

# MICROPLANKTON FROM AUSTRALIAN LOWER CRETACEOUS SEDIMENTS

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## Abstract

Three new genera and seventeen new species of microplankton are described from Australian Cretaceous (chiefly Lower Cretaceous) sediments.

## Introduction

In a previous paper (Cookson and Eisenack 1960), we have described principally Upper Cretaceous species of Australian microplankton. This article is restricted almost entirely to Lower Cretaceous forms. Some of the new types described are from sediments previously examined (Cookson and Eisenack 1958) for their microplankton content, while others are from sediments obtained from new locations. New records of previously described types are also included.

## Location and Age of Sediments

### WESTERN AUSTRALIA

#### Carnarvon Basin—

Windalia Radiolarite, Wapet's Rough Range No. 4 Bore at 3,532-50 ft. Age: Aptian and Lower Albian (McWhae et al. 1958, p. 112).

Lower Gearle Siltstone. Wapet's Rough Range No. 7 Bore at 2,360-75 ft., No. 1 Bore at 2,750 ft. Age: Albian (McWhae et al. 1958, p. 112).

#### Perth Basin—

Gingin Area, Moora Bore at 86-170 ft. Age: Albian (Cookson and Eisenack 1958, p. 66).

Regan's Ford on Moore R., Wapet's Seismic shot-hole L8 at 240 ft. Age: Albian (Cookson and Eisenack 1958, p. 66).

Perth Metropolitan Area, South Perth Formation, Attadale Artesian Bore at 809 ft. Age: Aptian (Cookson and Eisenack 1958, p. 69).

### SOUTH AUSTRALIA

South Australian-Northern Territory Oil Search Ltd. ('Santos') Oodnadatta Bore at 327 ft. Age: Albian (authors). Also at 1,052-61 ft. Age: Lower Cretaceous—Aptian or older (authors).

Lake Phillipson Bore about 12 m. E. of eastern margin of the lake at 87 ft. 10 in. Age: Lower Cretaceous—Aptian or older (authors).

### NORTH QUEENSLAND

Longreach Drill Co.'s Balmoral Well, No. 1 on 'Padua' property at 1,000 ft. Age: Aptian (authors).

Roma Formation. Well on Batavia Downs Station, Cape York Peninsula at 45-9 ft. Age: Aptian.

Frome-Broken Hill Co. Pty. Ltd., Wyaaba No. 1 Bore, Galbraith at 2,229-30 ft. Age: Probably Aptian (authors). Also at 2,636-7 ft. Age: Lower Cretaceous—Aptian or older (authors).

**Description of Types**

The registered numbers given for the types are those in the palaeobotanical collection of the National Museum of Victoria.

## DINOFLAGELLATES

## Family DELFANDREIDAE

Genus *Deflandrea* Eisenack 1938***Deflandrea rotundata* sp. nov.**

(Pl. I, figs. 1, 2; holotype fig. 1, P17858)

AGE AND OCCURRENCE: Albian: Santos's Oodnadatta Bore, S.A., at 327 ft.

DESCRIPTION: Shell somewhat flat, broadly oval in outline, divided unequally by a broad and deep circular girdle; epitheca slightly larger than the hypotheca with a broadly rounded apex; hypotheca with one or occasionally two slight antapical prolongations and a broad longitudinal furrow. Capsule almost circular in outline, not filling the shell laterally. Shell-membrane thin, smooth and transparent; wall of capsule slightly granular. A pylome has not been observed.

DIMENSIONS: Type—80 $\mu$  long, 58 $\mu$  broad, capsule 48 $\mu$  x 46 $\mu$ . Range—52-80 $\mu$  long, 45-62 $\mu$  broad.

COMMENTS: *Deflandrea rotundata* differs from all other described species of the genus in the absence of an apical horn. It is relatively common in the Oodnadatta Bore sample.

***Deflandrea foliacea* sp. nov.**

(Pl. I, fig. 3; holotype P17859)

AGE AND OCCURRENCE: Turonian: Upper Gearle Siltstone, W.A., Wapet's Rough Range South No. 1 Bore, core 62 (2,505-11 ft.), core 63 (2,511-14 ft.). ?Upper Turonian to Middle Senonian: Molecap Greensand, W.A. (Cookson and Eisenack 1960).

DESCRIPTION: Shell flat, broadly oval in outline, divided almost equally by a rather broad shallow girdle and narrowing towards a short blunt apical projection and one or occasionally two slight antapical prominences. A short, broad longitudinal furrow is developed on the ventral surface of the hypotheca. The capsule is approximately circular in outline and does not fill the shell laterally. A pylome has not been observed. Shell-membrane thin, transparent, wall of capsule slightly granular.

DIMENSIONS: Type—57 $\mu$  long, 48 $\mu$  broad. Range—53-67 $\mu$  long, 43-52 $\mu$  broad.

COMMENTS: This species closely resembles *D. rotundata* sp. nov. but differs from it in the shape of the epitheca.

## Family GONYAULACIDAE

Genus *Gonyaulax* Diesing 1866***Gonyaulax helicoidea* sp. nov.**

(Pl. I, figs. 4, 9; holotype fig. 4, P17868)

AGE AND OCCURRENCE: Aptian: Longreach Drill Co.'s Balmoral Well, N.Q., at 1,000 ft. Lower Cretaceous (Aptian or older): Lake Phillipson Bore, S.A., at 87 ft. 10 in.

DESCRIPTION: Shell broadly oval, unequally divided by a strongly helicoid girdle; epitheca longer than hypotheca, surmounted by a hollow, thin-walled conical projection with a blunt apex; hypotheca broadly rounded. Both the girdle and plates are bordered by relatively high ledges with serrate edges. The surface of the plates is ornamented to varying degrees with small irregularly scattered tubercles. The

longitudinal furrow lies  $\pm$  obliquely to the long axis. A pylome may be developed by the removal of plate 3''.

DIMENSIONS: Type—78 $\mu$  long, 56 $\mu$  broad. Range—62-86 $\mu$  long, 48-67 $\mu$  broad.

**Gonyaulax helicoidea** subsp. **cassidata** subsp. nov.

(Pl. I, figs. 5, 6; holotype fig. 5, P17869)

AGE AND OCCURRENCE: Probably Cenomanian: Brickhouse Bore, W.A., (Cookson and Eisenack 1960) at 1,210 ft. ?Upper Albian to Cenomanian: N. of Gingin, W.A., Seismic shot-hole B1 at 210, 230 ft. (Cookson and Eisenack 1960). Albian: Santos's Oodnadatta Bore, S.A., at 327 ft. Aptian: Roma Formation, N.Q., Batavia Downs Well at 45-9 ft.

DESCRIPTION: Apex more prominent than in *G. helicoidea* s. str., dome-shaped, narrowing abruptly to a bluntly pointed horn; antapical region with a projection formed by the ledges and supported by thin spines deriving from the corners of the antapical plate 1''''.

DIMENSIONS: Type—83 $\mu$  long, 52 $\mu$  broad. Range—71-95 $\mu$  long, 47-57 $\mu$  broad.

Family HYSTRICHODINIDAE

Genus **Diconodinium** gen. nov.

(ex *Palaeohystrichophora* Defl. 1938)

DESCRIPTION: Shell fusiform to almost spherical, without tabulation and capsule, divided equally or unequally by a circular girdle; ventral surface with or without clear lines which run longitudinally from the end of the girdle to or towards both apex and antapex delimiting an area which corresponds in position to a longitudinal furrow. Epitheca terminated by a strongly marked to inconspicuous process with a bifid or concave tip; hypotheca with a prominent to much reduced spine-like projection. Shell-membrane thin, smooth or ornamented with granules, spinules, or small spines. Genotype *Diconodinium multispinum* (Defl. and Cookson).

COMMENTS: The genus *Diconodinium* is distinct from the genus *Palaeohystrichophora*, as exemplified by the genotype *P. infusorioides* Defl., in the absence of an internal body or capsule, the presence of a 'longitudinal furrow' and the shape of both apex and antapex.

**Diconodinium multispinum** (Defl. and Cookson)

*Palaeohystrichophora multispinata* Defl. and Cookson 1955, p. 257, Pl. 1, fig. 5.

*Palaeohystrichophora multispinata* in Cookson and Eisenack 1958, p. 38, Pl. X, fig. 13.

**Diconodinium pelliferum** (Cookson and Eisenack)

*Palaeohystrichophora* cf. *spinosissima* Defl. and Cookson 1955, Pl. 4, fig. 10; non *Palaeohystrichophora spinosissima* (Defl.) in Defl. and Cookson 1955, p. 257.

*Palaeohystrichophora pellifera* Cookson and Eisenack 1958, p. 38, Pl. X, fig. 11.

**Diconodinium dispersum** (Cookson and Eisenack)

*Palaeohystrichophora dispersa* Cookson and Eisenack 1958, p. 39, Pl. X, figs. 12, 14.

NEW OCCURRENCE: Subiaco Bore, W.A., at 358 ft. (light sample) (Cookson and Eisenack 1960).

**Diconodinium glabrum** sp. nov.

(Pl. I, fig. 11; holotype, P17860)

AGE AND OCCURRENCE: ?Upper Albian to Cenomanian: Wapet's Seismic shot-hole B1 at 200-20 ft. Albian: Moora Bore, W.A., at 86-170 ft.; Santos's Oodna-

datta Bore, S.A., at 327 and 367 ft.; Lower Gearle Siltstone, Wapet's Rough Range Bore No. 7 at 2,360-75 ft.

DESCRIPTION: Shell fusiform, epitheca usually longer than hypotheca, girdle prominent, 'longitudinal furrow' strongly or weakly outlined; apical process prominent, usually slightly bifid, antapical process well developed and sharply pointed. Shell-membrane smooth in optical section, surface either completely smooth or sparsely dotted with tiny granules.

DIMENSIONS: Type—120 $\mu$  long, 70 $\mu$  broad. Range—62-142 $\mu$  long, 41-72 $\mu$  broad.

COMMENTS: Forms which in surface structure appear to be intermediate between typical examples of *D. glabrum* and *D. multispinum* occur in the Lower Gearle Siltstone and Moora Bore deposit (Pl. I, fig. 10).

**Diconodinium inflatum** sp. nov.

(Pl. I, figs. 12, 13; holotype fig. 13, P17861)

AGE AND OCCURRENCE: ?Upper Albian to Cenomanian: N. of Gingin, W.A., Wapet's Seismic shot-hole B1 at 220 ft. (Cookson and Eisenack 1960).

DESCRIPTION: Shape broadly oval in outline, epitheca longer than hypotheca and terminated by a rather short, hollow, bifid process, hypotheca with a short spine. Shell-membrane two-layered, outer layer ornamented with rather widely-spaced spinules which tend to be arranged in longitudinal rows and to project slightly beyond the surface in optical section; region of 'longitudinal furrow' smooth, lines bounding it clearly defined.

DIMENSIONS: Type—88 $\mu$  long, 67 $\mu$  broad. Range—80-95 $\mu$  long, 52-67 $\mu$  broad.

COMMENTS: *D. inflatum* agrees in general morphological features with the other described species of *Diconodinium* but differs from them in having a two-layered wall.

**Diconodinium tenuistriatum** sp. nov.

(Pl. I, figs. 14-16; holotype figs. 14, 15, P17862)

AGE AND OCCURRENCE: ?Upper Albian to Cenomanian: N. of Gingin, W.A., Wapet's Seismic shot-hole B1 at 200, 210 ft. Probably Cenomanian: Brickhouse Bore, W.A., at 1,210 ft. (Cookson and Eisenack 1960).

DESCRIPTION: Shell ovoidal to nearly spherical, girdle usually faintly marked, epitheca longer than hypotheca, apical process very short, concave, antapical spine only slightly represented. Shell-membrane thin, ornamented with close rows of regularly and closely arranged small granules which converge towards both apex and antapex. Striation on the ventral surface outwardly directed towards the ends of the girdle leaving a wide unpatterned area which corresponds in position to a longitudinal furrow.

DIMENSIONS: Type—62 $\mu$  long, 58 $\mu$  broad. Range—48-67 $\mu$  long, 46-60 $\mu$  broad.

Family INCERTA

Genus **Apteodinium** Eisenack 1958

**Apteodinium maculatum** sp. nov.

(Pl. II, figs. 1-3; holotype fig. 1, P17863)

AGE AND OCCURRENCE: Albian: Lower Gearle Siltstone, W.A., Wapet's Rough Range No. 7 Bore at 2,360-75 ft.; Santos's Oodnadatta Bore at 87 and 327 ft. Aptian: Roma Formation, N.Q., Batavia Downs Well, 45-9 ft.

**DESCRIPTION:** Shell broadly oval to circular in outline (no doubt originally spherical but usually flattened) with or without a circular equatorial girdle with low borders. Epitheca terminated by a short solid horn which narrows from a broad base with straight or convex sides towards a blunt tip; a hoof-shaped pylome is developed between the base of the horn and the position of the girdle.

Shell-membrane thin, finely granular with a varying number of small thickened areas with circular outlines each of which, in stained preparations, is surrounded a more lightly stained 'halo'. The thickenings generally occur in groups and are usually particularly well developed on the lid of the pylome (Pl. II, fig. 2). In some examples the thickenings are numerous, in others only sparsely developed.

**DIMENSIONS:** Type— $88\mu$  long,  $78\mu$  broad. Range— $74$ - $105\mu$  long,  $70$ - $105\mu$  broad.

***Apteodinium conjunctum* sp. nov.**

(Pl. I, figs. 7, 8; holotype fig. 7, P17864)

*Apteodinium* sp. in Eisenack 1958, p. 387, Pl. XXIII, figs. 15-18.

**AGE AND OCCURRENCE:** Aptian: Roma Formation, N.Q., Batavia Downs Well at 45-9 ft.; S. Perth Formation, W.A., Attadale Bore at 809 ft. Age uncertain: A glacial boulder from N. Germany (Eisenack 1958).

**DESCRIPTION:** Shell relatively thick-walled, shortly ovoidal with a broad hypotheca, a short, abruptly delimited, pointed apical horn and sometimes as in the type, a short, blunt antapical horn. The girdle, which is usually clearly defined, is rather wide, circular and level with the surface.

A large, sometimes circular pylome extends from below the apex to the girdle.

**DIMENSIONS:** Type— $80\mu$  long,  $67\mu$  broad; paratype— $60\mu$  long,  $57\mu$  broad.

**Genus *Trichodinium* gen. nov.**

**DESCRIPTION:** Shell spherical to oval with a circular girdle and without indication of a longitudinal furrow and definite tabulation; epitheca with a short horn and a pylome on the dorsal surface. Shell-membrane  $\pm$  densely covered with hairs, bristles or spines. Genotype *Trichodinium pellitum* sp. nov.

**COMMENTS:** The genus *Trichodinium* differs from the genus *Apteodinium* in the ornamentation of the shell and from the genus *Cometodinium* Defl. and Courteville in the development of an apical horn.

***Trichodinium pellitum* sp. nov.**

(Pl. II, fig. 4; holotype, P17865)

**AGE AND OCCURRENCE:** Aptian: Longreach Drill Co.'s Balmoral Well, N.Q., at 1,000 ft.

**DESCRIPTION:** Shell oval, divided equally by an equatorial girdle, with a narrow, straight-sided apical horn which bears numerous short upwardly directed hairs. The shell-membrane is densely covered with rather long, frequently bent hairs which are particularly long and divergent on both sides of the girdle and form a tuft at the antapex. The pylome is rather large and semicircular.

**DIMENSIONS:** Type—Overall  $110\mu$  long,  $100\mu$  broad, shell  $82\mu$  x  $75\mu$ , horn  $15\mu$  long.

***Trichodinium paucispinum* sp. nov.**

(Pl. II, fig. 7; holotype, P17866)

**AGE AND OCCURRENCE:** Albian: Santos's Oodnadatta Bore, S.A., at 327 ft.; Lower Gearle Siltstone, W.A., Wapet's Rough Range No. 1 Bore at 2,750 ft.

**DESCRIPTION:** Shell oval to nearly spherical, girdle narrow, equatorial; apical horn narrow, straight-sided surmounted by three or more short, flat divergent fibres. Shell-membrane densely granular, sparsely covered with broadly-based spines. Pylome broad.

**DIMENSIONS:** Type—Overall  $100\mu$  long,  $81\mu$  broad, shell  $85\mu \times 81\mu$ , horn *c.*  $15\mu$  long. Overall  $76\text{--}100\mu$  long,  $60\text{--}82\mu$  broad.

***Trichodinium intermedium* sp. nov.**

(Pl. II, figs. 5, 6; holotype fig. 5, P17867)

**AGE AND OCCURRENCE:** Aptian to Lower Albian: Windalia Radiolarite, W.A., Wapet's Rough Range No. 4 Bore at 3,532-50 ft.

**DESCRIPTION:** Shell oval, with a rather indistinct equatorial girdle; epitheca with a small, spiny horn and a pylome on the dorsal surface. Shell-membrane granular, rather densely covered with short, stiff, pointed or slightly capitate spines.

**DIMENSIONS:** Type—Overall  $90\mu$  long,  $76\mu$  broad, shell  $78\mu \times 69\mu$ . Paratype (Pl. II, fig. 6)—Overall  $100\mu$  long,  $81\mu$  broad, shell  $90\mu \times 76\mu$ , horn *c.*  $8\mu$ .

***Oodnadattia* gen. nov.**

**DESCRIPTION:** Shell broader than long, apical and antapical surfaces convex, circular to broadly oval in outline with an embayment made by the longitudinal furrow. Transverse furrow circular, narrow, bordered by two broad membranous wings; longitudinal furrow winged especially in the hypotheca. The plates of the epitheca and hypotheca are bordered by low ledges and separated by radially arranged rectangular intermediate plates. Genotype *Oodnadattia tuberculata* sp. nov.

**COMMENTS:** The genus *Oodnadattia* is distinct from *Dinopterygium* Defl. 1935 in the absence of high ledges and the presence of intermediate plates in both epitheca and hypotheca.

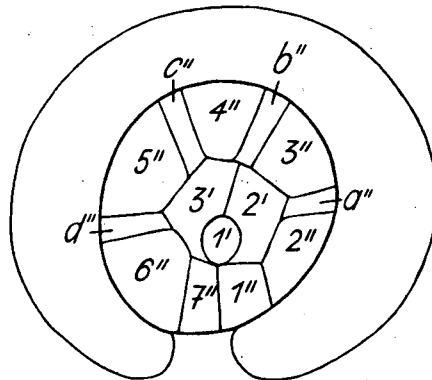


FIG. 1.—*Oodnadattia tuberculata* sp. nov., tabulation of the epitheca (schematic), see Pl. II, fig. 13.

***Oodnadattia tuberculata* sp. nov.**

(Pl. II, figs. 10-14; Fig. 1; holotype fig. 10, P17877)

*Dinopterygium cladoides* Deflandre in Deflandre and Cookson 1955, p. 261, Pl. 1, fig. 2.

**AGE AND OCCURRENCE:** Albian: Onepah Station, N.S.W. (Deflandre and Cookson 1955, p. 246); Santos's Oodnadattia Bore, S.A., at 327 ft.

**DESCRIPTION:** The epitheca is composed of 3 apical plates, plate 1' being circular and small and covering the apex, plates 2' and 3' being larger and polygonal, and 7 pre-equatorial plates, 5 of which are separated by 4 intermediate plates, a''-d''; both the pre-equatorial and intermediate plates extend to the equatorial wing (Fig. 1). Plates 2' and 3' and 1''-7'' are sparsely scattered with small circular tubercles, the intermediate plates are smooth. The hypotheca is composed of a relatively large antapical plate 1''', 5 post-equatorial plates and 4 (or 5?) intermediate plates, a'''-d'''. Plates 1'''-5''' and 1'''' are tuberculate, the intermediate plates are smooth. The equatorial wing of the hypotheca is narrower than that of the epitheca.

**DIMENSIONS:** Type—Overall diameter 108 $\mu$ . Overall range—95-112 $\mu$ .

Genus **Ceratocystidiopsis** Deflandre 1937

**Ceratocystidiopsis ludbrooki** Cookson and Eisenack

(Pl. III, fig. 1, P17889)

*Ceratocystidiopsis ludbrooki* Cookson and Eisenack 1958, p. 52, Pl. V, figs. 7, 8.

**NEW OCCURRENCE:** Albian: Santos's Oodnadatta Bore, S.A., at 327 ft.

**COMMENTS:** In the original description of *C. ludbrooki*, the presence of a girdle and tabulation was not sufficiently evident for even brief mention. Since then, a few examples, especially the one shown in Pl. III, fig. 1, have clearly demonstrated that both a girdle and simple form of tabulation do occur in this species.

On the dorsal surface of the figured specimen, a narrow girdle and a large square plate situated to one side of the hypotheca are clearly outlined, while on the ventral surface a broad, low-bordered longitudinal furrow lies between the two antapical horns and two lateral plates, which mark the end of the girdle, are indicated.

In the light of this example it is now possible to recognize faint representations of both the girdle and large hypothecal plate on the dorsal surface of the holotype.

The new examples have afforded proof of a connection between *Ceratocystidiopsis ludbrooki* and the dinoflagellates, a taxonomic position to which it has already been assigned, on the basis of the shape, by Gocht (1957).

Genus **Canningia** Cookson and Eisenack 1959

**Canningia colliveri** Cookson and Eisenack

*Canningia colliveri* Cookson and Eisenack 1959/60, Pl. II, figs. 3, 4.

**NEW OCCURRENCE:** Lower Cretaceous (Aptian or older): Santos's Oodnadatta Bore at 1,052-61 ft.

Genus **Broomea** Cookson and Eisenack 1958

**Broomea micropoda** sp. nov.

(Pl. II, figs. 8, 9; holotype fig. 9, P17890)

**AGE AND OCCURRENCE:** Albian: Santos's Oodnadatta Bore, S.A., at 327 ft. Aptian: Roma Formation, N.Q., Batavia Downs Well at 45 and 49 ft.; Frome Broken Hill Co.'s Wyaaba No. 1 Bore, Galbraith, N.Q., at 2,229-30 ft.

**DESCRIPTION:** Shell broadly fusiform to almost cylindrical, tapering to a short bluntly-pointed apical horn and with two small, usually unequal, pointed antapical projections; no indications of tabulation, 'girdle' or a pylome have been observed. Shell-membrane rather thick, coarsely and closely granular.

**DIMENSIONS:** Type—100 $\mu$  long, 47 $\mu$  broad. Range—83-108 $\mu$  long, 28-51 $\mu$  broad.

**COMMENTS:** In referring this species to the genus *Broomea* we are aware that the apparent combined absence of a pylome and 'girdle' may be considered as sufficient reason for separating it from this genus. However, a pylome, being a developmental feature, is not represented in every specimen of *B. ramosa* Cookson and Eisenack or *B. simplex* Cookson and Eisenack and the 'girdle' sometimes well developed in *B. ramosa* has not been seen as yet in *B. simplex*.

The shape of the shell of *B. micropoda* is essentially similar to that of the two other species of *Broomea*, the only difference being the extreme reduction in the size of the horns.

#### HYSTRICHOSPHERES

##### Family HYSTRICHOSPHERIDAE

##### Genus *Hystrichosphaeridium* Deflandre 1936

##### *Hystrichosphaeridium arundum* sp. nov.

(Pl. III, figs. 7-9; holotype fig. 7, P17891)

**AGE AND OCCURRENCE:** Albian: Santos's Oodnadatta Bore at 327 ft.; Lower Gearle Siltstone, Wapet's Rough Range No. 1 Bore at 2,750 ft.; Moora Bore, W.A., at 86-170 ft., Regan's Ford on Moore R., W.A., Wapet's Seismic shot-hole L8 at 240 ft.

**DESCRIPTION:** Shell spherical, slightly granular, provided with approximately 30 short, funnel-shaped appendages with delicate recurved edges. The width of the appendages may be uniform or variable in one and the same example. A pylome has not been observed despite the relative frequency of this species.

**DIMENSIONS:** Type—Diameter of shell 28 $\mu$ , overall diameter 42 $\mu$ . Range—Diameter of shell 24-32 $\mu$ , overall diameter 38-57 $\mu$ .

**COMMENTS:** *Hystrichosphaeridium arundum* sp. nov. is considerably smaller and has more numerous appendages than *H. siphoniphorum* Cookson and Eisenack; it is also clearly distinct from *H. salpingophorum* Deflandre.

##### Genus *Cannosphaeropsis* O. Wetzel 1933

##### *Cannosphaeropsis peridictya* sp. nov.

(Pl. III, figs. 5, 6; holotype fig. 6, P17892)

*Cannosphaeropsis fenestrata* Defl. and Cookson in Cookson and Eisenack 1958, pp. 46, 79, Pl. VII, figs. 1-3.

**AGE AND OCCURRENCE:** ?Upper Albian to Cenomanian: Subiaco Bore, W.A., at 358 ft. Albian: Lower Gearle Siltstone, W.A., Wapet's Rough Range No. 7 Bore at 2,360-75 ft. Aptian to Lower Albian: Windalia Radiolarite, W.A., Wapet's Rough Range No. 4 Bore at 3,532-50 ft.

**DESCRIPTION:** Shell spherical, thin-walled, completely enveloped in a wide-meshed network the threads of which are thin, cylindrical or occasionally flat. The supporting threads so evident in other species of *Cannosphaeropsis* are not clearly defined and usually the greater portion of the net is free from the shell.

**DIMENSIONS:** Type—Diameter of shell *c.* 43 $\mu$ , overall diameter *c.* 76 $\mu$ : Paratype (Pl. III, fig. 5)—Diameter of shell *c.* 48 $\mu$ , overall measurements *c.* 114 $\mu$  long, 76 $\mu$  broad; another example 100 $\mu$  long, 105 $\mu$  broad.

## Family PTEROSPERMOPSIDAE

Genus *Cymatiosphaera* O. Wetzel 1933 emend. Deflandre 1954*Cymatiosphaera stigmata* Cookson and Eisenack*Cymatiosphaera stigmata* Cookson and Eisenack 1958, p. 50, Pl. IX, fig. 14.

NEW OCCURRENCE: Lower Cretaceous (Aptian or older): Frome-Broken Hill Co.'s Wyaaba No. 1 Bore, N.Q., at 2,636-7 ft.; Lake Phillipson Bore, S.A., at 87 ft. 10 in.; Santos's Oodnadatta Bore, S.A., at 1,247-52 ft.

COMMENTS: A considerable variation in the size of the shell, as well as in the size and number of the fields, occurs among the examples from the localities listed above. In the smallest examples the number of fields approximates fairly closely to that of *C. punctifera* Defl. and Cookson. In large examples both the size and number of fields greatly exceed those given in the original description of *C. stigmata*.

*C. stigmata* seems to be confined to the deeper layers of the Lower Cretaceous. The Wyaaba, Oodnadatta and Lake Phillipson samples probably represent the Blythesdale Formation, while a Neocomian to Lower Aptian age has been suggested for the type locality (Meadow Station Bore, W.A., Cookson and Eisenack 1958, p. 21).

DIMENSIONS: Emended range in diameter 29-104 $\mu$ .

*Cymatiosphaera striata* sp. nov.

(Pl. III, figs. 10, 11; holotype fig. 11, P17893)

AGE AND OCCURRENCE: Probably Cenomanian: Brickhouse Bore, W.A., at 1,210 ft. ?Upper Albian to Cenomanian: Osborne Formation, W.A., Fremantle Traffic Bridge Bore No. 5 at 100 ft. Albian: Santos's Oodnadatta Bore, S.A., at 327 ft.; Moora Bore, W.A., at 86-170 ft.; Regan's Ford on Moore R., W.A., Wapet's Seismic shot-hole L8 at 240 ft. Aptian: Roma Formation, N.Q., Batavia Downs Well between 45 and 49 ft.

DESCRIPTION: Shell spherical, thin-walled, bearing high membranes which form large fields. Surface of shell granular; the membranes thin, transparent, and finely striated.

DIMENSIONS: Type—Diameter of shell *c.* 35 $\mu$ , overall diameter *c.* 70 $\mu$ . Range—Diameter of shell 35-57 $\mu$ , overall diameter 60-76 $\mu$ .

## INCERTAE SEDIS

Genus *Aptea* Eisenack 1958*Aptea* cf. *polymorpha* Eisenack

(Pl. III, figs. 2-4)

AGE AND OCCURRENCE: Albian: Lower Gearle Siltstone, W.A., Wapet's Rough Range No. 1 Bore at 2,750 ft.; Moora Bore, W.A., at 86-170 ft. Aptian: Frome-Broken Hill Co.'s Wyaaba No. 1 Bore, Galbraith, N.Q., at 2,229-30 ft.

COMMENTS: The Australian specimens compared with *Aptea polymorpha* resemble only those European Aptian examples which have no antapical processes.

Genus *Diplotesta* Cookson and Eisenack 1958*Diplotesta glaessneri* Cookson and Eisenack*Diplotesta glaessneri* Cookson and Eisenack 1959a, Pl. III, figs. 4-6.

NEW OCCURRENCE: Lower Cretaceous (Aptian or older): Frome-Broken Hill Co.'s Wyaaba No. 1 Bore, Galbraith, N.Q., at 2,636-7 ft.

Genus *Dioxya* Cookson and Eisenack 1958*Dioxya villosa* sp. nov.

(Pl. II, figs. 15, 16; holotype fig. 15, P17894)

AGE AND OCCURRENCE: Albian: Moora Bore, W.A., at 86-170 ft.; Regan's Ford on Moore R., W.A., Wapet's Seismic shot-hole L8 at 240 ft., L9 at 305 ft.; Lower Gearle Siltstone, Wapet's Rough Range No. 1 Bore at 2,750 ft.

DESCRIPTION: Shell broadly fusiform to almost spherical, with a truncate apical process surmounted by two short bristles; antapical process inconspicuous, pointed, situated in the mid-line or somewhat laterally. Shell-membrane thin, completely invested with minute spinules.

DIMENSIONS: Type—57 $\mu$  long, 43 $\mu$  broad. Range—52-60 $\mu$  long, 32-43 $\mu$  broad.

Gen. et sp. indet., **Form A**

(Pl. III, figs. 12-14; fig. 12, P17895)

AGE AND OCCURRENCE: Lower Cretaceous (Aptian or older): Frome-Broken Hill Co.'s Wyaaba No. 1 Bore, N.Q., at 2,636-7 ft.; Lake Phillipson Bore, S.A., at 87 ft. 10 in.; Santos's Oodnadatta Bore, S.A., at 1,052-61 ft. ?Upper Neocomian to Lower Aptian: Probably Grierson Member, Birdrong Formation, W.A., Meadow Station Bore No. 9.

DESCRIPTION: Body small, ring-like, wall thin with narrow, evenly-spaced ribs which run vertically from edge to edge and give it a striped appearance.

DIMENSIONS: Diameter 43-52 $\mu$ , depth 11-15 $\mu$ .

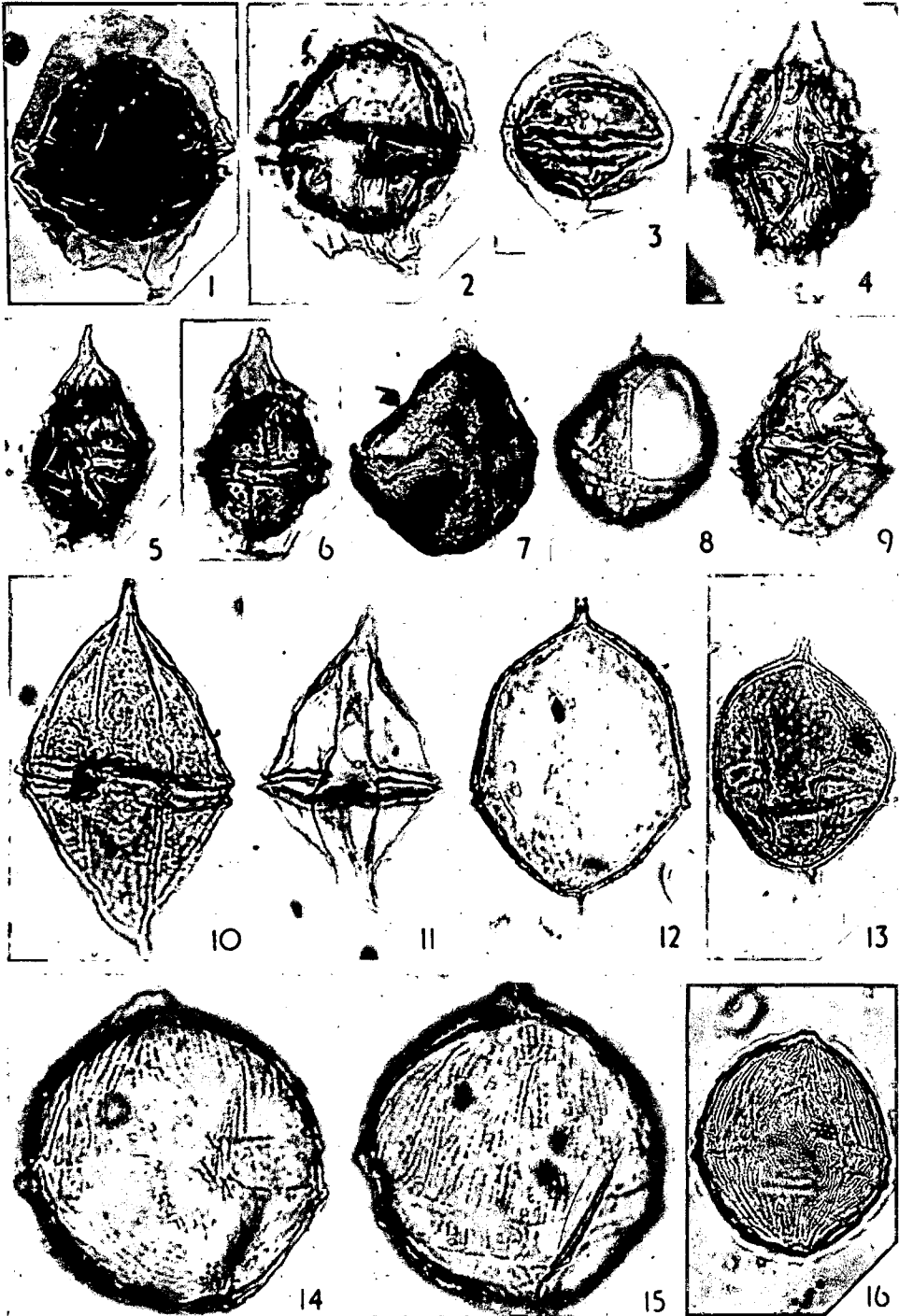
COMMENTS: The origin and nature of Form A are completely obscure and it is more than likely that it had no connection with the microplankton with which it is associated in the sediments referred to above. However, it seems worthy of mention as a possible marker fossil. Form A has not been observed in any of the Upper Cretaceous and Albian deposits examined and seems to be restricted to the deeper levels of the Lower Cretaceous, representative of the Blythesdale Formation in the Great Artesian Basin and the Birdrong Formation in Western Australia.

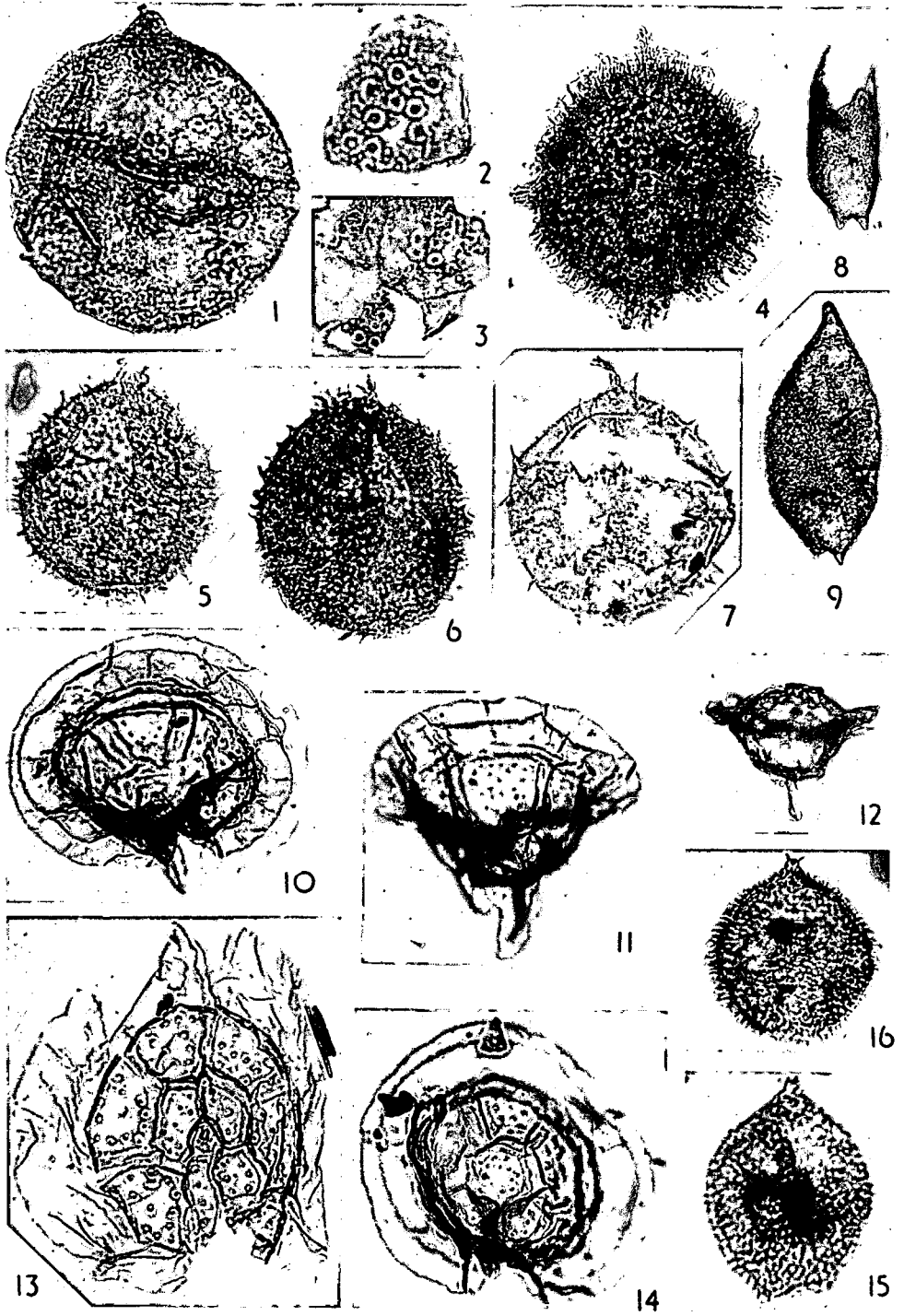
**Acknowledgement**

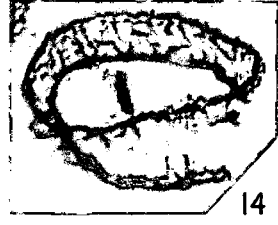
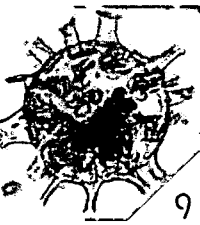
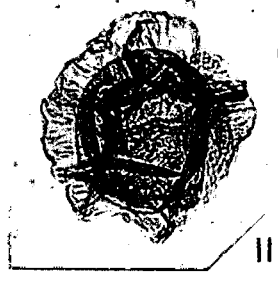
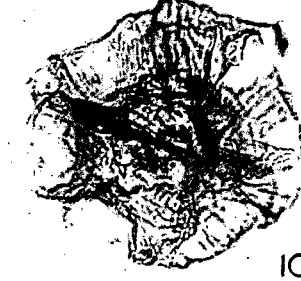
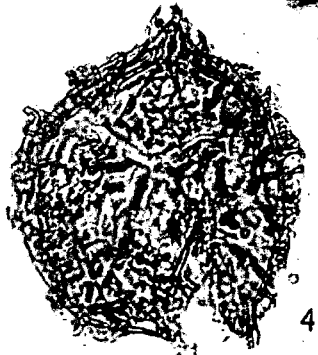
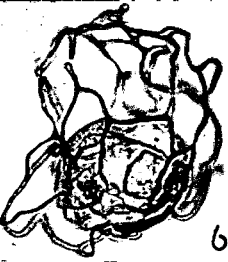
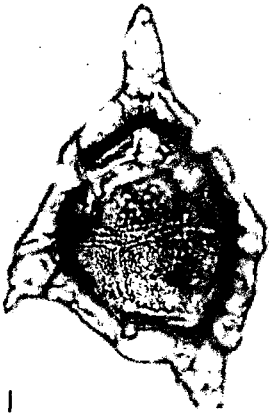
One of us (I.C.C.) wishes to thank the Australian Commonwealth Scientific and Industrial Research Organization for generous financial assistance.

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## Explanation of Plates

## PLATE I

- Figs. 1, 2.—*Deflandrea rotundata* sp. nov. Oodnadatta Bore, S.A., at 327 ft.  $\times c.$  500.  
 Fig. 3.—*Deflandrea foliacea* sp. nov. Rough Range South No. 1 Bore, W.A., at 2505-11 ft.  $\times c.$  500.  
 Figs. 4, 9.—*Gonyaulax helicoidea* sp. nov. Lake Phillipson Bore, S.A., at 87 ft. 10 in. Fig. 4, Type  $\times c.$  400; Fig. 9, Paratype  $\times c.$  400.  
 Figs. 5, 6.—*Gonyaulax helicoidea* subsp. *cassidata* subsp. nov. Oodnadatta Bore, S.A., at 327 ft. Fig. 5,  $\times c.$  360; Fig. 6,  $\times c.$  400.  
 Figs. 7, 8.—*Apteodinium conjunctum* sp. nov. Fig. 7, Roma Formation, N.Q., Well on Batavia Downs Station at 45-9 ft.  $\times c.$  400; Fig. 8, South Perth Formation, W.A., Attadale Bore at 809 ft.  $\times c.$  400.  
 Fig. 10.—*Diconodinium* cf. *multispinum* (Defl. and Cookson). Moora Bore, W.A., at 86-170 ft.  $\times c.$  500.  
 Fig. 11.—*Diconodinium glabrum* sp. nov. Oodnadatta Bore, S.A., at 327 ft.  $\times c.$  400.  
 Figs. 12, 13.—*Diconodinium inflatum* sp. nov. N. of Gingin, W.A., Seismic shot-hole B1 at 220 ft.  $\times c.$  400.  
 Figs. 14-16.—*Diconodinium tenuistriatum* sp. nov. N. of Gingin, W.A., Seismic shot-hole B1 at 210 ft. Figs. 14, 15, ventral and dorsal surfaces of type  $\times c.$  700; Fig. 16,  $\times c.$  560.

## PLATE II

- Figs. 1-3.—*Apteodinium maculatum* sp. nov. Oodnadatta Bore, S.A., at 327 ft. Fig. 1, type  $\times c.$  525. Fig. 2, plate of pylome  $\times c.$  600. Fig. 3, portion of shell-membrane  $\times c.$  600.  
 Fig. 4.—*Trichodinium pellitum* sp. nov. Longreach Drill Co.'s Balmoral Well, N.Q., at 1000 ft.  $\times c.$  400.  
 Figs. 5, 6.—*Trichodinium intermedium* sp. nov. Windalia Radiolarite, W.A., Rough Range No. 4 Bore at 3532-50 ft.  $\times c.$  400.  
 Fig. 7.—*Trichodinium paucispinum* sp. nov. Oodnadatta Bore, S.A., at 327 ft.  $\times c.$  400.  
 Figs. 8, 9.—*Broomea micropoda* sp. nov. Fig. 8, Roma Formation, N.Q., Well on Batavia Downs Station at 45-9 ft.  $\times c.$  350; Fig. 9, Oodnadatta Bore, S.A., at 327 ft.  $\times c.$  370.  
 Figs. 10-14.—*Oodnadattia tuberculata* sp. nov. Oodnadatta Bore, S.A., at 327 ft. Fig. 10, oblique view of antapex  $\times c.$  400; Fig. 11, side view (oblique)  $\times c.$  400; Fig. 12, side view  $\times c.$  260; Fig. 13, surface view of epitheca  $\times c.$  600; Fig. 14, antapex in surface view  $\times c.$  400.  
 Figs. 15, 16.—*Diorxia villosa* sp. nov. Fig. 15, Moora Bore  $\times c.$  540; Fig. 16, Regan's Ford, W.A., Seismic shot-hole L8 at 240 ft.  $\times c.$  540.

## PLATE III

- Fig. 1.—*Ceratocystidiopsis ludbrookii* Cookson and Eisenack. Oodnadatta Bore, S.A., at 327 ft.  $\times c.$  360.  
 Figs. 2-4.—*Aptea* cf. *polymorpha* Eisenack. Fig. 2, Wyaaba No. 1 Bore, Galbraith, N.Q., at 2229-30 ft.  $\times c.$  500; Figs. 3, 4, Moora Bore, W.A., at 86-170 ft.  $\times c.$  500.  
 Figs. 5, 6.—*Camosphaeropsis peridictya* sp. nov. Windalia Radiolarite, W.A., Rough Range No. 4 Bore at 3532-50 ft.  $\times c.$  400.  
 Figs. 7-9.—*Hystriochosphaeridium arundum* sp. nov. Figs. 7, 8, Oodnadatta Bore, S.A., at 327 ft. Fig. 7, type  $\times c.$  500; Fig. 8,  $\times c.$  700; Fig. 9, Moora Bore, W.A., at 86-170 ft.  $\times c.$  500.  
 Figs. 10, 11.—*Cymatiosphaera striata* sp. nov. Fig. 10, Fremantle Traffic Bridge Bore, W.A., at 100 ft.  $\times c.$  500; Fig. 11, Oodnadatta Bore, S.A., at 327 ft.  $\times c.$  400.  
 Figs. 12-14.—*Incertae sedis*, Form A. Figs. 12, 13, Lake Phillipson Bore, S.A., at 87 ft. 10 in.  $\times c.$  500; Fig. 14, Meadow Station Bore No. 9, W.A.,  $\times c.$  560.