CHLAMYDOPHYLLUM, *IOWAPHYLLUM*, AND *SINOSPONGOPHYLLUM* (RUGOSA) FROM THE DEVONIAN OF NEW SOUTH WALES

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ABSTRACT. The new species *Chlamydophyllum minus* and *Iowaphyllum cabonnense* are described from the Lower Devonian Garra Formation of New South Wales. This is the first record of *Iowaphyllum* from Australia. *Sinospongophyllum tabulatum* Hill, known from the Devonian limestones of Mt. Etna and Silverwood, Queensland, is also recorded from the Garra Formation. The correlation of these limestones with the Garra Formation is discussed; it is concluded that the three are representatives of an Eastern Australian faunal association of probable Emsian, and possible Early Eifelian age.

THE Garra Formation is a calcareous sequence of Devonian age, which crops out in a meridional belt, some 60 miles long and 5 miles broad, in the Molong–Wellington region of the central western slopes of New South Wales. The stratigraphy and structure have already been described and summarized (Strusz 1963, 1965*b*).

The localities from which the fossils described herein were collected are given in an appendix; their approximate positions are shown on the accompanying geological map (text-fig. 1).

Abbreviations used in the following descriptions are as defined in Strusz (1965*a*). Repositories of specimens mentioned are indicated by the following prefixes: SU; Palaeontological collection, Department of Geology and Geophysics, University of Sydney. UQ; Palaeontological collection, Department of Geology, University of Queensland.

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SYSTEMATIC PALAEONTOLOGY

Family STREPTELASMATIDAE

Genus *Chlamydophyllum* Počta 1902

Type species. Chlamydophyllum obscurum Počta (1902, p. 136, pl. 114, fig. 2, pl. 115, figs. 2–5). Lower Devonian (f2), Koněprusy, Bohemia.

Diagnosis. Solitary coral, with a very wide septal stereozone from which dissepiments are lacking; major septa, thin or slightly dilated in tabularium, may unite at axis in proximal parts of corallite, and on tabular surfaces in distal parts, where they are amplexoid; axial lobes few and thickened.

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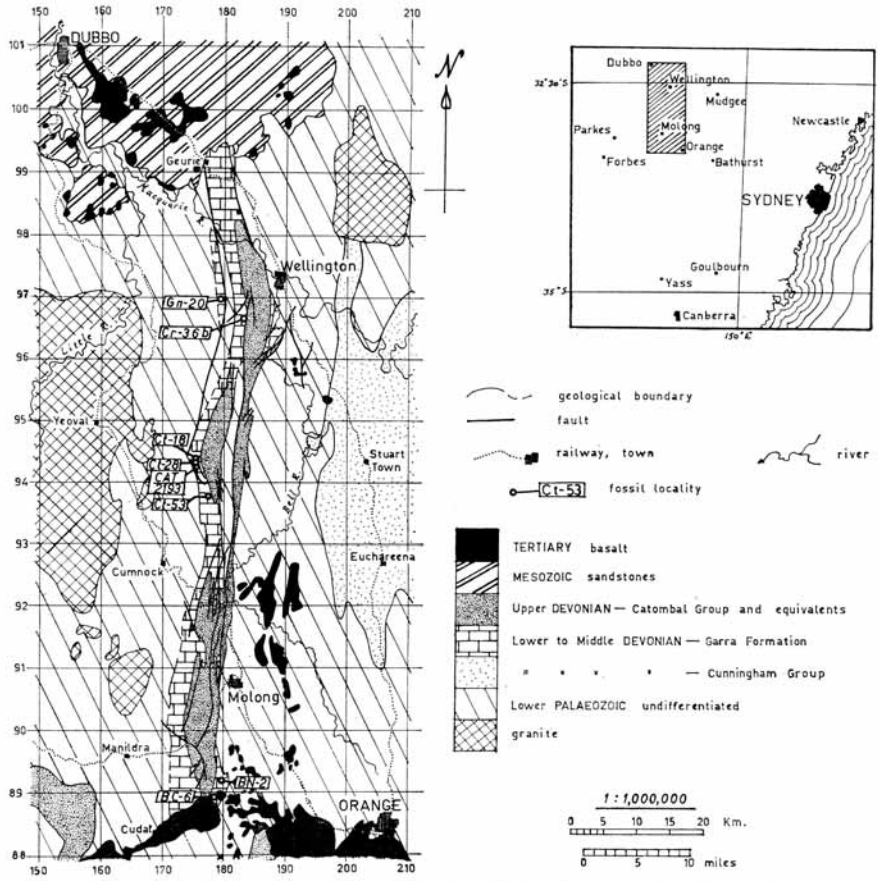
Remarks. *Chlamydophyllum* is distinguished from the related Silurian solitary Kodonophyllids *Kodonophyllum* Wedekind 1927 and *Schlotheimophyllum* Smith 1945 principally in having amplexoid septa in the more distal parts of the corallite. *Schlotheimophyllum* is distinguished from *Kodonophyllum* by its distinctive patellate growth form.



TEXT-FIG. 1. Geological map of the Dubbo–Wellington–Molong–Orange region, showing the approximate positions of localities mentioned in the text. Inset shows the geographic location of the area under study.

The European species attributed to *Chlamydophyllum* (see Penecke 1894, p. 593; Le Maître 1934, p. 160; discussion in Hill 1940, p. 160) agree in growth form—cylindrical to irregularly ceratoid. A number of specimens have been described from Eurasia under the name *Zelophyllia* Soshkina 1952 (see Soshkina 1952, p. 74; Spasskiy 1955, p. 96;

1959, p. 29; 1960, p. 119; Besprozvannykh 1964, p. 58) and *Rhegmaphyllum* (see Soshkina 1937, p. 58—*tabulatum* only). They agree in external and internal structure with *C. obscurum*, save that the marginaria are rather narrow. Until the type species is re-studied (cf. Hill 1940, p. 160), the Eurasian species are best placed in *Chlamydophyllum*, as suggested by Soshkina (p. 309 in Orlov 1962). The Australian specimens so far recorded have corallites which tend towards a patellate form—they are further discussed below.

Stumm (1964, p. 25) has reassigned to the otherwise Silurian genus *Schlotheimophyllum* some species from the Devonian of the Falls of the Ohio, previously considered to be *Ptychophyllum*. They differ from the latter in having greatly dilated septa in the marginarium. However, the writer considers that study of their internal structure is required (they are apparently known only from externals). They lack the patellate growth form of *Schlotheimophyllum*, and it is not clear whether they have the flat tabulae and amplexoid septa of *Chlamydophyllum*, or the rotated septa and domed tabulae of *S. patellatum*, type of *Schlotheimophyllum*.

Range. Upper Lower Devonian of Europe, U.S.S.R.; upper Lower to lower Middle Devonian, Europe and Australia; lower Middle Devonian, U.S.S.R.

Chlamydophyllum minus sp. nov.

Plate 67, figs. 1–8

Holotype. SU 14154, locality Ct–18. *Paratypes*. SU 14149, 14151, 14155–7, 14159, 14161, 14163, 14166–71, 18118, 20126.

Diagnosis. Small turbinate to patellate *Chlamydophyllum*, commonly with strong rejuvenescence; septa fairly thin in tabularium, not uniting axially; tabularium narrow.

Description. The corallites are solitary, low, turbinate to rather patellate, with broadly conical bases lacking attachment talons; they frequently show repeated strong rejuvenescence. Adults are normally 20–30 mm. in diameter, reducing to as little as 7 mm. during rejuvenescence. The calice is generally saucer-shaped with a sharp rim, and a shallow flat-bottomed axial pit, around which there may be a low reflexed shoulder.

EXPLANATION OF PLATE 67

Magnification ×2·0 unless otherwise stated.

Figs 1–8. *Chlamydophyllum minus* sp. nov., loc. Ct–18. 1, holotype SU 14154, viewed parallel to bedding; ×1·2. 2, 5, 6, paratype SU 14171; fig. 2 shows strongly amplexoid septa, and reflexed shoulder around axial pit; fig. 6 shows strongly dilated septa. 3, paratype SU 14167. 4, paratype SU 14159, with axially rotated moderately dilated septa. 7, paratype SU 14169, with septa withdrawn from axis. 8, paratype SU 14166, with attenuate septa.

Figs. 9–11. *Sinospongophyllum abrogatum* Hill 1942. 9, SU 20127, loc. Ct–53; corallite with thin, rather short septa. 10, 11, SU 12128, loc. BN–2; corallite with somewhat dilated septa extending to the axis.

Figs. 12–15. *Iowaphyllum cabonnense* sp. nov., holotype SU 11277, loc. BC–6. Note *Aulopora*? on corallum surface in fig. 12; division of the sectioned tabularium in fig. 14 was apparently caused by intrusion of a crinoid stem fragment; fig. 15 is part of fig. 14 enlarged to ×4·0, with the sediment-filled lumen of one tabularium inked in to emphasize the septal arrangement.

The septa cross the calice as low, faintly granulated rounded ridges. The outer parts of the calical wall are commonly quite thin. The epitheca is known only from thin sections; it is very thin (*c.* 0·05 mm.), and shows weak irregular growth wrinkles. In most instances, it is longitudinally weakly fluted, the grooves meeting in thin, low interseptal ridges 1·8–2·8 mm. apart.

Dimensions in millimetres.

SU No.	*Dc*	*Dt*	*Dt*/*Dc*	*n**	*n*/*Dt*	L_1**
14154***	29·5	5·0	0·17	—	—	—
14159	21+(*c.* 30?)	4·7	*c.* 0·16	46	9·8	0·7–0·9 *Rt*
14166	17·5+	5·5	*c.* 0·31	48	8·7	0·8–1·0 *Rt*
14166	*c.* 23 (worn)	4·2 av.	*c.* 0·18	44	*c.* 10·5	0·4–0·9 *Rt*
14167	18·0+	7·5	*c.* 0·42	—	—	—
14169	*c.* 31	4·4	*c.* 0·14	48	10·9	0·2–0·4 *Rt*
14171	18·0+	5·0	*c.* 0·28	50	10·0	0·7–1·0 *Rt*

* measured at margin of tabularium; ** in tabularium; *** holotype;
Rt= radius of tabularium.

In adults, $n = 44$–50; the septa are dilated to contact both vertically and laterally in a wide marginarium. The minor septa end abruptly at its inner margin, while the major septa extend almost to the axis as thin to moderately dilated, generally slightly curved lamellae, which may be vortically twisted near the axis. The septa are amplexoid, in some cases quite strongly (e.g. SU 14169—see table above), and occasionally bear sparse axial lobes. The septa consist of 0·1–0·2 mm. thick irregular rods of fibrous calcite, directed perpendicularly to the calical surface. Fine recrystallization has in most cases obscured the inner structure of these rods, but some sections suggest that they are probably monacanthine trabeculae. Within the tabularium, the septa consist of a single series of trabeculae, but in the marginarium this may increase to perhaps four or five rather irregular series. In this region, the marginal trabeculae may be directed gently away from the plane of the septum, in which case neighbouring septa are clearly distinguished. In other cases all the trabeculae are more or less vertical, and the individual septa may lose their identity.

The tabulae show some variation. They range from simple, rather distant flat tabulae to flatly domed tabulae with sloping to concave margins. They are usually complete, but in some sections there are additional axial flatly domed tabellae. Particularly where they are fairly simple, the tabulae may be thinly coated with lamellar stereoplasm, partly enveloping the thin to fairly thick amplexoid ends of the major septa.

There are no dissepiments.

Comparison. The only other Australian species, *C. expansum* Hill 1942*b*, is much larger, reaching a diameter of as much as 140 mm. With its liliiform mode of growth, it is intermediate between the European species and *C. minus*. It differs from *C. minus* also in having a relatively wider tabularium, in which the septa are often very strongly dilated, and in having 'rootlets' extending from the lower, conical part of the corallite.

The Eurasian species differ from *C. minus* in their conical to cylindrical corallites and relatively wider tabularia.

In its growth form and trabecular structure, this species is very similar to *Schlotheimophyllum patellatum* (Schlotheim 1820)—see Lang (1926, pl. xxx, figs. 4–6). The one

important difference lies in the presence in *C. minus* of strongly amplexoid septa. It is conceivable that *C. minus* is transitional between the two genera.

Remarks. Of the four localities from which this species is recorded, three are biostromal limestones and the fourth is a skeletal calcarenite laterally equivalent to one of the biostromes. The type locality is an outcrop of pink biostromal limestone consisting of coarse crinoidal debris stabilized by broad laminar *Favosites*. The corallites of *C. minus* sat in this coarse sand rather like downward-pointing arrow-heads, clearly unattached but held in place by their shape (as is the larger Recent *Fungites*).

Known localities: Ct–18 (type locality: 20 specimens collected); Ct–28 (same horizon: 7–8 specimens); CAT/2193 (same horizon: 3 specimens); Gn–20 (1 specimen).

Family CHONOPHYLLIDAE

Genus *Iowaphyllum* Stumm 1949

Type species. Smithia johanni Hall and Whitfield 1872, p. 234, pl. ix, fig. 10; Upper Devonian, Iowa, U.S.A. Subsequent designation Stumm (1949, p. 50).

Diagnosis. See Stumm (1949, p. 50).

Range. The only previous extra-American record of the genus is *I. cunctum* (Počta 1902) from the Bohemian Lower Devonian; the new species described below is from the Emsian.

Iowaphyllum cabonnense sp. nov.

Plate 67, figs. 12–15

Holotype. SU 11277, loc. BC–6.

Diagnosis. Iowaphyllum with small corallites completely lacking dissepiments; septa few, the major fusing axially to form a columella.

Description. The thamnastraeoid corallum takes the form of mat-like layers superposed one above the other, partly connected and partly separated by sediment; the layers vary in thickness from 3 mm. to over 15 mm. The basal holotheca, which occurs on the under surface of each layer, is moderately wrinkled. The upper surface of each layer is flat, crossed by subdued rounded septal ridges; individual calices are not distinguishable. The calical pits, 2–3 mm. in diameter, are shallow and cylindrical, with rims generally level with the corallum surface, and floors which are flat with a low axial boss. Their centres are 5–15 mm. apart, generally 8–10.

The septa, twenty-two–twenty-six in adult corallites, are dilated to contact throughout the marginarium. The minor septa end abruptly at its inner margin. The major septa continue into the tabularium as thin or moderately dilated, straight or curved lamellae. They unite axially, expanding to form a strong columella. At times they become axially discontinuous, forming amplexoid septal crests on the upper surfaces of the tabulae. In other cases the septal dilatation may spread over the surfaces of some tabulae as thin layers of fibrous calcite.

Dt = 2–3 mm. The tabulae are close, mostly complete, and generally slightly domed with concave margins. They may, however, be flat or sagging, with upturned margins. The columella is reinforced by occasional domed axial tabellae.

There are no dissepiments.

Comparison. In general appearance, and in their dense structure, the closest to *I. cabonnense* sp. nov. are *I. alpenense* (Rominger 1876) and *I. knotti* (Davis 1887). In 'hand specimen' *I. cabonnense* appears as structureless, almost porcellaneous, calcite; its microstructure is only clearly visible in thin section. These two American species appear to be rather similar in appearance, and probably therefore have similar internal structures, lacking dissepiments (see Stumm 1953, cards 102, 105, 106; 1964, p. 48). *I. alpenense*, from the middle Middle Devonian of Michigan, differs from *I. cabonnense* in: (1) having clearly discernible shallow calices separated by low ridges; (2) having more septa (*n* = 30–40); (3) larger maximum *Dt*. *I. knotti*, from the upper Middle Devonian of Kentucky, the surface of whose corallum is as flat as that of *I. cabonnense*, differs in larger size and more numerous septa (*n* = *c.* 60).

The remaining American species, all from the Lower Upper Devonian Hackberry Group of Iowa, form a group in which layers of extremely dilated septa are interspersed with layers of large flat dissepiments. All have *Dt* = about 3–5 mm., and *n* = about 30–40. *I. marginatum* (Fenton and Fenton 1924) has closely spaced calical pits (*Ts* = 8–10 mm.) with large axial bosses and everted rims. *I. johanni* (Hall and Whitfield)—the type species—shows considerable variation in calical spacing (*Ts* = 7–25 mm.), but generally this is noticeably greater than in *I. marginatum*. *I. johanni multiradiatum* (Hall and Whitfield 1872) is stated to have '. . . larger corallites . . . and on the average, more numerous septa . . .' than *I. johanni* (see Stumm 1953, card 108), but from the figures given by Stumm this is not immediately apparent. Study from more abundant material of the degree of variability may show that there is in fact no significant difference between the two.

I. cunctum (Počta 1902), from the Lower Devonian Slivenec Limestone of Bohemia (see Prantl 1951, and Chlupáč 1962, p. 15), is closest to the American Upper Devonian group in size, in number of septa, and in having a marginarium containing large flat dissepiments. It differs from all other species of the genus in that the septa frequently remain fairly strongly dilated in the tabularium. The tabulae do not form the flat-topped domes characteristic of the American species. As described by Prantl (1951, p. 11) the septal microstructure is identical to that of *I. cabonnense*.

Known localities. Known only from the type locality, BC–6.

Genus *Sinospongophyllum* Yoh 1937

Type species. Sinospongophyllum planotabulatum Yoh 1937, p. 56, pl. vi, figs. 2–5. Lower Givetian, Kwangsi, South China.

Diagnosis. Solitary; dissepimentarium narrow, consisting of a few large lonsdaleoid dissepiments; wide tabulae generally complete, flat, with down-turned edges; septa somewhat withdrawn from the axis. (After Hill 1942*b*, and in Moore 1956).

Range. Known from the Givetian of China and the Emsian? of Australia. The very

similar, probably closely related genus *Tabulophyllum* Fenton and Fenton 1924 is known from the Middle and Upper Devonian of North America, Australia, and Eurasia.

Sinospongophyllum abrogatum Hill 1942

Plate 67, figs. 9–11

1942*b* *Sinospongophyllum abrogatum* Hill, p. 20, pl. i, figs. 9–11.

Diagnosis. '*Sinospongophyllum* with some skeletal dilatation, with marked rejuvenescence, and with tabulae frequently replaced by tabellae' (Hill 1942*b*, p. 20).

Remarks. The limited Garra material differs from that of the Mt. Etna Limestone in having shorter major septa, and more generally complete tabulae. However the similarity of over-all structure is such that there can be little doubt of specific identity, even though later study of more abundant material from both localities may show consistent differences at a subspecific level.

Garra localities. BN–2 (1 specimen), Ct–53 (1 specimen), ? Cr–36b (1 specimen?).

Re-evaluation of the Silverwood and Mt. Etna faunas (Queensland)

Hill (1942*b*) noted the strong similarity of the Mt. Etna and Garra faunas, assigning them both to the Coblenzian. When describing the Silverwood fauna (1940) she assigned it to the Lower Couvinian, but later (1943) considered that it could be older. The writer has since had the opportunity of collecting considerable additional material from the Garra Formation, so greatly expanding the list of species now known from that sequence. He has also been able to examine the collections of corals from the two Queensland limestones held by the University of Queensland. On this basis, and taking into account recent revisions by European workers and the writer (Strusz 1965*a*, and in press), the accompanying comparative table has been drawn up (Table I).

Examination of Table 1 reinforces the suggestion of similarity between the Garra and Mt. Etna faunas. Of the Mt. Etna corals, about 60 per cent. are also known in the Garra fauna. The only significant difference is that the Mt. Etna fauna is much poorer (at least sixty-five species are now known to the author from the Garra fauna). The Silverwood fauna is less numerous still, but shows considerable similarity to the other two: 40 per cent. of the species occur in the Garra fauna, 30 per cent. in the Mt. Etna fauna.

The writer therefore considers that the three faunas belong to a single association, distinct from both the early Devonian faunas of Victoria (see Philip 1960, 1962; Talent 1963) and the Givetian faunas of Tamworth and North Queensland (Hill 1942*c*, 1942*a*). At present, from a consideration of the large Garra fauna, the age would appear to be Emsian, although it may extend into the earliest Eifelian. Finer subdivision, and thence more accurate correlation with the standard European successions, awaits detailed work on the limestones of Taemas (N.S.W.), the Mudgee district of N.S.W. (presently being studied by Dr. A. J. Wright), and the Broken River area of North Queensland (see Hill and Denmead 1960, pp. 149–51; at present being studied by Mr. J. S. Jell). All contain faunas which have at different times been referred to the Lower or lower Middle Devonian.

TABLE 1

	Garra	*Mt. Etna*	*Silverwood*
Acanthophyllum (*Neostringophyllum*) *implicatum*	x	x	x
Acanthophyllum sp. or *Dohmophyllum sp.*		e[1]	
Battersbyia sp. cf. *conglomeratum*			x
Billingsastraea carinata		x	
Calceola sp.[2]	x	x	
Chlamydophyllum expansum[3]		x	x
Chlamydophyllum minus sp. nov.[3]	x		
Hexagonaria densa			x
Hexagonaria lata			x
Plasmophyllum (*Plasmophyllum*) *caespitosum*[4]	x	x	
Plasmophyllum (*Plasmophyllum*) *secundum*[5]	x	x	
Pseudamplexus princeps	x	x	x
Pseudochonophyllum pseudohelianthoides	x		x
Rhizophyllum enorme	x	x	
Radiophyllum arborescens[6]	e		
Radiophyllum sp. nov.[6]	x	?	
Sinospongophyllum abrogatum	x	x	
Spongophyllum halysitoides halysitoides	x		
Spongophyllum halysitoides minor			x
Tryplasma sp.		e?	
Xystriphyllum dunstani	x		x
Xystriphyllum insigne		x	

Notes.

[1] e = endemic to that limestone (as presently known).

[2] Specimens very similar to the small *Calceola* described and figured from the Mt. Etna limestone (Hill, 1942*b*, p. 15, pl. i, fig. 3) are known from two localities within the Garra Formation.

[3] The Australian species of *Chlamydophyllum* are closer to one another than to the Eurasian species (see pp. 4, 7).

[4] '*Cystiphyllum*' *conjunctum* Hill 1942*d* is apparently conspecific with this German Middle Devonian phaceloid 'cystimorph'. The species has also been found at Mt. Etna (UQ 14746). See Birenheide (1964, p. 35).

[5] Birenheide (1964, pp. 23–24) places '*Cystiphyllum*' *sp.* Hill 1942*d*, from Wellington, in *Pl.* (*Plasmophyllum*) *originale* Birenheide 1964, but the writer's collections show that it belongs with the other Australian 'cystimorphs' placed by Birenheide in *Pl.* (*Pl.*) *secundum.*

[6] The specimens from Mt. Etna described as *Radiophyllum arborescens* are not conspecific with the Garra type. They may be conspecific with a new large species of *Radiophyllum* collected (but not yet described) from the Garra Formation by the writer; alternatively they may belong with *Sterictophyllum* Pedder 1965.

APPENDIX OF LOCALITIES

The general positions of these localities are shown in text-fig. 1; they are shown in somewhat more detail in Strusz (1965*a*). Detailed maps are contained in Strusz (1963). Grid references, given to the nearest 100 yds., are to the Dubbo (SI 55–4) and Bathurst (SI 55–8) 1:250,000 topographic maps. Further information may be obtained from Strusz (1963, 1965*a*).

BC–6: portion 70, Parish Boree Cabonne, Co. Ashburnham; in Mousehole Creek, 1,810 yds. east from the Orange–Parkes highway. Bathurst sheet, grid. ref. 1796.8890. 'Rubbly' limestone.

BN–2: junction of portions 4, 9, and 120, Parish Boree Nyrang, Co. Ashburnham; west bank of Walkers Creek, just west of road bridge. Bathurst sheet, grid ref. 1803.8928. Calcarenite (biostromal?).

Cr–36b: portion 173, Parish Curra, Co. Gordon, just west of Portion 112, and 150 yds. south of portion 172; near gully, south of the Wellington–Parkes road. Dubbo sheet, grid ref. 1836.9672. Calcarenite.

Ct–18: portion 45 (NW. sector), Parish Catombal, Co. Gordon, about 100 yds. east of portion 38; in gully (a tributary of Back Creek). Dubbo sheet, grid ref. 1755.9444. Pink biostromal limestone.

Ct–28: portion 40 (SW. corner), Parish Catombal, about 30 yds. east of junction with portions 30 and 45; field outcrop south of gully, 'Catombal' property. Dubbo sheet, grid ref. 1747.9437. Yellow biostromal limestone (same horizon as Ct–18).

Ct–53: portion 58 (N. side), Parish Catombal, midway between portions 77 and 79; south bank of Loombah Creek, extending over the interval 75–200 yds. north of the road. Dubbo sheet, grid ref. 1767.9391. Coral–brachiopod biostrome.

Gn–20: portion 30 (NW. corner), Parish Gundy, Co. Gordon; south side of Wellington–Parkes road, about 900 yds. east of Suntop Public School. Dubbo sheet, grid ref. *c.* 1795.9699. Calcarenite (biostromal?).

CAT/2193: 2,193 ft. along measured section CAT from the start point (the east side of the base of a pair of wheat silos, 'Catombal' property); on fence separating portions 41 and 43, Parish Catombal, and 1,160 ft. east from its junction with portion 29. Dubbo sheet, grid ref. 1755.9429. Grey skeletal calcarenite (same horizon as Ct–18, Ct–28).

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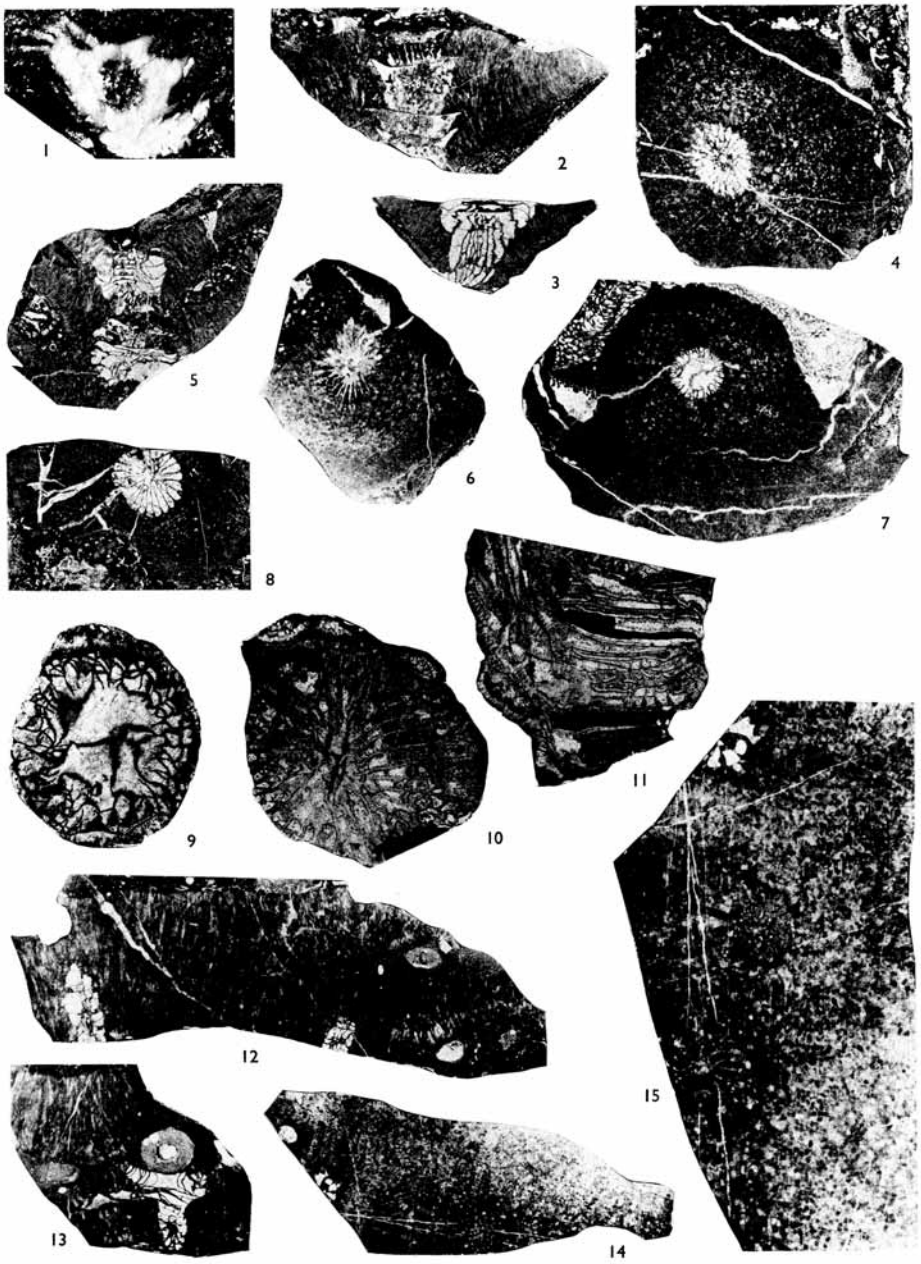

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