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MICROFLORAS IN BORE CORES FROM ALBERTON WEST, VICTORIA

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Abstract

Lower Cretaceous, Paleocene to Lower Eocene and Eocene (post Pebble Point Formation) microfloras isolated from sediments in the lower portion of bores at Alberton West in south-eastern Victoria are described and compared with equivalent microfloras in south-western Victoria and south-eastern South Australia.

A generalized quantitative analysis of the Paleocene to Lower Eocene microflora of the Alberton West cores and several deposits in south-western Victoria is included.

Introduction

In 1952, a series of bores was sunk in the Parish of Alberton West in south-eastern Victoria with the purpose of determining the extent of brown coal deposits in that area. Through the courtesy of Dr. D. E. Thomas, portions of the cores were later made available to us for palynological examination.

None of the cores is complete since the Tertiary brown coals were not retained. Moreover some of the deeper deposits are devoid of microfossils. However, from the remainder of the samples evidence has been obtained of the existence of an Upper Mesozoic and two Lower Tertiary microfloras. On present knowledge these approximate fairly closely to microfloras already described from sediments in other parts of Victoria and South Australia (Cookson 1953, Cookson 1954, and Cookson and Dettmann 1958).

Since many of the spores and pollen grains constituting these three microfloras have yet to be named and classified, none of the lists given is complete. Quantitative analyses of the Tertiary portions of the Alberton West deposits have been included wherever practicable. They were obtained from acetolysed residues mounted in glycerine jelly, care being taken to ensure that the contained spores and pollen grains were as evenly distributed as possible. Two hundred individuals in each of four slides per sample were counted and assigned to their particular group—Pteridophyta (ferns and lycopods), Gymnospermae (conifers) and Dicotyledonae. From the resulting percentages the general composition of the flora of the period can be fairly accurately estimated in spite of the fact that wind-pollinated types are over represented and insect-pollinated species under represented in any fossil microflora.

Microfloras of Alberton West Core Samples

A. Bore 137 in SE. corner of Allotment 62A, Section A (Fig. 1).

The core of this bore is one of the most complete of the series, and from it, eight samples (at 178, 174, 165, 136, 133, 127 and 118 ft.) have been examined. Among these, the sandy clay at 197 ft. and the sandy clays at 133, 127 and 119 ft., logged by the Victorian Department of Mines (Boring Records, 1951-1952, published 1955) as Jurassic, contain no microfossils. The other samples contain a relatively rich

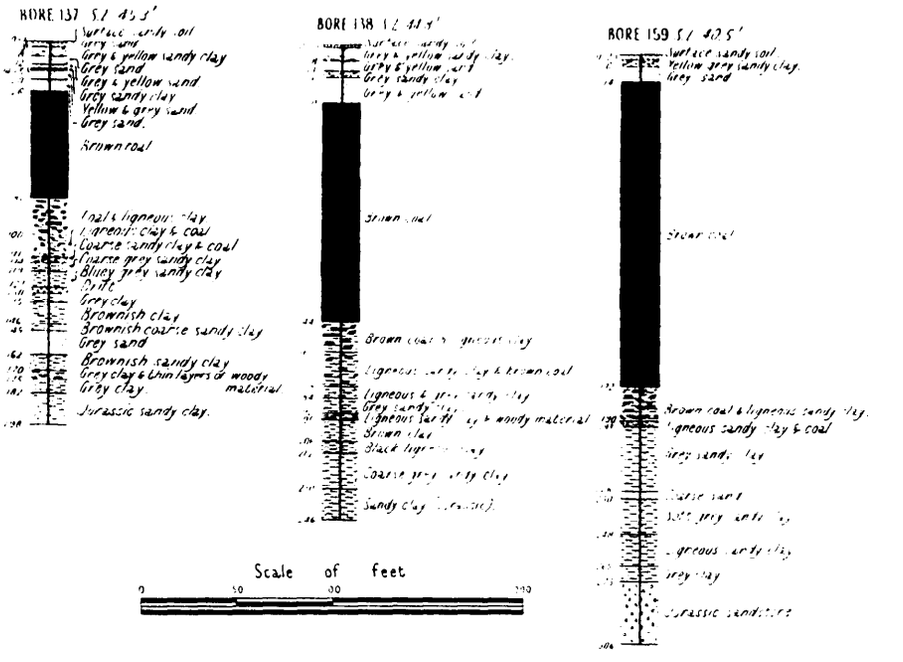


FIG. 1.—Sections of three of the Alberton West Bores (prepared by the Victorian Department of Mines).

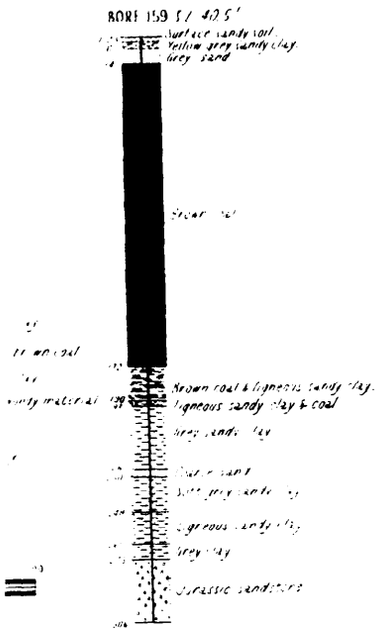
assortment of pollen grains and spores which constitute two distinct microfloras, one preserved in grey clay at 178 and 174 ft., the other in the brownish clay penetrated at 165 and 136 ft.

1. Grey clay at 178 ft. (Vic. Geol. Surv. Mus. No. 54079) and at 174 ft. (Vic. Geol. Surv. Mus. No. 54078). The microflora present at this level consists mainly of pteridophyte spores and coniferous pollen grains. Angiosperm pollen grains were not detected.

The pteridophyte spores include *Ceratosporites equalis* Cookson and Dettmann, *Cicatricosisporites australiensis* (Cookson), *Granulatisporites dailyi* Cookson and Dettmann, *Ischyosporites scaberis* Cookson and Dettmann, *Leptolepidites verrucatus* Couper, *Lycopodiumsporites austroclavatidites* (Cookson), *Neoraistrickia truncatus* (Cookson), *Osmundacidites comanumensis* (Cookson), *Perotrilites striatus* Cookson and Dettmann, and *Pilosisporites notensis* Cookson and Dettmann.

Coniferous pollen grains recognized are *Classopollis* cf. *C. torosus* Reissinger, *Microcachryidies antarcticus* Cookson, *Pityosporites grandis* (Cookson), *Podosporites micropterus* (Cookson and Pike).

2. Brownish clay at 165 ft. (Vic. Geol. Surv. Mus. No. 54077). This deposit has a high pollen and spore content, the approximate percentages of which are shown in Table 2. The following types have been recognized:



Alberton West Bores
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Bryophyta—*Sphagnites australis f. parva* Cookson.
Pteridophyta — *Lycopodiumsporites austroclavatidites, Gleichenia circinidites* Cookson, *Schizaea albertonensis* Cookson.
Coniferae—*Dacrydium mawsonii* Cookson, D. *mawsonii f. verrucatus* Cookson, *D. florinii* Cookson and Pike, *D. balmei* Cookson, *Microcachryidites antarcticus, Podosporites microplerus.*
Dicotyledonae—*Nothofagus* (*brassi* type), *Triorites edwardsii* Cookson and Pike, *Tricolpites gillii* Cookson, and several varieties of small triangular three-aperturate types.

3. Brownish clay at 136 ft. (Vic. Geol. Surv. Mus. No. 54076). The microflora present at this depth is similar in composition to the one just described, the only appreciable difference being the relative proportions of the groups represented. At 136 ft. the percentage of pteridophye spores has decreased from 33 % to 7% of the total spore and pollen types present, while coniferous types have increased from 55% to 73% and dicotyledonous pollen grains from 12% to 20%.

Comments

There is a marked difference between the pollen and spore content of the sediments at 178 and 174 ft., and at 165 and 136 ft. This is taken to indicate a considerable time-lapse between the two microfloras for the following reasons:

(a) The microflora at 178 and 174 ft. is Upper Mesozoic in character. It has a distinct affinity with the microflora contained in the sediments intersected by the Comaum Bore, South Australia between 674 and 708 ft. and in those from the Barrabool Hills, Victoria, the age of which is Lower Cretaceous, ?Albian (Cookson and Dettmann 1958). The inclusion of *Perotrilites striatus* suggests that the Alberton West microflora is younger than the microflora of the Wonthaggi Coal Measures of eastern Victoria. Support for a Lower rather than an Upper Cretaceous age is afforded by the absence of dicotyledonous pollen grains which apparently made their first appearance in Australia during the lower part of the Upper Cretaceous.

(b) The microflora contained in the deposits at 165 and 136 ft. is Lower Tertiary (Paleocene to Lower Eocene) in age. This age is indicated by the occurrence of *Dacrydium balmei, Triorites edwardsii* and *Tricolpites gillii,* three species which together with several unnamed dicotyledonous types are components of the Paleocene to Lower Eocene microfloras in the Pebble Point Formation, Western Victoria, the deposit at Lal Lal near Ballarat (Vic. Dept. of Mines Bore 51, 425-34 ft.) and the Benwerrin Brown Coal.

This is the first record of a Paleocene to Lower Eocene microflora in eastern Victoria.

B. Bore 159 in SE. corner of Allotment 62A, Section A (Fig. 1).

Six samples (at 306, 290, 265, 250, 202 and 192 ft.) have been examined. The 'Jurassic' sediments represented by the two samples taken at 306 ft. and 290 ft. contain no microfossils. The deposits represented by the other samples which contain Lower Cretaceous and Paleocene pollen and spore assemblages consist of (a) grey clay at 265 ft. which overlies unfossiliferous sediments logged as Jurassic (Fig. 1), and (b) the sample at 250 ft. (representative of the 17 ft. of ligneous sandy clay occupying the portion of the core between 248 and 265 ft.) and the samples at 202 and 192 ft. (representing the ligneous sandy clay and grey sandy clay underlying the brown coal).

1. Grey clay at 265 ft. (Vic. Geol. Surv. Mus. No. 54081). Spores and pollen grains are neither numerous nor well preserved at this level, but the Cretaceous character of the microflora is evident from the occurrence in it of *Cicatricosisporites australiensis*. This microflora bears a definite resemblance to the microflora present in the sediments at 178 and 174 ft. in Bore 137 and it is probable that its age is likewise Lower Cretaceous (Table 1). The apparent absence of dicotyledonous pollen grains supports such a correlation.

2. Ligneous sandy clay at 250 ft. (Vic. Geol. Surv. Mus. No. 54082). This deposit has a high carbonaceous content comprising spores, pollen grains, cuticular fragments and a dinoflagellate of the *Deflandrea* type. The microflora is Tertiary in character and Paleocene to Lower Eocene in type.

Spores of ferns account for *c.* 14% of the total spore and pollen content (Table 2). The majority are more or less smooth trilete types some of which strongly resemble spores of Australian species of *Cyathea*, a few smooth-walled monolete types have also been observed, *Gleichenia circinidites* occurs infrequently.

The most striking feature of this deposit is the high content (*c.* 78%) of conifer pollen. This includes *Araucariacites australis* Cookson, several two-winged podocarp types, *Microcachryidites antarcticus, Dacrycarpites australiensis* Cookson and Pike, *Dacrydium florinii, D. mawsonii, Podosporites micropterus.*

Pollen grains of dicotyledons are comparatively sparse (*c.* 8%). They include *Triorites edwardsii, Nothofagus* spp. (*brassi* type), *Tricolpites gillii.*

3. Ligneous sandy clay at 202 ft. (Vic. Geol. Surv. Mus. No. 54083). The carbonaceous content of this deposit is high and consists of cuticular and woody fragments and a relatively large number of spore and pollen grains.

The microflora is essentially similar to that of the ligneous clay at 250 ft. but differs from it in the relative proportions of the several groups (see Table 2). At the higher level (202 ft.) dicotyledonous types are more abundant and more varied.

Gymnosperm pollen types include *Ephedra notensis* Cookson, *Araucariacites australis, Microcachryidites antarcticus, Dacrydium florinii, D. mawsonii, D. balmei* and *Podosporites micropterus.*

Dicotyledonous types include several undescribed species and *Nothofagus* (*brassi* type) and *Tricolpites gillii.*

4. Grey clay at 192 ft. (Vic. Geol. Surv. Mus. No. 54084). There is considerably less carbonaceous material in this deposit than at 202 ft., the contained microflora shows no appreciable change in character.

C. Bore 138 in SE. corner of Allotment 62A, Section A (Fig. 1).

Seven samples taken (at 240, 218, 208, 203, 194, 188 and 179 ft.) have been examined. All occur below the level of the brown coal which occupies 114 ft. of the upper portion of the core (Fig. 1).

1. Sandy clay logged as Jurassic at 240 ft. (Vic. Geol. Surv. Mus. No. 51314). No plant microfossils were recovered from this deposit.

2. Coarse grey sandy clay at 218 ft. (Vic. Geol. Surv. Mus. No. 51312), black ligneous clay at 208 ft. (Vic. Geol. Surv. Mus. No. 51311) and brown clay at 203 ft. (Vic. Geol. Surv. Mus. No. 51310).

The pollen and spore content of all these sediments is the same, only the relative proportions of cuticular to woody tissue varying in the individual deposits. The microflora is Paleocene to Lower Eocene in type, the approximate percentages of the groups represented in it are given in Table 2.

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The spores and pollen grains recognized are:

Bryophyta—*Sphagnites australis f. parva.*

Pteridophyta—*Gleichenia circinidites* and a verrucate monolete form similar to the spores of living species of *Phymatodes.*

Coniferae—*Araucariacites australis, Dacrydium florinii, D. balmei, D. mawsonii, Microcachryidites antarcticus* and *Podosporites micropterus.*

Dicotyledonae—*Nothofagus aspera* Cookson, *Nothofagus* spp. (*brassi* type), *Triorites edwardsii, Tricolpites gillii.*

The alga *Botryococcus braunii* Kützing and a dinoflagellate of the *Deflandrea* type occur sparsely, suggesting brackish water sedimentation.

3. Grey sandy clay at 188 ft. (Vic. Geol. Surv. Mus. No. 51306). The carbonaceous content of this portion of the core is considerably lower than that at 218, 208 and 203 ft. and consists mainly of *Nothofagus* pollen. The dominance of Nothofagus at this level is in striking contrast to its infrequent representation in the lower and apparently older sediments in the bore. This distinction in pollen content is further emphasized by the introduction of such modern dicotyledonous types as *Anacolosidites luteoides* Cookson and Pike, *Banksieidites* sp., *Cupanieidites orthoteichus* Cookson and Pike, *Santalumidites cainozoicus* Cookson and Pike and *Triorites harrisii* Couper.

The relative proportions of the various groups present are ferns *c.* 1%, conifers *c.* 15% and dicotyledons *c.* 84%. The following individual types have been identified:

Gymnospermae—*Dacrydium mawsonii, Microcachryidites antarcticus, Dacrycarpites australiensis, Podosporites micropterus.*

Dicotyledonae—*Anacolosidites luteoides, Banksieidites* sp., *Nothofagus aspera, N. deminuta* Cookson, *N. emarcida* Cookson, *N. falcata* Cookson, *N. vansteenisi* Cookson, *Santalumidites cainozoicus, Tricolpites thomasii* Cookson and Pike, *Triorites harrisii, Triorites magnificus* Cookson.

4. Ligneous and grey sandy clay at 179 ft. (Vic. Geol. Surv. Mus. No. 51305). Apart from the appearance of a few new dicotyledonous genera, the microflora at this level is similar to that occurring at 188 ft.. *Nothofagus* pollen is still the most frequent but its proportion in relation to the total collective occurrence of the other dicotyledonous types is lower.

The percentage frequencies of the major groups present are: ferns 1%, conifers 20%, dicotyledons 79% (*Nothofagus* 42%). The following types occur:

Gymnospermae—*Dacrycarpites australiensis, Dacrydium florinii, D. mawsonii, Podosporites micropterus.*

Dicotyledonae—*Anacolosidites luteoides Banksieidites* sp., *Beaupreaidites elegansiformis* Cookson, *Casuarinidites cainozoicus* Cookson and Pike, *Myrtaceidites eugeniioides* Cookson and Pike, *M. mesonesus* Cookson and Pike, *Nothofagus aspera, N. cincta* Cookson, *N. emarcida, N. falcata, N. incrassata* Cookson, *Proteacidites crassus* Cookson, *Tricolpites thomasii, Triorites magnificus.*

COMMENTS

Since the lowest sample, at 240 ft., logged as Jurassic contains no microfossils it cannot be correlated, on this basis, with the Lower Cretaceous portions of Bores 137 and 159.

The deposit at 218 ft. in Bore 138 is clearly of Tertiary age and, since it contains *Triorites edwardsii* and *Tricolpites gillii*, can be correlated with the Paleocene to Lower Eocene deposits in the Alberton West Bores 137 and 159 (Table 1) and with

sediments in Western Victoria, such as the Pebble Point Formation, the Eastern View Coal Measures, the Benwerrin Coal, and those in the Birregurra Bore between 1,006 and 1,020 ft. and the Nelson Bore between 3,650 and 4,025 ft.

The microflora at 188 ft. has a distinctly younger aspect because it includes several dicotyledonous pollen types comparable with those of living genera. Most of these are present in Australian post Paleocene to Lower Eocene beds.

The occurrence at this level of *Anacolosidites luteoides*, *Triorites magnificus* and *Tricolpites thomasii*, which elsewhere appear to be restricted to Eocene beds (post Pebble Point Formation (Baker 1953)), suggests a similar age for the Alberton West deposit at 188 ft. in Bore 138.

Triorites magnificus has been recorded from the brown coal at Moorlands, the coaly deposit of the Canopus Bore between 925 and 860 ft. and at Noarlunga in South Australia, and from the Birregurra Bore between 925 and 760 ft. and Darriman (Frome-Broken Hill Ltd.) Bore No. 1 at 1,942 to 1,941 ft. in Victoria.

Tricolpites thomasii occurs in the Canopus Bore, South Australia, between 925 and 860 ft., in the Birregurra Bore No. 1 at 843 to 842 ft. and at Castle Cove in Victoria, and in the Vegetable Creek deposits in New South Wales.

Anacolosidites luteoides has been recorded from the deposit in the Canopus Bore, South Australia, between 910 and 900 ft., the Birregurra Bore, Victoria, between 898 and 760 ft., the carbonaceous sandstones at Anglesea, Victoria, and from the Dilwyn Clay, Victoria.

The mircroflora of which the above-mentioned species are components are more or less comparable with 'Microflora C' as originally described from the Birregurra Bore (Cookson 1954). However, the index species of 'Microflora C' *Proteacidites pachypolus* Cookson and Pike has not been observed in any of the comparable deposits at Alberton West.

D. Bore 158 from SE. corner of Allotment 62A, Section A.

Only samples from 212, 182 and 174 ft. have yielded spores and pollen grains in sufficient numbers for consideration.

1. From the sandstone at 212 ft. (Vic. Geol. Surv. Mus. No. 54088) a few examples of *Cicatricosisporites australiensis* have been observed. This indicates a Cretaceous rather than the Jurassic age cited in the bore log.

2. The ligneous clays at 192 ft. (Vic. Geol. Surv. Mus. No. 54086) and at 174 ft. (Vic. Geol. Surv. Mus. No. 54085) contain a microflora similar to the one occurring at 188 ft. in Bore 138 in which *Nothofagus* pollen predominates (Table 1). This microflora is younger in type than that of the Paleocene to Lower Eocene deposits of Alberton West and Western Victoria and its occurrence in beds at the same stratigraphical position (beneath the brown coal) in Bore 158 at 192 ft., and Bore 138 at 188 ft. suggests that both deposits are of approximately the same age, i.e. Eocene (post Pebble Point Formation).

E. Bore 135 from SE. corner of Allotment 62A, Section A.

Samples from 237, 229, 215, 193, 174 and 153 ft. have been examined.

1. The mudstone between 237 (Vic. Geol. Surv. Mus. No. 54072) and 215 ft. (Vic. Geol. Surv. Mus. No 54070) logged as Jurassic contains a Lower Cretaceous microflora approaching that at 178 and 174 ft. in Bore 137, at 212 ft. in Bore 158 and at 265 ft. in Bore 159 (Table 1).

2. The brownish clay between 193 ft. (Vic. Geol. Surv. Mus. No. 54069) and 174 ft. (Vic. Geol. Surv. Mus. No. 54068) contains a microflora which, in the

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occurrence of *Triorites edwardsii*, is comparable with that found in the Paleocene to Lower Eocene sediments at 165 and 136 ft. in Bore 137, at 225 ft. in Bore 157 and at 203 and 218 ft. in Bore 138 (Table 1).

TABLE 1

Stratigraphical correlations between the sediments in some Alberton West Bores

Age	Bore 137 ft.	Bore 159 ft.	Bore 138 ft.	Bore 158 ft.	Bore 135 ft.
Eocene (post Pebble Point Formation)			179 188	174 192	
Paleocene—Lower Eocene	136 165	192 202 250	203 208 218		174 193
Lower Cretaceous	174 178	265		212	215 237

Quantitative Composition of some Victorian Paleocene to Lower Eocene Microfloras

Quantitative analyses of early Tertiary microflora containing *Triorites edwardsii* from Alberton West compare closely with similar microfloras from carbonaceous deposits at Coal Mine Creek near Eastern View, Lal Lal near Ballarat (Victorian Department of Mines Bore 51 at 425-435 ft.), Pebble Point near Princetown and Benwerrin.

TABLE 2

Percentage composition of the microflora present in Early Tertiary deposits at Alberton West and in Paleocene—Lower Eocene deposits of Western Victoria

Plant Groups	Eastern Victoria									Western Victoria			
	Alberton West									Coal Mine Creek	Lal Lal	Pebble Point	Benwerrin
	Bore 138					Bore 137		Bore 159					
	179′	188′	203′	208′	218′	136′	165′	192′	250′				
Pteridophyta and Bryophyta ..	1	1	7	10	9	7	33	3	15	6	29	11	11
Gymnospermae (Coniferae) ..	21	15	77	80	77	73	55	80	78	76	48	50	25
Dicotyledonae (excluding *Nothofagus*) ..	36	14	13	9	12	18	12	15	7	15	20	37	64
Nothofagus ..	42	70	3	1	2	2	—	2	—	3	3	2	—

Eocene (Post Pebble Point Formation)

Paleocene—Lower Eocene

These analyses reveal that coniferous pollen grains greatly outnumber those of other groups (Table 2) in the Coal Mine Creek, Lal Lal and Alberton West deposits. This high frequency suggests that similar plant communities, probably of coniferous type with ferns and dicotyledonous species as secondary components, existed in these areas.

The predominance of dicotyledonous pollen grains and the relatively low content of coniferous pollen in the Benwerrin coal indicate a different type of plant community.

Two possible reasons for this variance are suggested, namely—

(1) the flora of the Benwerrin coal may have been somewhat younger than that represented in the Alberton West, Eastern View and Lal Lal deposits when a greater number and variety of dicotyledonous forms would be expected; (2) it may have existed approximately contemporaneously with the floras represented in the other deposits but under different ecological conditions.

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