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UPPER MESOZOIC MICROFLORAS FROM SOUTH-EASTERN AUSTRALIA

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University of Queensland**Abstract**

Dispersed spores from Upper Mesozoic sediments of SE. Australia are described in detail and an account is given of their stratigraphical and geographical distribution. The samples examined are broadly representative of the partly marine Upper Mesozoic sequence developed in the South Australian portion of the Great Artesian Basin and the non-marine successions of the Otway Basin and E. Victoria. This paper includes systematic descriptions of 110 dispersed-spore species embracing 60 genera. 25 new species and 5 new genera are proposed, and the diagnoses of 7 genera have been amended. Serial sections of 28 species, including azonate, zonate, and saccate forms, are discussed, and it is shown that sections aid the elucidation of wall features. Consideration is given to relevant problems in dispersed-spore nomenclature and taxonomy, and the system initiated by Potonié and Kremp for the classification of forms referable to the Anteturma Sporites H. Potonié is revised. Botanical relationships are indicated for certain of the spore taxa. 3, distinct, successive, microfloral assemblages are distinguishable in sediments examined from the Great Artesian Basin and from elsewhere in SE. Australia. The presence in each of the microfloras of species recorded previously from both within and without Australia permits inter-Australian and world-wide correlation. Evidence is adduced as to the ages of the microfloras and it is concluded that they are of probable lowermost Cretaceous (Valanginian or older), Valanginian-Aptian, and Aptian-Albian ages respectively.

Introduction

The present account incorporates the results of a detailed investigation of dispersed spores from SE. Australian Upper Mesozoic strata. The object of this study was twofold: firstly, to describe systematically the spores, and secondly, to utilize the spores in the inter-Australian and world-wide correlation of SE. Australian Upper Mesozoic sediments.

Results of preliminary palynological (spore) analyses of Mesozoic deposits from E. Australia were presented by Cookson (1953, 1954), Cookson and Dettmann (1958a, b; 1959a, b), and Dettmann (1959). These authors demonstrated that regional correlations of E. Australian Mesozoic strata are possible by means of the microfloras contained therein. The material upon which their investigations were based include marine and non-marine samples from scattered outcrops and bore sequences in the Great Artesian Basin, Victoria, Queensland, and Papua. The majority of the samples yielded diverse and well-preserved microfloras which suggested a Lower Cretaceous age. Further evidence for such an age is provided by numerous other samples, recorded herein, from well-documented reference sequences in the Great Artesian and Otway Basins.

Many of the SE. Australian spore types are referable to spore species previously described from other parts of the world. The spore species are based on morphological criteria and are assigned to similarly based generic categories (form genera). These form categories are classified into an artificial system since the botanical affinities of the larger majority of pre-Quaternary dispersed spore forms are unknown. Nomenclature of the taxa of generic and lower rank is determined by the

4. Devil's Kitchen, Gellibrand River (sample P22584).

The sample, which was taken from just below the Mesozoic/Palaeocene unconformity, has yielded a sparse microflora referable to the Paradoxa Assemblage. Age: Aptian-Albian.

5. Forrest Bore No. 1, sample 7 (P16770).

The sample yielded a poorly preserved microflora which, in containing *Crybelosporites striatus*, *Pilosisorites notensis*, *Foraminisporis asymmetricus*, *F. wonthaggiensis*, and *Rouseisorites reticulatus*, is probably referable to the Speciosus Assemblage. The occurrence of *Crybelosporites striatus* together with *Pilosisorites notensis* is indicative of an Aptian age.

6. Bellarine Peninsula, sample P22586.

A well-preserved, prolific microflora representative of the Paradoxa Assemblage was recovered from this sample (see also Cookson and Dettmann 1958a, b). Age: Aptian-Albian.

7. Barrabool Hills, sample P22587.

The presence of the Speciosus Assemblage suggests that the sample was taken from a horizon stratigraphically below the deposit examined by Cookson and Dettmann (1958b). The occurrence of *Pilosisorites notensis* and *Crybelosporites striatus* indicates an Aptian age.

8. Birregurra Bore No. 1 between 1,079 ft and 1,102 ft.

Certain of the species recovered from these horizons are listed by Cookson and Dettmann (1958b, p. 120); these species comprise a microflora referable to the Paradoxa Assemblage. Age: Aptian-Albian.

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1. San Remo Peninsula, sample P22588.

A comparatively poorly preserved microflora referable to the Speciosus Assemblage was recovered from this deposit which was examined by Cookson and Dettmann (1958b). Age: Valanginian-Aptian.

2. Kilcunda, sample M.U.G.D. 2513.

This coal yielded a restricted microflora with species diagnostic of the Speciosus Assemblage. Age: Valanginian-Aptian.

3. Wonthaggi State Coal Mine Area.

Samples P22589 to P22598 inclusive, some of which were examined by Cookson and Dettmann (1958b), all contain the Speciosus Assemblage indicative of a Valanginian-Aptian age.

The coal, P22599, from Kirrak Area yielded *Crybelosporites stylosus*, and is the only Victorian sample in which the Stylosus Assemblage has been identified. Age: lowermost Cretaceous (Valanginian or older).

4. Cape Paterson.

Samples P22600 and P22601 (studied earlier by Cookson and Dettmann 1958b) both contain well-preserved microfloras representative of the Speciosus Assemblage. Species present include *Dictyotosporites speciosus*, *Cyclosporites hughesi*, and *Pilosisorites notensis*. Age: Valanginian-Aptian.

5. Outtrim.

The highly carbonaceous samples from Bore No. 6, Bore No. 7, and Bore No. 8 have yielded restricted microfloras referable to the Speciosus Assemblage. Age: Valanginian-Aptian.

6. Jumbunna Bore No. 57 between 230 ft and 1,107 ft.

Each of the samples examined contains a poorly-preserved microflora recognizably conformable with the Speciosus Assemblage. Stratigraphically important species include *Dictyosporites speciosus*, *Krauselisporites linearis*, and *Pilosporites notensis*. Age: Valanginian-Aptian.

7. Whitelaw Railway Station, sample P12805.

This sample, which was studied by Cookson and Dettmann (1958b), yielded a microflora referable to the Speciosus Assemblage. Age: Valanginian-Aptian.

8. Paradise Creek, Boola Forest; sample P22733.

A prolific, but poorly preserved, microflora referable to the Speciosus Assemblage was obtained from this sample which was collected from near the base of the Tyers Group at Paradise Creek. Stratigraphically important species include *Dictyosporites speciosus*, *Murospora florida*, *Contignisporites cooksonii*, and *Biretisporites spectabilis*. Age: Valanginian-Aptian.

9. Rintoul's Creek, sample P22602.

This outcrop sample of the Tyers Group contains a poorly preserved microflora not certainly identifiable with either the Stylosus or Speciosus Assemblages. *Contignisporites cooksonii* is the only stratigraphically significant species that has been recognized.

Another sample from the Tyers Group (Tyers Bore No. 2 at 860 ft) was studied by Cookson and Dettmann (1958b) and contains the Speciosus Assemblage indicative of a Valanginian-Aptian age.

10. Bengworden South Bore No. 1 at 3,977 ft.

A well-preserved microflora referable to the Speciosus Assemblage was identified in this horizon from which Cretaceous foraminifera have been reported (Taylor in Webb 1961). Microplanktonic organisms have not been observed in the writer's preparations, and constituent spore species include *Dictyosporites speciosus*, *Pilosporites notensis*, *Cicatricosisporites hughesi*, and *Cooksonites variabilis*. Age: Valanginian-Aptian.

The following E. Victorian samples, not mentioned above but studied by Cookson and Dettmann (1958b) and Dettmann (1959), contain the Speciosus Assemblage: Korumburra Sunbeam Collieries, shale above coal at 350 ft. Woodside Well No. 2 between 6,402-8,860 ft. Woodside Well No. 3 between 5,711-24 ft. Hedley Well No. 1 between 2,099-2,132 ft. The age of these deposits is considered as Valanginian-Aptian. The sample at 6,892 ft in Woodside Well No. 2 contains *Dictyosporites speciosus*, *Cyclosporites hughesi*, and *Crybelosporites striatus* which suggest that the horizons between 6,402 ft and 6,892 ft in this bore are Aptian in age.

E. Victorian deposits in which *Coptospora paradoxa* has been identified include: Woodside Well No. 1 between 5,950-55 ft. Woodside Well No. 2 between 4,114-256 ft. Woodside Well No. 3 at 5,386 ft. The microfloral evidence indicates that these horizons are Aptian-Albian in age.

3. Comaam Bore No. 2, sunk by South Australian Department of Mines, Hundred of Comaam (see Ludbrook 1961b). Core samples of the Runnymede Formation from:
 - (a) 651 ft, grey mudstone; D367.
 - (b) 708 ft, grey siltstone; D248, D262.

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1. Dergholm Bore No. 1, sunk by Victorian Department of Mines, Parish of Dergholm. Earth socket sample from 532 ft; brownish-grey mudstone; D210, D216, D299, ICC60/1.
2. Devil's Kitchen, 3½ miles SE. of mouth of Gellibrand River. Outcrop sample; grey mudstone from below Mesozoic/Palaeocene unconformity, Otway Group; coll. G. Baker, P22584; D219, D223.
3. Barongarook Creek, W. branch, 3 miles SE. of Colac. Outcrop sample; brownish siltstone with plant fragments, Otway Group; coll. E. D. Gill, P22585; D203.
4. Forrest Bore No. 1, sunk by Victorian Department of Mines. Core sample 7; dark grey mudstone containing *Velesunio* sp., Otway Group; P16770; D165.
5. Parish of Bellarine. Grey mudstone probably from No. 2 shaft marked on Q.S. 23 SE.; P22586; D163.
6. Barrabool Hills. Grey mudstone from carbonaceous conglomerate outcrop along Barwon River, Barrabool Sandstone; P22587; D249.

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1. San Remo Peninsula. Outcrop sample; dark grey mudstone containing *Sphenopteris hispoli* Oldham & Morris from above coal measures; Strzelecki Group; P22588; D145, D150.
2. Kilcunda. Dull coal from outcrop on beach, Strzelecki Group; MUGD 2513; D134.
3. Wonthaggi State Coal Mine Area.
 - (a) Grey shale, from an unspecified locality, containing '*Coniopteris hymenophylloides*' Brongn., Strzelecki Group; P22589; D239, D240.
 - (b) No. 18 shaft. Banded coal, Strzelecki Group; coll. A. B. Edwards, P22590; D143, D278.
 - (c) No. 18 shaft, Bore No. 2 at base of pillar. Coal, Strzelecki Group; coll. A. B. Edwards, P22591; D193.
 - (d) No. 20 shaft, bottom seam, 1 E. (SE. dip). Blue coal, Strzelecki Group; coll. A. B. Edwards, P22592; D140.
 - (e) No. 20 shaft, bottom seam, 1 E. (SE. dip). Splint and blue coal, Strzelecki Group; coll. A. B. Edwards, P22593; D141.
 - (f) Western Area, top seam (W. dip). Coal, Strzelecki Group; P22594; D170.
 - (g) Western Area, bottom seam (W. dip). Coal, Strzelecki Group; P22595; D171.
 - (h) Western Area, top seam (E. workings). Coal, Strzelecki Group P22596; D142, D277.
 - (i) Western Area, Bore No. ? at 100-140 ft. Coal, Strzelecki Group; P22597; D138.
 - (j) Kirrak Area, W. heading (2). Coal, Strzelecki Group; coll. A. M. S. Ketch, P22598; D137.
 - (k) Kirrak Area, W. heading (41²). Coal, Strzelecki Group; coll. A. M. S. Ketch, P22599; D139.
4. Cape Paterson.
 - (a) Shore platform near Petrel Rock, between Inverloch and Cape Paterson. Outcrop sample; grey mudstone, Strzelecki Group; coll. A. Baker, P22600; D146, D149.
 - (b) Shore platform E. of dyke marked on Q.S. 76 SW., W. of Inverloch. Outcrop sample; grey laminated siltstone with plant fragments, Strzelecki Group; coll. E. D. Gill, P22601; D162.
5. Parish of Outtrim.
 - (a) Bore No. 6, sunk by Victorian Department of Mines, at 225.6 ft. Core sample; coal, Strzelecki Group; D309.
 - (b) Bore No. 7, sunk by Victorian Department of Mines, at 669.9 ft. Core sample; coaly shale, Strzelecki Group; D310.
 - (c) Bore No. 8, sunk by Victorian Department of Mines, at 325.9 ft. Core sample; coaly shale, Strzelecki Group; D311.

6. Parish of Jumbunna E. Bore No. 57, sunk by Victorian Department of Mines. Core samples examined include:

Depth (ft)	Rock type	Stratigraphical unit	Preparation
230	coal	Strzelecki Group	D269
252	coaly shale	" "	D271
1,022	coal	" "	D279
1,065	coaly shale	" "	D270
1,107	" "	" "	D268

7. Whitelaw Railway Station. Outcrop sample; shale containing *Brachyphyllum gippslandicum* McCoy, Strzelecki Group (see Medwell 1954b); P12805; D176.
8. Paradise Creek, Boola Forest. Outcrop sample; highly carbonaceous slate from near base of Tyers Group; coll. J. Douglas, P22733; D397.
9. Rintoul's Creek, N. of Traralgon. Outcrop sample; coal from lowest seam, Tyers Group (see Philip 1958); coll. G. M. Philip, P22602; D316.
10. Parish of Bengworden South. Bore No. 1, sunk by commission of Commonwealth and Victorian Governments near W. shore of Lake Victoria, at 3,977 ft. Core sample; grey mudstone (see Crespin 1941, Webb 1961); Victorian Department of Mines No. 44627; D315.

NEW SOUTH WALES

1. County Gregory, Warren District; Portion 6, Parish Nina; Bore No. 10528 at 560 ft. Coal; P22603; D319.

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Explanation of Plates

PLATE I

All figures $\times 500$ unless otherwise specified; from unretouched negatives.

- Fig. 1-3—*Cyathidites australis* Couper. 1, Proximal focus; Robe Bore No. 1 at 4,300 ft, D227b/2 49.2 127.5 (P21960). 2, Distal focus; Robe Bore No. 1 at 3,860 ft, D226/1 54.9 121.3 (P21961). 3, Proximal focus of corroded specimen; Wonthaggi, sample P22589, D239/2 39.3 119.8 (P21962).
- Fig. 4, 5—*Cyathidites minor* Couper. 4, distal view; Tilcha Bore No. 2 at 460-80 ft, D218/1 40.6 127.0 (P21963). 5, Proximal focus, Wonthaggi No. 20 shaft, sample P22593, D141/1 55.6 127.9 (P21964).
- Fig. 6-9—*Cyathidites punctatus* (Delcourt & Sprumont). 6, 7, Proximal and distal foci; Penola Bore No. 1 at 1,805-15 ft, D294/1 29.9 110.2 (P21965). 8, Optical section of specimen showing 'lips' at margins of one laesura; Penola Bore No. 1 at 1,805-15 ft, D286/2 54.9 127.1 (P21966). 9, Proximal view of corroded specimen; Robe Bore No. 1 at 1,400 ft, D217/9 35.5 119.3 (P21967).
- Fig. 10-16—*Cyathidites asper* (Bolkhovitina). 10, 11, Proximal and sectional foci; Penola Bore No. 1 at 1,805-15 ft, D286/2 54.7 110.0 (P21966). 12, 13, Sectional and distal foci; Penola Bore No. 1 at 1,610-20 ft, D295/1 55.5 108.7 (P21968). 14, Corroded specimen, proximal view; Robe Bore No. 1 at 1,400 ft, D224/1 33.7 112.2 (P21969). 15, lateral view; Penola Bore No. 1 at 1,610-20 ft, D295/2 35.0 120.8 (P21970). 16, Section showing one-layered exine which is weakly thickened at laesurate margins; Robe Bore No. 1 at 1,400 ft, D217/S58b/1 27.2 117.3 (P21971).
- Fig. 17-19—*Cyathidites concavus* (Bolkhovitina). 17, Distal focus; Cootabarlow Bore No. 2 at 1,330-48 ft, D338/1 34.9 123.8 (P21972). 18, 19, Proximal and sectional foci; Cootabarlow Bore No. 2 at 1,469-70 ft, D302/9 33.8 116.7 (P21973).
- Fig. 20, 21—*Stereisporites antiquasporites* (Wilson & Webster). 20, $\times 750$ showing distal polar and equatorial radial thickenings; Cape Paterson, sample P22600, D146/1 57.8 115.2 (P21974). 21, Proximal view $\times 750$; Robe Bore No. 1 at 3,325 ft, D245/2 48.9 123.8 (P21975).

PLATE II

All figures $\times 500$ and from unretouched negatives

- Fig. 1, 2—*Biretisporites* cf. *B. potoniaei* Delcourt & Sprumont. Proximal and distal foci; Robe Bore No. 1 at 1,780 ft, D339/1 47.0 110.2 (P21976).
- Fig. 3, 4—*Biretisporites spectabilis* sp. nov. Holotype; proximal surface, high and low foci. Cootabarlow Bore No. 2 at 1,376-77 ft, D289/3 46.5 123.8 (P21977).
- Fig. 5-8—*Biretisporites spectabilis* sp. nov. 5, Proximal view; Kopperamanna Bore at 2,970 ft, D241/1 47.3 121.3 (P21978). 6, Lateral view; Cootabarlow Bore No. 2 at 1,376-77 ft, D289/35 22.1 110.0 (P21979). 7, 8, Sections showing one-layered exine which forms the elevated laesurate lips; Cootabarlow Bore No. 2 at 1,376-77 ft, D289/S69/1-2 55.3 124.0 and 46.0 123.0 (P21980).
- Fig. 9-12—*Dictyophyllidites pectinataeformis* (Bolkhovitina). 9, Proximal view showing thickened laesurate margins and membranous lips; Penola Bore No. 1 at 1,805-15 ft, D286/2 57.4 125.0 (P21966). 10-12, Proximal, sectional, and distal foci; Robe Bore No. 1 at 1,400 ft, D224/1 22.6 116.6 (P21969).

PLATE III

All figures $\times 500$ unless otherwise specified; from unretouched negatives.

- Fig. 1, 2—*Dictyophyllidites crenatus* sp. nov. Holotype, proximal and sectional foci. Cootabarlow Bore No. 2 at 1,469-70 ft, D302/17 38.0 119.4 (P21981).
- Fig. 3-5—*Dictyophyllidites crenatus* sp. nov. 3, Proximal view; Penola Bore No. 1 at 3,850-55