)	c
5026' - 8'	2'	In )		)	e
5028' - 30'	193'	Prep- )		)	o
5223' - 5'	2'	arat-) ion) 819-27)		)	u

cont....7/-

Depth.	Depth Diff.	Slide Nos.	Micro - Fossils		Age
			Plantae	Plankton	
5225' - 7'	2'	828-31)	Dinoflagellates, & Micro plankton with Genus <i>Hystriichosphaeridium</i> Characteristic		Marine Upper Cretaceous
5227' - 9'	2'	832-41)			
5229' - 31'	431'	842-49)			
5662'-5663'	6"	)	Barren		
5701'	37'6")			
5706'	5'	)	Cicatricosisporites australiensis, Cookson, Podocarpaceae etc.		Pre-dominately.
5706'	224'	740-3)			
5930'	2'	811-8)	Cingulatisporites, Podocarpaceae	Deflandrea) cretacea)	Non Marine
5932'-4'		773-8)			

At 4754' a zone of marine Upper Cretaceous sediments characterized by microplankton of the genus *Hystriichosphaeridium* and other forms extends to at least 5231'.

No corings were available from here to 5662' where preparations were barren.

This depauperate zone extends to 5706' where the sporomorph *Cicatricosisporites australiensis* appears. (Cf. Nelson and Belfast bores). Although this latter is confined to a narrow horizon here the appearance of the Dinoflagellate *Deflandrea cretacea* at 5930' shows that the incursions of marine seas had not finished, although the large number of plant macrofossils (*Teeniopteris spatulata* Oldham and Morris, *Ginkgoites* sp. and Articulated stems) indicates that these were more in the nature of estuarine or brackish lake deposits.

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Locality : P. Timboon
 Spudded in: October 1959
 Depth : 3691' Surface Level: 315'
 Bore No : 5

Sampling of the Departmental water bore at Timboon has of necessity been rather perfunctory, and is listed below:

Depth	Depth Diff.	Slide Nos.	Micro - Fossils		Age
			Plantae	Plankton	
2182'-98'	94'6"	850-5	Nothofagus sp. Podocarpaceae Proteacidites sp. Pteridophyte spores.	) )	Tertiary
3286'6" -97'		856-8	Triorites sp. Generally depauperate		
3407'-10		867-74	Podocarpaceae. Dinoflagellates) Cicatricosisporites australiensis)	} Marine } Upper } Cretaceous	
3500'-4'		(729-32) (733-37)	Cicatricosisporites australiensis Tricolpites. Podocarpaceae)		} Predominantly } non-marine
3562'-9'		738-40	Barren		
3680'6"-3691'		859-66	Cicatricosisporites australiensis)		

Further sampling is proceeding

A Lower Tertiary microflora at 2192' is characterized by Nothofagus pollens and the Tertiary-Cretaceous contact is between this depth and 3407' where Dinoflagellates and the sporomorph Cicatricosisporites occur.

At 3691' this latter is still present, whilst no Dinoflagellates have been observed under 3504'. This wide, (3407'-3691'), zone with Cicatricosisporites in abundance is in contrast to the other deep bores. Below 3504' the sediments are predominantly non-marine.

The absence of Hystrichosphaeridean microplankton also points to some interruption to sedimentation between Timboon and Port Campbell in particular. The absence of Hystrichosphaerideans may be explained by the very intermittent samplings, but their absence from the 3286'-3297' sample indicates that any Hystrichosphaeridean zone that does occur is very restricted.

Upper Cretaceous marine beds are much less extensive at Timboon.

Summary

Microfossil examination has enabled the delineation of an Upper Cretaceous marine zone and has been particularly useful in separating Mesozoic and Tertiary sediments which are lithologically similar.

Correlation shows that the Timboon bore with much thinner Tertiary and Upper Cretaceous marine beds presents a problem in structural geology.

It is to be noted that the introduction of Cretaceous Stages to the sediments has been avoided, as the Systematics of the pertinent microplankton and microfloras are not yet fully known.

The pre-Upper Cretaceous sediments are those which have hitherto been mapped as Jurassic and described as Lower Jurassic (Medwell 1954).

Much of the Gippsland Mesozoic non marine sequence has been determined as Albian (Lower Cretaceous), or a little older, by Cookson and Dettman, but as no final correlation has been made between these and the Western District sediments the term "Pre-Upper Cretaceous predominantly non marine sediments" is used.

Work is proceeding on a qualitative and quantitative investigation of the microfossils to elucidate the problems discussed above and help make clearer our picture of the stratigraphy of the Western District Tertiary and Mesozoic sediments.

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