APPENDIX IV

PALYNOLOGICAL REPORT

HAWKESDALE NO. 1, 1,245-5,690 FEET

by

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CONTENTS

PALYNOLOGICAL REPORT ON HAWKESDALE No.1 WELL, 1245 - 5690 FEET

INTRODUCTION

Twenty three samples of cores taken from Hawkesdale No.1 well in the Otway Basin have been examined palynologically in an attempt to date the sediments occurring between 1245 feet and 5690 feet. Samples investigated include sidewall cores from the Eumeralla formation (1245 - 3095 feet), the Pretty Hill sandstone (3159 - 3925 feet), and from thin carbonaceous horizons within and below a volcanic sequence (4025 - 5690 feet).

The samples were prepared for palynological examination by procedures involving the use of hydrofluoric acid, zinc bromide, and ultrasonic vibration (see Dettmann 1968a). The ultimate residues were examined for the yield and preservation quality of the contained plant microfossils. All but the lowest two samples of the Eumeralla formation were found to contain abundant and diverse plant microfossil suites in a fair to good state of preservation (see Table 1). Several samples from the upper part of the Pretty Hill sandstone also yielded reasonably well preserved plant microfossils in sparse to fair concentrations. However, samples from the lower portion of the formation were found to be almost completely devoid of plant material (Table 1). Samples taken from below the Pretty Hill sandstone at 5627 feet and 5634 feet were found to contain moderately carbonized plant matter, including common to sparse spores and pollen grains whilst horizons at 4025 feet

69/100

and 5690 feet failed to yield plant material of any description (Table 1).

Detailed qualitative and quantitative analyses of the spore-pollen floras was carried out after the residues were further treated with Schulze solution followed by brief immersion in 1% ammonium hydroxide. Residues from the Eumeralla formation and the Pretty Hill sandstone were subjected to the Schulze treatment for 1 - 3 minutes; those from 5627 feet and 5634 feet for 10 - 15 minutes.

An assessmant of the microfloral evidence indicates that the sequence incorporates strataof?late Jurassic and Lower Cretaceous age, and that it may be subdivided in terms of the spore-pollen zonation scheme outlined by Dettmann and Playford (1969) and Dettmann (1969 a,b). The Eumeralla formation includes sediments attributable to the Crybelosporites striatus Subzone (1245 - 1442 feet) and to the Foraminisporis asymmetricus Unit of the Cyclosporites hughesi Subzone (1714 - 2878 feet). Zonal attribution of the Pretty Hill sandsone is less securely based, owing to paucity of contained microfloras; however, there is some evidence that horizons at 3340 feet and 3475 feet are probably within the Murospora florida Unit of the Cyclosporites hughesi Subzone. Sediments at 5627 feet and 5634 feet, beneath a volcanic sequence, are of uppermost Jurassic or lowermost Cretaceous age; their microfloras contain insufficient diagnostic species for more precise age determination.

70/100

Microfloras of the Eumeralla formation and the Pretty Hill sandstone are composed chiefly of land derived plant microfossils, including spores, pollen grains, and wood and cuticular material. Some samples also yielded occassional examples of forms of uncertain derivation but possibly referable to the Acritarcha. Reworked spores and pollen grains were also noted in the majority of samples; these occur rarely and include forms of Permian, Triassic, and early Cretaceous age.

Microfloras obtained from sediments at 5627 feet and 5634 feet beneath the volcanic sequence, are composed entirely of land derived plant microfossils and include significant proportions (up to 30%) of reworked Permian and Triassic spores and pollen grains.

2. MICROFLORAL CONTENT AND AGE OF SAMPLES

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

A. 1245 - 1442 feet

1245 feet

An abundant and diverse assemblage of well preserved plant microfossils was obtained from the sample. Types identified include:

71/100

Spores:	Aequitriradites spinulosus (Cookson & Dettmann)	R
	Baculatisporites comaumensis (Cookson)	R
	Ceratosporites equalis Cookson & Dettmann	R
	Cicatricosisporites australiensis (Cookson)	C
	C. hughesi Dettmann	R
	Concavissimisporites cf. penolaensis Dettmann	R
	Crybelosporites striatus (Cookson & Dettmann)	R
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab
	C. punctatus (Delcourt & Sprumont)	C
	Dictyophyllidites crenatus Dettmann	R
	Dictyotosporites filosus Dettmann	R
	D. speciosus Cookson & Dettmann	R
	Foraminisporis asymmetricus (Cookson & Dettmann)	R
	F. wonthaggiensis (Cookson & Dettmann)	R
	F. dailyi (Cookson & Dettmann)	R
	Leptolepidites verrucatus Couper	R
	Lycopodiumsporites austroclavatidites (Cookson)	C
	L. eminulus Dettmann	R
	Matonisporites cooksoni Dettmann	R
	Neoraistrickia truncata (Cookson)	R
	Pilosisporites notensis Cookson & Dettmann	R
	Stereisporites antiquasporites (Wilson & Webster)	Ab
	Velosporites triquetrus (Lantz)	R
Pollen:	Araucariacites australis Cookson	Ab
	Alisporites grandis (Cookson)	Ab
	A. similis (Balme)	Ab
	Classopollis cf. classoides Pflug	C
	Cycadopites nitidus (Balme)	C
	Microcachryidites antarcticus Cookson	Ab
	Podocarpidites cf. ellipticus Cookson	Ab
Incertae Sedis:	Schizosporis reticulatus Cookson & Dettmann	R
	S. spriggi Cookson & Dettmann	R

1442 feet

The sample yielded abundant, reasonably well preserved spores and pollen grains. Species identified include:

Spores:	Baculatisporites comaumensis (Cookson)	Ab
	Ceratosporites equalis Cookson & Dettmann	C
	Cicatricosisporites australiensis (Cookson)	C
	C. hughesi Dettmann	R
	Crybelosporites striatus (Cookson & Dettmann)	R
	Cingutriletes clavus (Balme)	R
	Cyclosporites hughesi (Cookson & Dettmann)	R
	Cyathidites australis Couper	Ab
	C. minor Couper	C
	C. punctatus (Delcourt & Sprumont)	R

72/100

	Dictyotosporites speciosus Cookson & Dettmann	C
	D. complex Cookson & Dettmann	R
	Foraminisporis asymmetricus (Cookson & Dettmann)	C
	F. dailyi (Cookson & Dettmann)	R
	F. wonthaggiensis (Cookson & Dettmann)	R
	Ischyosporites punctatus Cookson & Dettmann	C
	Klukisporites scaberis (Cookson & Dettmann)	R
	Kuylisporites lunaris Cookson & Dettmann	R
	Leptolepidites verrucatus Couper	C
	Lycopodiumsporites austroclavatidites (Cookson)	Ab
	L. eminulus Dettmann	R
	L. facetus Dettmann	R
	L. nodosus Dettmann	R
	Neoraistrickia truncata (Cookson)	C
	Pilosisporites parvispinosus Dettmann	R
	Rouseisporites reticulatus Pocock	R
	Stereisporites antiquasporites (Wilson & Webster)	Ab
	Velosporites triquetrus (Lantz)	R
Pollen:	Alisporites grandis (Cookson)	Ab
	A. similis (Balme)	R
	Araucariacites australis Cookson	C
	Classopollis cf. classoides Pflug	C
	Cycadopites nitidus (Balme)	R
	Microcachryidites antarcticus Cookson	Ab
	Podosporites microsaccatus (Couper)	Ab
	Podocarpidites cf. elliptícus Cookson	Ab
	Tsugaepollenites dampieri (Balme)	C
Incertae Sedis:	Schizosporis reticulatus Cookson & Dettmann	R
	S. spriggi Cookson & Dettmann	R
Remanie:	Aratrisporites sp. - Triassic	R
	Lundbladispora denmeadi (de Jersey) - Triassic	R
	Striatites spp. - Permian, Triassic	R

Both samples yielded Dictyotosporites speciosus together with Crybelosporites striatus and are thus referred to the Crybelosporites striatus Subzone of Lower Albian age (see Dettmann 1969a). The lower sample (1442 feet) also yielded Cyclosporites hughesi which suggests that the horizon is near the base of the C. striatus Subzone.

B. 1714 - 2878 feet

1714 feet

Abundant plant material was extracted from the sample and the following species of fairly preserved plant microfossils

73/100

were identified:

Spores:	Baculatisporites comaumensis (Cookson)	Ab
	Ceratosporites equalis Cookson & Dettmann	R
	Cicatricosisporites australiensis (Cookson)	C
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab
	Cyclosporites hughesi (Cookson & Dettmann)	R
	Dictyotophyllidites crenatus Dettmann	C
	Dictyotosporites complex Cookson & Dettmann	C
	D. speciosus Cookson & Dettmann	C
	Foraminisporis dailyi (Cookson & Dettmann)	C
	F. wonthaggiensis (Cookson & Dettmann)	R
	Klukisporites scaberis (Cookson & Dettmann)	C
	Lycopodiumsporites austroclavatidites (Cookson)	C
	L. eminulus Dettmann	C
	L. facetus Dettmann	R
	Leptolepidites verrucatus Couper	C
	L. major Couper	C
	Neoraistrickia truncata (Cookson)	R
	Pilosisporites notensis Cookson & Dettmann	C
	Stereisporites antiquasporites (Wilson & Webster)	C
Pollen:	Alisporites grandis (Cookson)	Ab
	A. similis (Balme)	C
	Araucariacites australis Cookson	C
	Classopollis cf. classoides Pflug	Ab
	Microcachryidites antarcticus Cookson	Ab
	Podosporites microsaccatus (Couper)	R
	Podocarpidites cf. ellipticus Cookson	C
Incerate Sedis:	Schizosporis reticulatus Cookson & Dettmann	C
	S. spriggi Cookson & Dettmann	R

2018 feet

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

Spores:	Aequitriradites spinulosus (Cookson & Dettmann)	R
	A. verrucosus (Cookson & Dettmann)	R
	Baculatisporites comaumensis (Cookson)	C
	Cicatricosisporites australiensis (Cookson)	Ab
	Couperisporites tabulatus Dettmann	R
	Coronatispora foveolata Dettmann	R
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab
	Cyclosporites hughesi (Cookson & Dettmann)	R

74/100

	Dictyophyllidites crenatus Dettmann	C
	Dictyotosporites speciosus Cookson & Dettmann	R
	Foraminisporis asymmetricus (Cookson & Dettmann)	R
	F. wonthaggiensis (Cookson & Dettmann)	C
	Klukisporites scaberis (Cookson & Dettmann)	R
	Kuylisporites lunaris Cookson & Dettmann	R
	Leptolepidites verrucatus Couper	C
	L. major Couper	R
	Lycopodiumsporites austroclavatidites (Cookson)	C
	L. nodosus Dettmann	R
	Pilosisporites notensis Cookson & Dettmann	C
	P. parvispinosus Dettmann	C
	Rouseisporites reticulatus Pocock	R
Pollen:	Alisporites grandis (Cookson)	C
	Araucariacites australis Cookson	C
	Classopollis cf. classoides Pflug	C
	Microcachryidites antarcticus Cookson	Al
	Podosporites microsaccatus (Couper)	C
	Podocarpidites cf. ellipticus Cookson	Al
Incertae Sedis:	Schizosporis spriggi Cookson & Dettmann	R

2325 feet

An abundant and diverse plant microfossil assemblage was pbtained from the sample. The following species were identified:

Spores:	Aequitriradites spinulosus (Cookson & Dettmann)	C
	A. verrucosus (Cookson & Dettmann)	C
	Baculatisporites comaumensis (Cookson)	A
	Ceratosporites equalis Cookson & Dettmann	R
	Cicatricosisporites australiensis (Cookson)	R
	Cooksonites variabilis Pocock	R
	Couperisporites sp.	C
	Cyatheidites australis Couper	A
	C. minor Couper	C
	Dictyophyllidites crenatus Dettmann	R
	Dictyotosporites speciosus Cookson & Dettmann	R
	Foraminisporis asymmetricus (Cookson & Dettmann)	C
	F. dailyi (Cookson & Dettmann)	R
	F. wonthaggiensis (Cookson & Dettmann)	C
	Klukisporites scaberis (Cookson & Dettmann)	R
	Kuylisporites lunaris Cookson & Dettmann	C
	Lycopodiumsporites austroclavatidites (Cookson)	C
	L. circolumenus Cookson & Dettmann	R
	Neoraistrickia truncata (Cookson)	R
	Pilosisporites notensis Cookson & Dettmann	C
	P. parvispinosus Dettmann	R

75/100

	Rouseisporites reticulatus Pocock	R
Pollen:	Alisporites grandis (Cookson)	C
	Araucariacites australis Cookson	C
	Classopollis cf. classoides Pflug	C
	Microcachryidites antarcticus Cookson	Ab
	Podocarpidites cf. ellipticus Cookson	Ab
Incertae Sedis:	Schizosporis reticulatus Cookson & Dettmann	R
	S. spriggi Cookson & Dettmann	R
	Spheripollenites psilatus Couper	Ab
Acritarcha:	Michrystridium sp.	Ab

2576 feet

The spore-pollen content of the sample is rich, both in numerical representation and in types present. The following species were observed:

Spores:	Baculatisporites comaumensis (Cookson)	Ab
	Ceratosporites equalis Cookson & Dettmann	C
	Cicatricosisporites australiensis (Cookson)	R
	Cyclosporites hughesi (Cookson & Dettmann)	R
	Cyathidites australis Couper	Ab
	C. asper (Bolkhovitina)	C
	C. minor Couper	C
	Cooksonites variabilis Pocock	R
	Couperisporites sp.	R
	Dictyophyllidites crenatus Dettmann	R
	Dictyotosporites speciosus Cookson & Dettmann	C
	Foraminisporis wonthaggiensis (Cookson & Dettmann)	R
	Klukisporites scaberis (Cookson & Dettmann)	R
	Kuylisporites lunaris Cookson & Dettmann	R
	Leptolepidites verrucatus Couper	Ab
	Lycopodiumsporites austroclavatidites (Cookson)	Ab
	L. circolumenus Cookson & Dettmann	R
	L. eminulus Dettmann	Ab
	L. nodosus Dettmann	R
	Neoraistrickia truncata (Cookson)	R
	Stereisporites antiquasporites (Wilson & Webster)	Ab
	Trilites cf. tuberculiformis Cookson	C
	Velosporites triquetrus (Lantz)	R
Pollen:	Alisporites grandis (Cookson)	C
	Araucariacites australis Cookson	C
	Classopollis cf. classoides Pflug	C
	Cycadopites nitidus (Balme)	Ab
	Microcachryidites antarcticus Cookson	Ab
	Podocarpidites cf. ellipticus Cookson	C

76/100

2800 feet

Plant material extracted from the sample includes abundant woody tissue together with the following diverse assemblage of spores and pollen grains:

Spores:	Aequitriradites spinulosus (Cookson & Dettmann)	R
	Baculatisporites comaumensis (Cookson)	Ab
	Ceratosporites equalis Cookson & Dettmann	Ab
	Cicatricosisporites australiensis (Cookson)	C
	Couperisporites tabulatus Dettmann	R
	C. sp.	R
	Contignisporites cooksoni (Balme)	R
	Cooksonites variabilis Pocock	R
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab
	Dictyotosporites speciosus Cookson & Dettmann	R
	Foraminisporis asymmetricus (Cookson & Dettmann)	R
	F. wonthaggiensis (Cookson & Dettmann)	C
	Januasporites spinulosus Dettmann	R
	Kuylisporites lunaris Cookson & Dettmann	R
	Leptolepidites verrucatus Couper	R
	Lycopodiumsporites austroclavatidites (Cookson)	C
	L. circolumenus Cookson & Dettmann	R
	Pilosisporites notensis Cookson & Dettmann	C
	Rouseisporites reticulatus Pocock	R
	Sestrosporites pseudoalveolatus (Couper)	R
	Stereisporites antiquasporites (Wilson & Webster(	Ab
Pollen:	Alisporites grandis (Cookson)	Ab
	A. similis (Balme)	C
	Araucariacites australis Cookson	C
	Classopollis cf. classoides Pflug	Ab
	Cycadopites nitidus (Balme)	R
	Microcachryidites antarcticus Cookson	C
	Podosporites microsaccatus (Couper)	R
	Podocarpidites cf. ellipticus Cookson	Ab
Incertae Sedis:	Schizosporis reticulatus Cookson & Dettmann	R

2878 feet

A diverse plant microfossil assemblage containing the following species of spores, pollen grains, and organisms of uncertain derivation was extracted from the sample:

Spores:	Aequitriradites spinulosus (Cookson & Dettmann)	R
	A. verrucosus (Cookson & Dettmann)	R

77/80

	Baculatisporites comaumensis (Cookson)	Ab
	Ceratosporites equalis Cookson & Dettmann	R
	Cicatricosisporites ludbrooki Dettmann	Ab
	C. hughesi Dettmann	R
	Coronatispora perforata Dettmann	R
	Contignisporites cooksoni	R
	Cooksonites variabilis Pocock	R
	Cyclosporites hughesi (Cookson & Dettmann	R
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab
	C. punctatus (Delcourt & Sprumont)	C
	Dictyophyllidites crenatus Dettmann	Ab
	Dictyotosporites speciosus Cookson & Dettmann	C
	Foraminisporis asymmetricus (Cookson & Dettmann)	R
	F. wonthaggiensis (Cookson & Dettmann)	C
	Ischyosporites punctatus Cookson & Dettmann	R
	Klukisporites scaberis (Cookson & Dettmann)	C
	Kraeuselisporites irregularis (Cookson & Dettmann)	R
	Leptolepidites major Couper	R
	L. verrucatus Couper	C
	Lycopodiacidites asperatus Dettmann	R
	Lycopodiumsporites austroclavatidites (Cookson)	C
	L. circolumenus (Cookson & Dettmann)	R
	L. eminulus Dettmann	C
	Neoraistrickia truncata (Cookson)	C
	Pilosisporites notensis Cookson & Dettmann	C
	Rouseisporites reticulatus Pocock	C
	Sestrosporites pseudoalveolatus (Couper)	R
	Velosporites triquetrus (Lantz)	R
Pollen:	Alisporites grandis (Cookson)	C
	A. similis (Balme)	C
	Araucariacites australis Cookson	C
	Classopollis cf. classoides Pflug	C
	Cycadopites nitidus (Balme)	C
	Microcachryidites antarcticus Cookson	Ab
	Podocarpidites cf. ellipticus Cookson	Ab
	Podosporites microsaccatus (Couper)	C
	Tsugaepollenites dampieri (Balme)	R
Incertae Sedis:	Schizosporis reticulatus Cookson & Dettmann	R
	S. spriggi Cookson & Dettmann	C
Remanié:	Lundbladispora dermeadi (de Jersey) - Triassic	R
	Murospora florida (Balme) - early Cretaceous	R

Spore-pollen assemblages extracted from samples between 1714 feet and 2878 feet contain Dictyotosporites speciosus, Cyclosporites hughesi, and Foraminisporis asymmetricus. These species diagnose the presence of the

78/100

early Cretaceous Foraminisporis asymmetricus Unit of the Cyclosporites hughesi Subzone (see Dettmann 1969a). The representation of Cooksonites variabilis in samples between 2325 feet and 2878 feet suggests that the horizons are within the basal portion of the Foraminisporis asymmetricus Unit.

C. 2913 - 3278 feet

2913 feet

An extremely sparse assemblage of fairly preserved spores and pollen grains was extracted from the sample. One to several representatives of the following species were observed:

Spores: Baculatisporites comaumensis (Cookson)
Cicatricosisporites australiensis (Cookson)
Cyclosporites hughesi (Cookson & Dettmann)
Cyathidites australis Couper
Leptolepidites verrucatus Couper
Lycopodiumsporites austroclavatidites (Cookson)
Neoraistrickia truncata (Cookson)
Pollen: Araucariacites australis Cookson

3095 feet

This sample was found to be devoid of plant microfossils.

3159 feet

Sparse palnt material including isolated examples of the following spore-pollen species was obtained from the sample:

Spores: Baculatisporites comaumensis (Cookson)
Cyathidites australis Couper
C. minor Couper
Foraminisporis dailyi (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)
Pollen: Microcachryidites antarcticus Cookson

79/100

3278 feet

The sample provided a small residue of plant material. The following spore-pollen types occur rarely and are fairly preserved:

Spores: Aequitriradites spinulosus (Cookson & Dettmann)
Ceratosporites equalis Cookson & Dettmann
Cooksonites variabilis Pocock
Cyathidites australis Couper
C. minor Couper
Foraminisporis wonthaggiensis (Cookson & Dettmann)
Lycopodiumsporites austroclavatidites (Cookson)

Pollen: Alisporites similis (Balme)
Classopollis cf. classoides Pflug
Microcachryidites antarcticus Cookson

Samples between 2913 feet and 3278 feet yielded extremely sparse microfloras that provide insufficient evidence for precise zonal attribution of the sediments. However, it is evident that the horizons are within the Cyclosporites hughesi Subzone because of the presence of Cyclosporites hughesi at 2913 feet and of Cooksonites variabilis at 3278 feet.

D. 3340 - 3475 feet

3340 feet

A small residue containing good concentrations of plant microfossils was obtained from the sample. Species observed include:

Spores:	Aequitriradites spinulosus (Cookson & Dettmann)	C
	Baculatisporites comaumensis (Cookson)	C
	Ceratosporites equalis Cookson & Dettmann	C
	Cicatricosisporites australiensis (Cookson)	R
	Cooksonites variabilis Pocock	R
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab

80/100

	Dictyotosporites speciosus Cookson & Dettmann	R
	Dictyophyllidites crenatus Dettmann	C
	Foraminisporis dailyi (Cookson & Dettmann)	C
	F. wonthaggiensis (Cookson & Dettmann)	R
	Klukisporites scaberis (Cookson & Dettmann)	R
	Leptolepidites verrucatus Couper	R
	Lycopodiumsporites austroclavatidites (Cookson)	C
	L. nodosus Dettmann	R
	Murospora florida (Balme)	R
	Pilosisporites notensis Cookson & Dettmann	C
Pollen:	Alisporites grandis (Cookson)	Ab
	A. similis (Balme)	Ab
	Araucariacites australis Cookson	C
	Microcachryidites antarcticus Cookson	C
	Podosporites microsaccatus (Couper)	C
	Podocarpidites cf. elipticus Cookson	Ab
Incertae Sedis:	Schizosporis reticulatus Cookson & Dettmann	C
	S. spriggi Cookson & Dettmann	R

3475 feet

Reasonably well preserved spores and pollen grains occur frequently in the residue together with minor wood and cuticular material. The following types were identified:

Spores:	Aequitriradites spinulosus (Cookson & Dettmann)	R
	Baculatisporites comaumensis (Cookson)	Ab
	Ceratosporites equalis Cookson & Dettmann	C
	Cicatricosisporites ludbrooki Dettmann	R
	Cooksonites variabilis Pocock	R
	Crybelosporites sp.	R
	Cyclosporites hughesi (Cookson & Dettmann)	R
	Cyathidites australis Couper	Ab
	C. minor Couper	Ab
	Dictyotosporites speciosus Cookson & Dettmann	R
	Leptolepidites verrucatus Couper	R
	L. major Couper	R
	Lycopodiumsporites austroclavatidites (Cookson)	Ab
	L. circolumenus Cookson & Dettmann	R
	L. facetus Dettmann	R
	L. nodosus Dettmann	C
	L. eminulus Dettmann	R
	L. reticulumsporites (Rouse)	C
	Matonisporites cooksoni Dettmann	R
	Neoraistrickia truncata (Cookson)	C
	Stereisporites antiquasporites (Wilson & Webster)	Ab
Pollen:	Alisporites grandis (Cookson)	C
	A. similis (Balme)	C

81/100

	Araucariacites australis Cookson	Ab
	Classopollis cf. classoides Pflug	R
	Cycadopites nitidus (Balme)	C
	Microcachryidites antarcticus Cookson	Ab
	Podocarpidites cf. elliptica Cookson	Ab
Remanié:	Aratrisporites sp. - Triassic	R

Samples from 3340 feet and 3475 feet are clearly within the early Cretaceous Cyclosporites hughesi Subzone because of their content of Dictyotosporites speciosus and Cyclosporites hughesi. The presence of Murospora florida at 3340 feet further suggests that the strata may be within the Murospora florida Unit. However, only one example of Murospora florida was found and the possibility that it has been reworked needs to be considered.

E. 3506 - 4025 feet

Several samples within the interval 3506 - 4025 feet have been investigated (see Table 1). All failed to yield spores and pollen grains although several provided small quantities of wood and cuticular material.

F. 5627 - 5634 feet

5627 feet

Abundant carbonaceous matter including moderately carbonized spores, pollen grains, and wood and cuticular fragments was obtained from the sample. The following types were identified:

Spores:	Aequitriradites verrucosus (Cookson & Dettmann)	R
	Baculatisporites comaumensis (Cookson)	C
	Biretisporites spectabilis Dettmann	R
	Ceratosporites equalis Cookson & Dettmann	Ab
	Cicatricosisporites australiensis (Cookson)	R

82/100

	Cyathidites australis Couper	Ab
	C. minor Couper	C
	Foraminisporis wonthaggiensis (Cookson & Dettmann)	R
	Kraeuselisporites lincaris (Cookson & Dettmann)	R
	Leptolepidites verrucatus Couper	Ab
	L. major Couper	C
	Lycopodiumsporites austroclavatidites (Cookson)	C
	L. eminulus Dettmann	Ab
	Neoraistrickia truncata (Cookson)	C
	Osmundacidites wellmanii Couper	C
	Stereisporites antiquasporites (Wilson & Webster)	Ab
Pollen:	Araucariacites australis Cookson	C
	Classopollis cf. classoides Pflug	R
	Cycadopites nitidus (Balme)	C
	Microcachryidites antarcticus Cookson	Ab
	bisaccate grains gen. et sp. indet.	Ab
Remanié:	Lundbladispora denmeadi (de Jersey) - Triassic	R
	Aratrisporites spp. - Triassic	Ab
	striatitid bisaccate grains - Permian/Triassic	Ab

5634 feet

A small quantity of plant material was obtained from the sample. Spores and pollen grains observed are carbonized and are referable to the following types:

Spores:	Cyathidites spp.	Ab
	Baculatisporites comaumensis (Cookson)	C
	Leptolepidites verrucatus Couper	Ab
Pollen:	trisaccate grains	Ab
	Cycadopites nitidus (Balme)	C
Remanié:	Aratrisporites spp. - Triassic	Ab
	Lundbladispora denmeadi (de Jersey) - Triassic	C
	Guthorlisporites cancellosus Playford & Dettmann - Triassic	C
	striatitid bisaccate grains - Permian/Triassic	C

The sample from 5627 feet yielded a microflora containing Cicatricosisporites australiensis, Biretisporites spectabilis, Kraeuselisporites linearis, and Aequitriradites verrucosus. These species are well documented from Lower Cretaceous strata and also occur in horizons that may be of uppermost Jurassic age (see Evands 1966, Dettmann 1968b). Reworked types occur in minor, but significant proportions

83/100

(5%) in the assemblage. Types identified are believed to have derived from Triassic and possibly Permian sediments.

The assemblage from 5634 feet yielded a higher proportion (30%) of reworked Triassic/Permian forms together with types that are widely distributed in Australian Jurassic and Cretaceous sediments.

3. CONCLUSIONS

Microfloral evidence indicates that sediments in Hawkesdale No.1 well, 1245 - 5634 feet range in age from uppermost Jurassic or lowermost Cretaceous to lower Albian.

The Eumeralla formation (sampled between 1245 feet and 3095 feet) is shown to include horizons of the Crybelosporites striatus Subzone (1245 - 1442 feet) and the Foraminisporis asymmetricus Unit (1714 - 2878 feet) of the Cyclosporites hughesi Subzone. The basal part of the Eumeralla formation (2913 - 3095 feet) and the upper portion of the Pretty Hill sandstone (3159 - 3278 feet) are also within the Cyclosporites hughesi Subzone but insufficient evidence has been obtained to ascertain which unit of the C. hughesi Subzone is represented. Horizons of the Pretty Hill sandstone between 3340 feet and 3475 feet are tentatively assigned to the Murospora florida Unit, but underlying strata representing the basal portion of the Pretty Hill sandstone could not be dated by palynological means.

Sediments (5627-34 feet) occurring below a volcanic sequence are considered to be of uppermost Jurassic or lowermost

84/100

Cretaceous age; these also contain significant proportions of reworked Triassic and Permian plant microfossils.

Recycled spores and pollen grains of Triassic and Permian age also occur spasmodically throughout productive horizons of the Pretty Hill sandstone and the Eumeralla formation; whilst early Cretaceous reworked types were found near the base of the Eumeralla formation.

The Hawkesdale microfloras are composed dominantly of land-derived spores and pollen grains with minor representation of possible aquatic forms (Schizosporis, Michrystridium) at certain horizons of the Pretty Hill sandstone and the Eumeralla formation.

The Hawkesdale sequence may be correlated on microfloral evidence with the Lower Cretaceous sequences developed in Eumeralla No.1, Pretty Hill No.1, and Moyne Falls No.1 wells. The top of the Eumeralla formation in Hawkesdale No.1 is within the Crybelosporites striatus Subzone and is thus older than upper horizons of the same formation in Pretty Hill No.1, Eumeralla No.1 (both Tricolpites pannosus Zone), and Moyne Falls No.1 (Coptospora paradoxa Zone) (see Dettmann 1969a, 1970). Underlying sediments of the Hawkesdale development of the Eumeralla formation (1714 - 2878 feet) are referable to the Foraminisporis asymmetricus Unit and are thus correlative with middle portions of the Eumeralla formation in Eumeralla No.1 (7225 - 7717 feet) and Moyne Falls No.1 (1802 - 2022 feet) and the basal horizons of the same formation in Pretty Hill No.1 (5935-47 feet)

(Dettmann 1969a, 1970). The Rouseisporites reticulatus Unit which occurs in the lower intersections of the Eumeralla formation in Eumeralla No.1 (8143 - 9890 feet) and Moyne Falls No.1 (2166 - 2330 feet) has not been detected in Pretty Hill No.1, and if represented in Hawkesdale No.1 would be restricted to about 200 feet of sediments at the base of the formation.

The age limits of the Pretty Hill sandstone in Pretty Hill No.1 and Hawkesdale No.1 have not been assessed accurately due to paucity of palynological data. Available evidence indicates that the formation includes horizons of the Cyclosporites hughesi Subzone (including the Murospora florida Unit) in both wells and possible representation of the Crybelosporites stylosus Zone in Pretty Hill No.1 (see Dettmann 1969a).

4. REFERENCES

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86/100

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18th March, 1970.

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87/100

EXPLANATION OF TABLE 1

Preservation and zonal attribution of plant microfossil assemblages in sidewall cores of Hawkesdale No.1 well, 1245 - 5690 feet.

Abbreviations:

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

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

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

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

Spore-pollen Zones are those defined by Dettmann and Playford (1969) and Dettmann (1969a,b).

TABLE IV-1

Depth (ft.)	Yield	Spore-Pollen		Wood		Cuticle		Spore-Pollen Zone	Stratigraphy
		Col.	Pres.	Col.	Pres.	Col.	Pres.		
1245	Ab	DY-LBr	Good-Fair	Br-Bl	Fair	DY-LBr	Fair	*Crybelosporites striatus* Subzone	SKUP — ELMERALDA FORMATION
1442	"	"	"	"	"	"	"		
1714	"	"	Fair	"	"	"	"	*Foraminisporis asymmetricus* Unit	
2018	"	"	"	"	"	"	"		
2325	"	"	"	"	"	"	"		
2576	"	"	"	"	"	"	"		
2800	"	"	"	"	"	"	"		
2878	"	"	"	"	"	"	"		
2913	Sp	"	"	"	"	"	"	*Cyclosporites hughesi* Subzone (unit indeterminate)	
3095	B	—	—	—	—	—	—		
3159	Sp	DY-LBr	Fair	Br-Bl	Fair	DY-LBr	Fair		
3278	"	"	"	"	"	"	"		
3340	C	"	"	"	"	"	"	? *Murospora florida* Unit	KAWAI — PRATT HILL EST.
3475	"	"	"	"	"	"	"		
3506	B	—	—	—	—	—	—	indeterminate	
3698	"	—	—	—	—	—	—		
3810	"	—	—	Br-Bl	Fair	—	—		
3895	"	—	—	"	"	Br	Poor		
3925	"	—	—	"	Poor	—	—		
4025	"	—	—	—	—	—	—		
5627	Ab	Br-Bl	Poor	Bl	Poor	Br	Poor	lowermost Cretaceous or uppermost Jurassic	OTO — POLK HILL UNIT
5634	Sp	"	"	"	"	"	"		
5690	B	—	—	—	—	—	—	indeterminate	