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MIDDLE DEVONIAN CYSTIPHYLLID CORALS FROM THE HUME FORMATION, NORTHWESTERN CANADA

R. A. McLean

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PREFACE

The coral fauna of the Middle Devonian Hume Formation of northwestern Canada is one of the richest and best preserved of its age in the world. This report describes the morphology and stratigraphic occurrence of the taxonomically controversial, cystiphyllid species of the fauna.

Data provided in this report will help refine biostratigraphic correlations of Middle Devonian strata of the western and Arctic Canada sedimentary basins, which in turn will lead to a better understanding of the natural resources of these areas.

D.J. McLaren
Director General
Geological Survey of Canada

Ottawa, September 15, 1976

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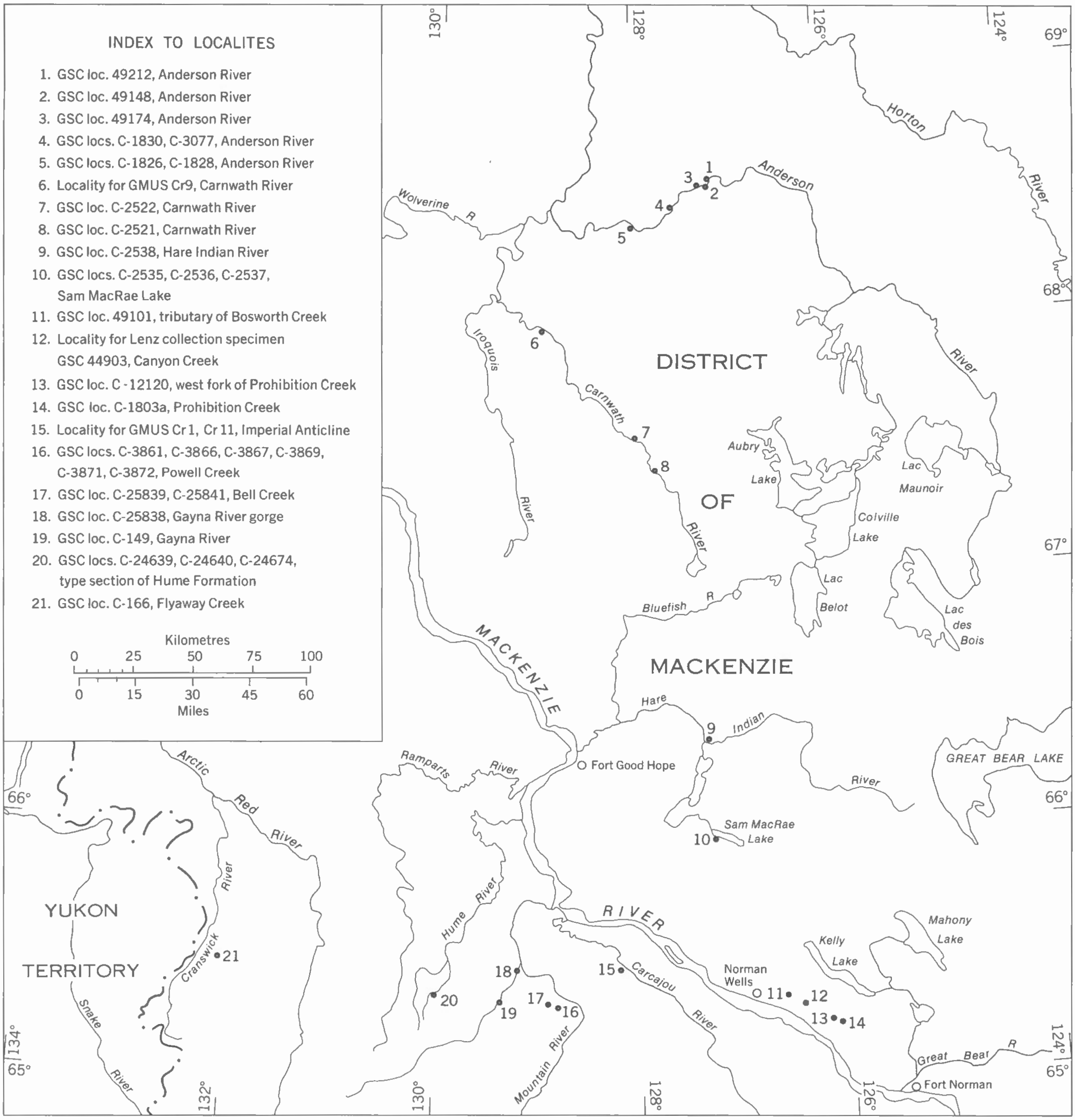
ABSTRACT

The following cystiphyllid corals are described from the Hume Formation (late Eifelian) of northwestern Canada: *Cystiphylloides macrocystis* (Schlüter), *C. pumilum* sp. nov., *Microplasma caespitosum* (Schlüter), *M. hadron* sp. nov., *Zonophyllum petilum* sp. nov., *Digonophyllum rectum* (Meek), *D. powellense* sp. nov., *Lekanophyllum ellipticum* sp. nov., *L. mediale* sp. nov., *L. andersonense* sp. nov., *L. andersonense* var. *major* var. nov. and *L. vescum* sp. nov. This fauna is a typical Middle Devonian assemblage and its greatest affinities are with those of the Old World. A lectotype of *Digonophyllum rectum* (Meek) is selected. The type species of *Cystiphylloides*, *C. aggregatum* (Billings) from southern Ontario, is revised and a neotype proposed. Comparative material of the species *Microplasma gotlandicum* Dybowski from Gotland, *M. fasciculatum* (Swartz) from Virginia and *Cystiphylloides fruticosum* (Nicholson) from southern Ontario is discussed and illustrated.

RESUME

L'auteur décrit les cystiphillidés suivants, et attribue leur provenance à la formation de Hume du Eifélien supérieur, située dans le nord-ouest du Canada: *Cystiphylloides macrocystis* (Schlüter), *C. pumilum* sp. nov., *Microplasma caespitosum* (Schlüter), *M. hadron* sp. nov., *Zonophyllum petilum* sp. nov *Digonophyllum rectum* (Meek), *D. powellense* sp. nov., *Lekanophyllum ellipticum* sp. nov., *L. mediale* sp. nov., *L. andersonense* sp. nov., *L. andersonense* var. *major* var. nov. et *L. vescum* sp. nov. Cette faune est un assemblage typique du Dévonien moyen, dont on trouve les plus grandes affinités dans l'ancien monde. Un lectotype de *Digonophyllum rectum* (Meek) est retenu. L'espèce type de *Cystiphylloides*, *C. aggregatum* (Billings) du sud de l'Ontario, est réexaminée et un néotype est proposé. L'auteur commente et illustre des spécimens comparables, les espèces *Microplasma gotlandicum* (Dybowski) en provenance du Gotland, *M. fasciculatum* (Swartz) de la Virginie et *Cystiphylloides fruticosum* (Nicholson) trouvé dans le sud de l'Ontario.



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TEXTFIGURE 1. Index map showing collecting localities, Hume Formation

MIDDLE DEVONIAN CYSTIPHYLLID CORALS FROM THE HUME FORMATION, DISTRICT OF MACKENZIE, NORTHWESTERN CANADA

INTRODUCTION

The Hume Formation (Bassett, 1961) comprises interbedded limestone and shale and is a widely distributed platform facies in the District of Mackenzie. The type section, which is 121.9 m (400 ft) thick (402 ft, Braun, 1966, p. 250), was measured on the "east branch of the Hume River" at the front of the Mackenzie Mountains (Bassett, *op. cit.*, p. 486; *see* Textfigure 1, loc. 20). However, the basal unit of the Hume Formation, 7.6 m (25 ft) thick, and consisting of interbedded grey-brown limestone and shale, according to Bassett (*ibid.*) is referred now to the underlying Gossage Formation of Tassonyi (1969). This is based on an unpublished measurement of the type section (114.6 m; 376 ft) at that locality (A.E.H. Pedder, pers. com., 1975). The thickness of the Hume Formation varies throughout the outcrop area. It is 60.1 m (197 ft) thick at the Anderson River section in the northeast (A.E.H. Pedder, pers. com., 1976), but thickens considerably to the south and west. Further comments may be found in Norris (1968) and, for detailed lithostratigraphy of the formation on the basis of subsurface data, see Tassonyi (1969). Other work on the stratigraphy and abundant fauna of the Hume Formation has been summarized by Caldwell (1964, 1971) and Pedder (1975). Detailed stratigraphy and faunal lists from particular sections have been published by Lenz and Pedder (1972, Powell Creek) and Cook and Aitken (1971, Hare Indian River, Carnwath River; 1975, Andrew River, Carnwath River).

Pedder (1975) has recognized subdivision of the Hume Formation into three zones (or Teilzones) on the basis of brachiopods: the *adoceta*, *dysmorphostrota* and *castanea* zones, in ascending order. The *castanea* zone includes the uppermost few feet of the Hume Formation and the lowest beds of the overlying Hare Indian Formation. Cystiphyllid corals are most abundant in the *dysmorphostrota* zone, which occupies the bulk of the upper two thirds of the succession, and minor occurrences are found in the *adoceta* zone; they are absent apparently in the *castanea* zone.

The Nahanni and Headless Formations of southwestern District of Mackenzie (south of the area of outcrop of the Hume Formation) have been correlated with the Hume (Pedder, 1964; Chatterton, 1974) and, at one locality in the northern Funeral Range, are underlain by strata with Eifelian goniatites (House and Pedder, 1963). Because Eifelian conodonts have been reported in the Hume and Nahanni Formations (Uyeno *in* Lenz and Pedder, 1972; Chatterton, 1974; Uyeno and Mason, 1975) and the *castanea* zone generally is regarded as early Givetian (House and Pedder, 1963; *see also* review of Ludvigsen and Perry, 1975, p. 63), a late Eifelian age seems most probable for the *adoceta* and *dysmorphostrota* zones of the Hume Formation. The cystiphyllids generally do not give definite indications of the age of the Hume, beyond suggesting a general Eifelian-Givetian assignment, with late Eifelian to early Givetian being most likely.

Rugosans from the Hume Formation have been described in a number of works (Meek, 1867; Crickmay, 1960, 1962, 1968; Lenz, 1961; Pedder, 1964, 1971a, b), but cystiphyllids have received little attention, except for small faunas briefly described by Meek (1867) and Lenz (1961). Genera now recognized in the Hume include *Xystriphyllum*, *Taimyrophyllum*, *Radiastraea*, *Aphroidophyllum*, *Dendrostella*, *Redstonea*, *Dohmophyllum*, *Disphyllum*, *Kunthia*, *Sociophyllum*, *Exilifrons*, *Utaratuia*, *Mackenziephyllum*, *Cystiphylloides*, *Microplasma*, *Zonophyllum*, *Digonophyllum* and *Lekanophyllum*. It is noteworthy in this assemblage that the common Old World Eifelian genera *Calceola* and *Acanthophyllum* are absent and, although the cystiphyllids show closest similarities to the Old World faunas (those of the Eifel and Urals, *see* discussion in systematic descriptions below), they are dominated by new species. Also, there is little similarity to the Middle Devonian cystiphyllids of Nevada and, hence, there is some notable endemism among the Hume rugosan fauna.

The cystiphyllids identified by Lenz (1961) are listed below, together with their taxonomic assignments suggested here (in brackets).

Microplasma cf. *fongi* Yoh
    [*Microplasma caespitosum* (Schlüter)]
Digonophyllum rectum (Meek)
    [*Digonophyllum rectum* (Meek)]
Zonodigonophyllum cf. *simplex* Wedekind
    [*Digonophyllum rectum?*]
Cystiphylloides? americanum arcticum (Meek)
    [*Digonophyllum rectum?*]
Cystiphylloides kwangsiense? Yoh
    [*?Zonophyllum petilum* sp. nov.]
Atelophyllum fultum (Hill)
    [*Lekanophyllum andersonense* sp. nov.]

Locality data for this fauna may be found in the Appendix.

The zonal distribution of the Hume cystiphyllids studied is listed below in Table 1. An attempt was made to section representative amounts of the Hume material but, because of the large volume of material available, the apparent lack of particular species in a zone should not be regarded as certain.

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SPECIES	*ADOCETA* ZONE	*DYSMORPHOSTROTA* ZONE
Cystiphylloides macrocystis		X
Cystiphylloides pumillum		X
Microplasma caespitosum	X	X
Microplasma hadron		X
Zonophyllum petilum	X	X
Digonophyllum rectum	X	X
Digonophyllum powellense		X
Digonophyllum sp.		X
Lekanophyllum ellipticum		X
Lekanophyllum mediale	X	X
Lekanophyllum andersonense	X	X
Lekanophyllum aff. *L. andersonense*	X	
Lekanophyllum andersonense var. *major*		X
Lekanophyllum vescum		X

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TABLE 1. Zonal distribution of cystiphyllid corals in the Hume Formation

SYSTEMATIC PALEONTOLOGY

The morphological terminology followed here is basically that of Hill (1956), with some slight modifications. The simpler term "presepiment" ("präsepimente" of Schouppé and Stacul, 1966) is preferred for "lonsdaleoid dissepiments". Their structure in relation to the septa is well illustrated by Schouppé and Stacul (1966, p. 130-134, Figs. 111-115). The term "septal cone" has been used commonly to describe the septal apparatus of the Devonian cystimorphs since the work of Wedekind (1924). However, it does not describe adequately the shape or variability of the septa, as noted by Tsyganko (1972b), and is used here only in an informal sense. Septal structure is described in terms of "crusts", composed of layers of closely packed trabeculae on the surfaces of horizontal skeletal elements (in some cases the crusts consist only of fibrous sclerenchyme in which no trabeculae can be distinguished). These crusts may be split into rows of radially fused trabeculae or "crests", forming ridges on the horizontal skeletal elements and usually appearing as clear, radial septa in a transverse section. The crests commonly break down to discrete spines. This variation in septal structure in the Devonian cystimorphs is illustrated clearly by Soshkina (1949, p. 27, Figs. 8-11). The term "discrete carinae" is used here for series of discrete, arched plates found in the peripheral region of presepiments of some Devonian cystimorphs. They have been described under a number of names in the past, including "arched laminae", "cross bar carinae" and "strip carinae", while their structure and relationships to the presepiments were well described under the name "septalleisten" by Vollbrecht (1922).

The following abbreviations are used for the names of collections containing type specimens to which reference is made:

GSC	Geological Survey of Canada, Ottawa
USNM	United States National Museum, Washington, D.C.
GMUS	Geological Museum, University of Saskatchewan, Saskatoon
ROM	Royal Ontario Museum, Toronto
RM	Naturhistoriska riksmuseet, Stockholm
GMBo	Geological Museum, University of Bonn, West Germany
SUI	Department of Geology, University of Iowa, Iowa City

Locality details may be found in the Appendix.

Family CYSTIPHYLLIDAE Edwards and Haime, 1850

Subfamily CYSTIPHYLLINAE McCoy, 1851

Discussion. A large number of schemes of suprageneric classification of the Devonian cystimorphs has been proposed (*see* particularly the review of Ulitina, 1968). Birenheide (1974), however, has clearly shown the close relationship between the Devonian cystimorphs and the Silurian cystiphyllids and he placed the former in the family Cystiphyllidae. He considered that the Silurian and Devonian forms could be separated at the subfamily level, using the Cystiphyllinae for the former and Digonophyllinae Wedekind, 1923 for the latter. However, because the simpler Devonian forms, referred to *Cystiphylloides* Chapman and *Zonophyllum* Wedekind, which were included in the Digonophyllinae under the name *Mesophyllum* (*Cystiphylloides*) by Birenheide, show such close similarities to Silurian cystiphyllinids *Cystiphyllum* Lonsdale and *Hedstroemophyllum* Wedekind, it is felt that they should not be separated at subfamily level. The recognition in this paper of Devonian representatives of the "Silurian" cystiphyllinid *Microplasma* Dybowski, a form also similar to *Cystiphylloides*, further indicates that *Cystiphylloides* is better included in the Cystiphyllinae.

The following are recognized to be Devonian representatives of the Cystiphyllinae: *Cystiphylloides* Chapman, 1893; *Microplasma* Dybowski, 1874; *Diplochone* Frech, 1886; *Cayugaea* Lambe 1901 (morphologically very similar to *Coronoruga* Strusz, 1961); *Zonophyllum* Wedekind, 1924; *Mackenziephyllum* Pedder, 1971a (=*Zonastraea* Tsyganko, 1972a) and *Loboplasma* Spasskiy, Kravtsov and Tsyganko, 1974. Although provisionally retained, *Coleophyllum* Hall, 1883, *Bucanophyllum* Ulrich, 1886, *Edaphophyllum* Simpson, 1900, and *Cladionophyllum* Stumm, 1961 are possible synonyms of *Cystiphylloides*.

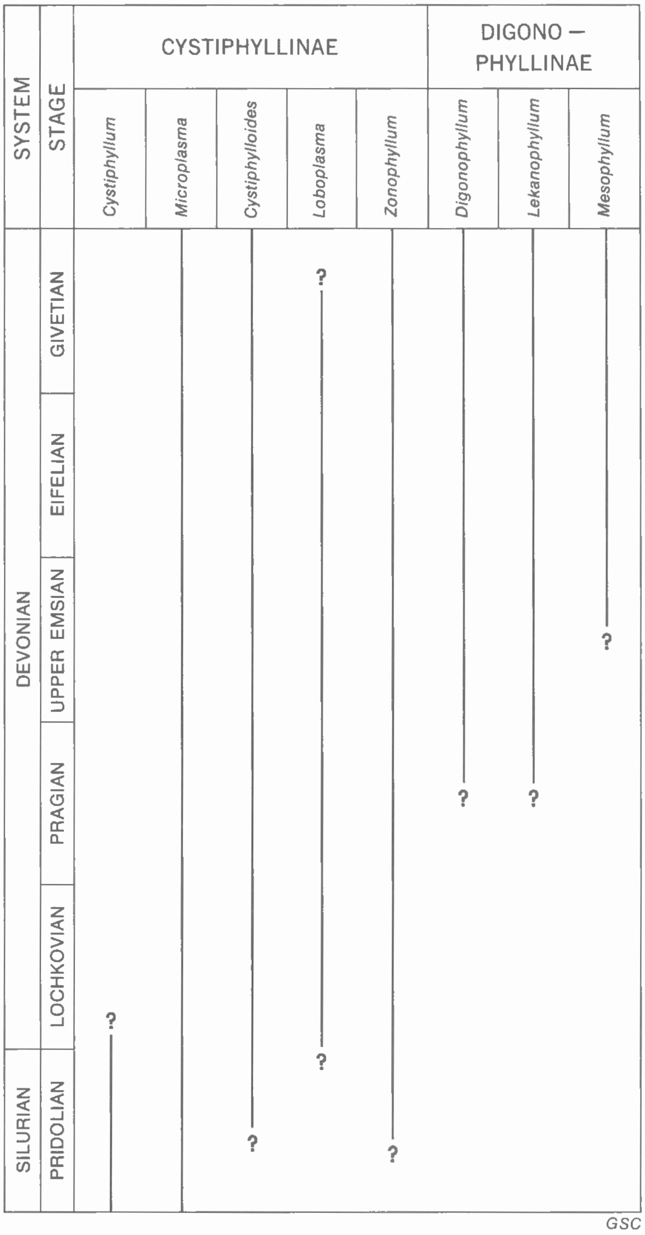
In this work, the subfamily Digonophyllinae is reserved for those Devonian forms that have a tendency toward development of complete, radial septa. Birenheide (1974) included all such forms in *Mesophyllum* (*Mesophyllum*) Schlüter, 1889. Although some transitional forms between these genera and *Cystiphylloides* and *Zonophyllum* are known in both Europe and western Canada, recognition of the subfamily is justified. The Digonophyllinae currently are not known from Lochkovian or earlier strata, whereas the Cystiphyllinae are known to range from Silurian to Givetian strata (*see* Textfig. 2).

Genus *Cystiphylloides* Chapman, 1893

Cystiphylloides Chapman, 1893, p. 46.
Pseudozonophyllum Wedekind, 1924, p. 25.
Lythophyllum Wedekind, 1925, p. 32.
Paralythophyllum Wedekind, 1925, p. 35.
Nardophyllum Wedekind, 1925, p. 36.
Plagiophyllum Wedekind and Vollbrecht, 1931, Pl. 17, figs. 4, 5, Pl. 27, figs. 6, 7.
Skoliophyllum Wedekind, 1937, p. 50, 52.
Wedekindophyllum Stumm, 1949, p. 39.
?*Praenardophyllum* Spasskiy, 1955, p. 99.
Comanaphyllum H. Flügel *in* Flügel and Flügel, 1961, p. 388.
Patridophyllum Ulitina, 1968, p. 86.

Type species. *Cystiphyllum aggregatum* Billings, 1859. ?Bois Blanc Formation (Late Emsian), Ontario.

Diagnosis. Corallum fasciculate or solitary. Septa developed as short, discrete spines and crusts of fused trabeculae or "fibrous" sclerenchyme, based mainly on dissepiments and, to a minor degree, on corallite wall. Short, discontinuous septal crests may be developed, but they do not form complete, radial septa in transverse section. Crusts may be vertically fused to fill varying amounts of corallite interior.



TEXTFIGURE 2. Chart showing world-wide range of selected genera of the Cystiphyllinae and Digonophyllinae

Discussion. Morphologically simple Devonian forms here included in *Cystiphylloides* resemble species of *Cystiphyllum* Lonsdale, 1839. *Cystiphyllum* is characterized by a random distribution of short, holacanthine septal spines that are well developed on the dissepimental surfaces. These spines commonly may be wrapped in sclerenchyme, as in *C. cylindricum* Lonsdale, 1839 (Lang and Smith, 1927, Pl.

36). However, the extent to which sclerenchymal layering is developed in *Cystiphyllum* varies greatly (McLean, 1974).

Various views have been put forward for distinguishing Silurian species of *Cystiphyllum* from similar Devonian forms. Wedekind and co-workers regarded the development of "septal cones" in the latter as a diagnostic feature. However, such "cones", or successive layers of trabeculae, are, in many cases, well developed in *Cystiphyllum* and other Silurian cystiphyllids (*see* McLean, 1974; Birenheide, 1974) and cannot be considered as a distinguishing criterion. The biological significance of "septal cones" is still debated (Tsyganko, 1972b).

Hill (1939, 1942a) suggested that *Cystiphyllum* could be distinguished from the Devonian cystimorphs by its having holacanthine rather than monacanthine trabeculae. Holacanths, however, have been claimed in Devonian cystimorphs by Birenheide (1964) and are common in the cystiphyllid fauna of the Hume Formation. Wang (1948, p. 33) proposed that the Devonian forms could be separated on the basis of their having fibrous rather than lamellar sclerenchymal tissue. It has been demonstrated clearly by a number of workers, including Kato (1963), Sorauf (1971) and Oekentorp (1972, 1974), that the presence of lamellar tissue in Rugosa is of secondary origin, resulting from recrystallization of an original fibrous structure and, hence, cannot be regarded in itself as having taxonomic significance. Besprozvannykh and Ivanovskiy (1975) used the supposed presence of holacanths with lamellar tissue in some Devonian cystiphyllids (e.g. *Lythophyllum* and *Skoliophyllum*) to distinguish them from other forms with monacanths (e.g. *Nardophyllum*). In addition, they erroneously placed the former in synonymy with *Cystiphyllum*, believing them to have comparable microstructure. Because of the effects of recrystallization mentioned above, the taxonomic scheme of Besprozvannykh and Ivanovskiy cannot be accepted.

Stumm (1949, p. 38) stated that *Cystiphyllum* "has septal crests developed from lateral acanthine septa, while Devonian forms possess cones derived from calycinal septal striae". However, acanthine septa commonly are developed among Devonian cystimorphs that may not always clearly show "septal cones". McLaren (1964, p. 25) suggested "the differences between the two genera may be in the greater differentiation into dissepimentarium and tabularium, possibly the absence of spinose septal elements axially, and a greater tendency towards formation of septal cones in *Cystiphylloides*". All these features, however, are extremely variable in both genera and cannot be considered generic distinctions. Strusz (1969, p. 310) suggested that "the major difference between the genera lies in the arrangement of the trabeculae, which in the Devonian forms can always be shown to make up radial septa". By no means all species of *Cystiphylloides* exhibit radial septa [e.g. some species of *Plasmophyllum* (*Plasmophyllum*) sensu Birenheide, 1964]. Most Silurian representatives of *Cystiphyllum* show a radial alignment of septal spines in the calice, as noted by Merriam (1973, p. 24), although the spines are too short for this to be apparent in transverse section (e.g. Lang and Smith, 1927, Pl. 36, fig. 3). Such also is the case with many species of *Cystiphylloides*. A further possible distinction between *Cystiphyllum* and *Cystiphylloides* was suggested by Merriam (1973, p. 24), who stated that in the former the septal spines "are usually more slender and more numerous than the stronger crests and spines which characterize some species of *Cystiphylloides*". This is certainly true in many cases but cannot be used as a universal criterion for distinguishing the genera.

It is evident that it can be extremely difficult to distinguish *Cystiphyllum* from some of the morphologically simpler Devonion forms that have been included in *Cystiphylloides*, although the common Devonian forms as a whole can be clearly separated from the Silurian ones. It would seem that the only possible criterion for separating the simpler species generically lies in the septal structure. The common development of relatively coarse, dilated monacanths (or holacanths resulting from recrystallization) forming thick crusts of closely packed trabeculae in the Devonian forms, as opposed to the generally well spaced, small, slender holacanths in *Cystiphyllum*, seems to provide the best means of distinguishing them on a general basis.

The name *Cystiphylloides* is retained here for these Devonian forms, although it is unfortunate that the type species, *C. aggregatum* (Billings, 1859), revised herein, is intermediate in structure between *Cystiphyllum* and the typical Devonian forms in question, such as *"Cystiphyllum" americanum* Edwards and Haime, 1851 and *"Cystiphyllum" pseudoseptatum* Schulz, 1883, upon which the concept of *Cystiphylloides* generally has been based. In *C. aggregatum*, many corallites have little or no septal development but, where apparent, tend to have small clumps of dilated trabeculae and one example (Pl. 2, figs. 1, 4) shows thick dissepimental coating of divergent fibres; in some cases, dilated monacanths are apparent. Hence, on the basis of the most pronounced type of septal development in this species, it is felt justified to consider it congeneric with the Devonian forms mentioned above. It should be noted, however, that *C. aggregatum* is morphologically atypical of the genus *Cystiphylloides* as a whole.

The species regarded as representative of *Cystiphylloides* (*see* below) fall within the range of variation of the subgenus *Plasmophyllum* (*Plasmophyllum*) Dybowski, 1873 sensu Birenheide (1964). However, as has been pointed out by Weyer (1971), the type species of *Plasmophyllum* is *Cystiphyllum brevilamellatum* McCoy, 1850 from the Wenlock limestone and is unrelated to the Devonian species assigned to *Plasmophyllum* by Birenheide. As a result, Birenheide (1974) proposed the use of the name *Mesophyllum* Schlüter, 1889 to replace *Plasmophyllum* of his earlier interpretation, regarding it as the next available synonym. *Plasmophyllum* (*Plasmophyllum*) then was replaced by *Mesophyllum* (*Cystiphylloides*), although the writer considers that differences between *Mesophyllum* and *Cystiphylloides* are sufficient to warrant their separation at the generic level (*see* discussion of *Mesophyllum* in this report). The present interpretation differs somewhat from that of Birenheide (1964, 1974) in other respects also. The genera *Cystiphylloides*, *Pseudozonophyllum*

Wedekind, 1924, *Lythophyllum* Wedekind, 1925, *Paralythophyllum* Wedekind, 1925, *Nardophyllum* Wedekind, 1925, *Plagiophyllum* Wedekind and Vollbrecht, 1931, *Skoliophyllum* Wedekind, 1937, *Wedekindophyllum* Stumm, 1949 and *Comanaphyllum* H. Flügel *in* Flügel and Flügel, 1961 were regarded as synonymous by Birenheide and this view is followed here. In addition, *Patridophyllum* Ulitina, 1968 also is considered a synonym. However, *Zonophyllum* Wedekind, 1924, *Pseudomicroplasma* Soshkina, 1949, *Cystiphylloides* Yoh, 1937 (non Chapman, 1893) and *Cystiplasma* Taylor, 1951, included by Birenheide (1964, 1974) in *Mesophyllum* (*Cystiphylloides*), are considered here to be distinct from *Cystiphylloides*. These forms are discussed in the relevant sections below concerning *Microplasma* and *Zonophyllum*.

Devonian forms included in *Cystiphylloides* are listed below.

Colonial species:

Cystiphyllum aggregatum Billings, 1859. ?Bois Blanc Formation, late Emsian, Ontario.

Cystiphyllum fruticosum Nicholson, 1875a. ?Bois Blanc Formation, late Emsian, Ontario.

Mesophyllum robertsense Stumm, 1937, revised by Merriam (1974). Nevada Formation, Devonian coral zone D_2, late Emsian, Nevada.

Cystiphylloides petoskeyense Stumm, 1962. Petoskey Formation, late Givetian, Michigan.

Cystiphylloides phacelliforme Stumm, 1962. Ferron Point Formation, early Givetian, Michigan.

Cystiphylloides alpenense Stumm, 1962. Genshaw Formation, early Givetian, Michigan.

Pseudomicroplasma fasciculata Ivaniya, 1965. Chielev Beds, late Givetian, Mountainous Altai.

Solitary species:

Cystiphyllum americanum Edwards and Haime, 1851, revised by Stumm (1961) and others. Numerous localities in eastern North America, of Eifelian and Givetian ages (*see* Bassler, 1950).

Cystiphyllum conifollis Hall, 1877, revised by Fenton and Fenton (1938). Hamilton Group, Givetian, New York, Ontario.

Pseudozonophyllum halli Wedekind, 1924 and *P. logani* Wedekind, 1924. Lower Nohn Beds, early Eifelian, the Eifel.

Cystiphyllum sp. of Le Maître (1934). Chaudefonds Limestone, Emsian, western France.

Lythophyllum minimum Soshkina, 1936, *L. excentricum* Soshkina, 1936, *L. aconicum* Soshkina, 1936 and *L. platycalix* Soshkina, 1936. ?Late Eifelian, Northern Urals.

Paralythophyllum centrale Soshkina, 1936. ?Late Eifelian, Northern Urals.

Zonodigonophyllum simplex Soshkina, 1936. ?*Calceola* Beds, late Eifelian, Northern Urals.

Mesophyllum lonense Stumm, 1937, revised by Merriam (1974). Nevada Formation, Devonian coral zone C, late Pragian, Nevada.

"*Cystiphyllum*" aff. *australe* Etheridge sensu Hill, 1940 (?non Etheridge, 1902). Cavan Limestone, late Pragian, New South Wales.

Nardophyllum vermiforme Soshkina, 1949. Chusov Beds, middle Givetian, Northern Urals.

Pesudozonophyllum excentricum Rozkowska, 1954. ?Eifelian, Holy Cross Mountains, Poland.

Nardophyllum primitivum Spasskiy, 1955. *Calceola* Beds, late Eifelian, Central Urals.

Lythophyllum acutum Ermakova, 1956 and *L. aequivesiculare* Ermakova, 1956. ?Givetian, Northern Urals.

Lythophyllum giganteum Ivaniya, 1957 and *L. karatshumyshense* Ivaniya, 1957. Mamontov Beds, late Eifelian, Kuznets Basin.

Pseudomicroplasma kuznetskiense Bulvanker, 1958. Shandin Beds, Eifelian, Kuznets Basin.

Nardophyllum magnum Vaganova, 1959. ?Eifelian, Northern Urals.

Pseudozonophyllum zmeinogorskiense Spasskiy, 1960. Strizhkov Beds, Givetian, Rudniy Altai.

Cystiphylloides radugini Ivaniya *in* Zheltonogova and Ivaniya, 1961. Siberian Lebedyan Beds, late Givetian, Kuznets Basin.

Comanaphyllum tumidum H. Flügel *in* Flügel and Flügel, ?Late Eifelian-early Givetian, Anti-Taurus.

Cystiphylloides tabulatum Stumm, 1962. Gravel Point Formation, middle Givetian, Michigan.

Cystiphylloides potterense Stumm, 1962. Potter Farm Formation, Petoskey Limestone, late Givetian, Michigan.

Lythophyllum alpenense Stumm, 1962. Genshaw Formation, early Givetian, Michigan.

Cystiphylloides tenuiconicum Ulitina, 1963a. Late Eifelian-Givetian, Transcaucasus.

Cystiphylloides crassiconicum Ulitina, 1963a. Late Givetian, Transcaucasus.

Nardophyllum crassiconicum Ulitina, 1963b. ?Eifelian, Transcaucasus.

Nardophyllum planiconicum Ulitina, 1963b. Late Eifelian, Transcaucasus.

Pseudozonophyllum imulum Kravtsov, 1963 and *P. eohalli* Kravtsov, 1963. Yunkhod Beds, late Pragian, Central Taimyr.

Plasmophyllum (P.) secundum secundum (Goldfuss) sensu Birenheide, 1964. Lower Nohn Beds, early Eifelian, the Eifel.

Plasmophyllum (P.) secundum conistructum (Quenstedt) sensu Birenheide, 1964. Junkerberg Beds, middle Eifelian, the Eifel.

Plasmophyllum (P.) secundum pseudoseptatum (Schulz) sensu Birenheide, 1964. Dreimühlen Beds, middle Givetian, the Eifel.

Plasmophyllum (P.) lamellosum (Goldfuss) sensu Birenheide, 1964. Ahrdorf-Junkerberg Beds, middle Eifelian, the Eifel.

Plasmophyllum (P.) macrocystis (Schlüter) sensu Birenheide, 1964. Ahbach-Loogh Beds, late Eifelian-early Givetian, the Eifel.

Plasmophyllum (P.) originale Birenheide, 1964. Heisdorf Beds, late Emsian, the Eifel.

Cystiphylloides varium Ivaniya, 1965 and *C. salairicum* Ivaniya, 1965. Shandin Beds, Eifelian, Kuznets Basin.

Cystiphylloides wedekindi Bulvanker *in* Kravtsov, 1965. Guba Morzhovaya Horizon, ?late Lochkovian-early Pragian, Novaya Zemlya, Vaygach Island.

Nardophyllum clarum Kravtsov, 1965. Guba Morzhovaya Horizon, ?late Lochkovian-early Pragian, Novaya Zemlya.

Nardophyllum sibiricum Ivaniya, 1965. ?Eifelian, Kuznets Basin.

Cystiphylloides subdivisum Kravtsov, 1966, *C. corneum* Kravtsov, 1966, *C. oblitterum* Kravtsov, 1966 and *C. originale* Kravtsov, 1966. Valn'ev Horizon, Pragian, Novaya Zemlya.

"Patridophyllum" pachyacanthum Ulitina *in* Sytova and Ulitina, 1966. Nadaynasu Horizon, ?Lochkovian, Kazakhstan.
Cystiphylloides kaerlykense Cherepnina, 1967. ?Late Givetian, Mountainous Altai.
Pseudomicroplasma minima Cherepnina, 1967. Shivertin Beds, late Eifelian, Mountainous Altai.
Cytiphylloides amplovesiculatum Gorianov *in* Bulvanker *et al.*, 1968. Talbulak Formation, Pragian, Zeravshan Range, Tadzhikistan.
Cystiphylloides porfirjevi Bulvanker *in* Bulvanker *et al.*, 1968. "?Gedinnian", Novaya Zemlya.
Cystiphylloides gumushlukense Ulitina, 1968. Late Givetian, Transcaucasus.
Zonophyllum lucasense Stumm, 1968a. Ten Mile Creek Dolomite, middle Givetian, Ohio.
Cayugaea? transitorius Stumm, 1968b. Silica Formation, early Givetian, Ohio.
Pseudomicroplasma assuetum Ulitina, 1968. Late Eifelian, late Givetian, Transcaucasus.
Patridophyllum paternum Ulitina, 1968. Late Eifelian, Transcaucasus.
Patridophyllum digonophylloides Sytova, 1968. Skala Horizon, Pridolian, Podolia.
Cystiphylloides rosiforme Tsien, 1969. Horizon Cole, early Eifelian, Dinant Basin.
Cystiphylloides pseudomesophyllum Tsien, 1969. Horizon Co2b, early Eifelian, Dinant Basin.
Cystiphylloides pseudofongi Tsien, 1969, *C. lecomptei* Tsien, 1969 and *C. crassiseptatum* Tsien, 1969. Horizon Co2c, middle Eifelian, Dinant Basin.
Plasmophyllum (P.) magnivesiculosum Jell and Hill, 1969. Ukalunda Beds, late Emsian-early Eifelian, North Queensland.
Nardophyllum ineptum Sytova, 1970. Vaygach Horizon, Pridolian, Vaygach Island.
Pseudomicroplasma fongi (Yoh) sensu Brice, 1970 (non Yoh, 1937). Givetian, Afghanistan.
Patridophyllum crassocristatum Spasskiy *in* Dubatolov and Spasskiy, 1971. Pribalkhash Horizon, ?Lochkovian, Kazakhstan.
Edaphophyllum irregularum Mitchell and Driscoll, 1971. Lower Arkona Formation, Givetian, Ontario.
Cystiphylloides lonense Merriam, 1974. Nevada Formation, Devonian coral zone C, late Pragian, Nevada.
Cystiphylloides pumilum sp. nov. Hume Formation, late Eifelian, District of Mackenzie.

Listed above are the only species it is felt can be placed in *Cystiphylloides* with any certainty. However, as their ontogeny and intraspecific variation are to a large extent unknown, an objective synonymy of many of these forms is not yet possible. It is likely that a large number will be merged later and a tentative synonymy of some of them in relation to forms from the Hume Formation is discussed below.

Stumm (1965) revised and placed into *Cystiphylloides* many of the North American Middle Devonian cystimorph species originally described by Hall (1877, 1882, 1883), Nicholson (1874), Davis (1887), Greene (1898-1906) and Herzer (1902), from the Jeffersonville Limestone of Indiana-Kentucky, Columbus Limestone of Ohio (both Eifelian) and Beechworth Limestone (middle Givetian) of Indiana-Kentucky. It is unfortunate that most of these forms have not been studied in thin section (much of the material is silicified), but it would seem very likely that many will prove to be synonyms of the common Eifelian-Givetian species *C. americanum* (Edwards and Haime). At the present state of knowledge, these species (Stumm, 1965, p. 54-56) are of little value for comparison.

Coleophyllum Hall, 1883, *Bucanophyllum* Ulrich, 1886, *Edaphophyllum* Simpson, 1900 and *Cladionophyllum* Stumm, 1961 are very closely related to *Cystiphylloides* and further work may show them to be synonyms. *Coleophyllum*, as exemplified by the type species *C. romingeri* Hall, 1883 (Indiana, Jeffersonville Limestone, Eifelian), is apparently a large, silicified form but, based on sections illustrated by Stumm (1961, Pl. 5, figs. 1, 2; 1965, Pl. 53, figs. 3, 4), it apparently lacks, almost totally, horizontal skeletal elements, the corallite interior being filled with tightly packed septal crusts. The writer tentatively follows Birenheide (1974) in separating this genus from *Cystiphylloides*. *Bucanophyllum*, with type species *B. gracile* Ulrich, 1886 (=*Cystiphyllum ohioense* Nicholson, 1875a) from the Jeffersonville Limestone (Eifelian) of Indiana-Kentucky, has not been illustrated in thin section but, from the descriptions of Stumm (1961, 1965), differs from *Cystiphylloides* largely in growth form, having a thin, tube-like proximal portion (apparently hollow) and a broadly flaring distal part with sparse dissepiments and septal crusts. *Cladionophyllum* with type species *C. cicatriciferum* (Davis, 1887), also from the Jeffersonville Limestone, is comparable in growth form to *Bucanophyllum*, but is much larger. In internal morphology, it is identical to *Cystiphylloides* (Stumm, 1961, Pl. 6, figs. 1-3; 1965, Pl. 48, fig. 9) and may be synonymous with it or, as suggested by Birenheide (1974, p. 457), with *Bucanophyllum*. *Edaphophyllum*, with type species *E. bipartitum* (Hall, 1882), from the same horizon and locality, is characterized by a considerably dilated counter septum and marked cardinal fossula in the calice, producing a pronounced bilateral symmetry. Although the type species has not been studied in thin section, illustrations of *E. bifurcatum* (Hall, 1882), also from the same horizon and locality, show an internal similarity to *Cystiphylloides*, although with notably thick and dense septal crusts (Stumm, 1961, Pl. 5, figs. 6-9; 1965, Pl. 52, figs. 4-7). *Edaphophyllum* is retained tentatively because of its distinctive calical characteristics and the lack of sections of the type species, but it is probably a junior synonym of *Cystiphylloides*.

The internal morphology of *Praenardophyllum* Spasskiy, 1955 is illustrated only by transverse section of the type species (*P. domrachevi* Spasskiy, 1955, Pl. 2, fig. 1v, from the *Calceola* Beds of the western slopes of the central Urals). The septal crust is irregularly developed and apparently lacks differentiation into clear trabeculae, but *Praenardophyllum* is probably synonymous with *Cystiphylloides*.

Cystiphylloides is the longest ranging of the "Devonian" cystiphyllids, with Pridolian records of *"Patridophyllum" digonophylloides* Sytova, 1968 from the Skala Horizon of Podolia and *"Nardophyllum" ineptum* Sytova, 1970 from the Vaygach Horizon of Vaygach Island.

Cystiphylloides aggregatum (Billings, 1859)

Plate 1, figures 1, 2; Plate 2, figures 1-6;
Plate 3, figures 2, 4, 5

Cystiphyllum aggregatum Billings, 1859, p. 137, Fig. 28.
?Cystiphyllum aggregatum Billings; Rominger, 1876, p. 139.
Cystiphyllum aggregatum Billings; Lambe, 1901, p. 193, Pl. 18, fig. 3.
?Cystiphylloides aggregatum (Billings); Stumm, 1961, p. 231, Pl. 4, fig. 3, Pl. 5, fig. 5.
?Cystiphylloides petoskeyense Stumm, 1962, p. 223, Pl. 2, fig. 10, Pl. 3, fig. 9, Pl. 6, figs. 1-3.
?Cystiphylloides phacelliforme Stumm, 1962, p. 223, Pl. 1, figs. 4, 5, Pl. 5, fig. 2.
Cystiphylloides aggregatum (Billings); Merriam, 1974, p. 65.

Type material. Neotype (here chosen) GSC 6331, ?Bois Blanc Formation, Lot 6, Conc. 13, Walpole tp., approximately 5 km (3 miles) west of Hagersville, Ontario. ?Late Emsian.

Additional material. ROM 895 UH, "Hagersville, Ontario"; GSC 44798, "Cayuga, Ontario"; GSC 44799, "Walpole tp., Ontario". These specimens also are believed to be from the Bois Blanc Formation.

Diagnosis. Corallum phaceloid. Septa are weakly developed as short spines, usually in clumps. Septal crusts are often difficult to distinguish, septal crests are lacking.

Description. Corallum is phaceloid with corallites either closely appressed or well spaced. Increase is lateral, non-parricidal, with offsets commonly developed from calices at stages of rejuvenescence. Corallites commonly are distorted when in lateral contact, as illustrated by Billings (1859, p. 137, Fig. 28). Growth lines are clearly marked on epitheca. Corallite diameter is highly variable, ranging from 6 to 30 mm, with an average of 15 to 22 mm.

Septal development is typically weak, with sparse, short spines occurring usually in clumps on dissepimental surfaces. They rarely may become more coarsely developed, forming a thick coating of fibrous sclerenchyme in which incipient development of coarse monacanths can be seen (GSC 44798, Pl. 2, fig. 4). Many corallites show no clear development of septa, although there is usually a very thin coating of sclerenchyme on corallite walls.

Dissepiments are small peripherally, globose to weakly elongate and in gently sloping series. Axial tabellae are large, in flat or slightly sagging series.

Remarks. There has been much confusion in the past as to the internal morphology of *C. aggregatum*, the type species of *Cystiphylloides*, owing to the fact that illustrations of thin sections of the type material have never been published. As Billings' original type specimen is lost and its locality and horizon doubtful ("near Simcoe", Billings, 1859, p. 137), selection of a neotype has become of great importance to the understanding of the genus, but presents a number of problems. It is not certain if Billings' specimen came from the Bois Blanc Formation or the overlying Edgecliff Member of the Onondaga Limestone (for a review of the stratigraphy of these horizons in southern Ontario, *see* Oliver, 1967; Telford and Tarrant, 1975a, b). The state of preservation, however, appears more representative of that in Bois Blanc material and, if this is the case, it would most likely be a drift specimen (W.A. Oliver, Jr., pers. com., 1975) since there are no known outcrops of the Bois Blanc near Simcoe. A second specimen referred to this species is that illustrated by Lambe (1901, Pl. 18, fig. 3) from "Lot 6, Conc. 13, Walpole tp., Ontario". This specimen (GSC 6331) has been sectioned by the writer and, from the general state of preservation and lithology of the matrix, would appear to be almost certainly from the Bois Blanc, which outcrops immediately to the north of the stated locality. Hence this specimen may well have been in situ, or close to being so, when collected. The writer has examined two other specimens in the GSC collections and they undoubtedly are conspecific with Lambe's specimen, although lacking adequate locality data. They also show typical Bois Blanc lithology and preservation and all the specimens have a similar external appearance to that of the Billings specimen. The writer has collected fragmentary material of a possible colonial species of *Cystiphylloides* from the overlying Edgecliff Member at a number of localities in southern Ontario and, although possibly being conspecific with the Bois Blanc material, these specimens show a different state of preservation and the lithology of the matrix is markedly different. Unfortunately, neither W.A. Oliver, Jr. nor P.G. Telford, who have collected extensively in the relevant areas, nor the writer has found any specimens referrable to *C. aggregatum* in outcrops of the Bois Blanc Formation. From all lines of evidence, however, it would seem reasonable to assume that Lambe's specimen is both conspecific with and from the same horizon as the original specimen of *Cystiphyllum aggregatum*. Hence, as Lambe's specimen is also the only one available to the writer for which there is reasonable locality data, it is here selected as neotype and illustrated in Plate 1, figure 1, Plate 2, figures 2, 3 and Plate 3, figure 2.

Merriam (1974, p. 65) has discussed the Royal Ontario Museum specimen of *C. aggregatum* figured herein (Pl. 1, fig. 2; Pl. 2, fig. 6). He believed there was a total lack of septa in this specimen, but further sectioning has revealed that, while they are very sparse, short septal spines are in fact present. This specimen, however, has the weakest septal development of any representative of *C. aggregatum* here considered.

The specimen described as *Cystiphylloides aggregatum* by Stumm (1961, p. 231, Pl. 4, fig. 3, Pl. 5, fig. 5) from the Fogelsanger Quarry near Williamsville, New York, is derived from a reef of the Edgecliff Member (W.A. Oliver, Jr., pers. com., 1975). Stumm's specimen shows generally greater septal development than is typical of *C. aggregatum* from the ?Bois Blanc of Ontario, although in all other respects it is similar. Dr. Oliver kindly loaned another specimen from the Fogelsanger Quarry that shows rather weaker septal development, reminiscent of the ?Bois Blanc material. Stumm's form thus is tentatively included in *C. aggregatum* as an extreme variant of the species.

The phaceloid *C. alpenense* Stumm, 1962 from the Givetian Traverse Group of Michigan has well-developed septa comparable to Stumm's *C. aggregatum?* but generally has greater corallite diameter, weaker development of discrete septal spines and more globose dissepiments. It is regarded provisionally as a distinct species of *Cystiphylloides*. A specimen in the collections of the University of Iowa (SUI 39107) labelled *"Cystiphyllum aggregatum"*, from the Cedar Valley Formation (probably Solon Member, Givetian) of Independence, Iowa, differs from *C. aggregatum* in its larger corallite diameter (average 30-35 mm) and generally greater septal development. It may be conspecific with *C. alpenense*. It should be noted, however, that the degree of development of septal spines is highly variable in cystiphyllid species, as noted previously (McLean, 1974) in Australian Early Silurian species of *Cystiphyllum*. It is unfortunate that colonial specimens of *Cystiphylloides* are so rare and that very few have been studied in any detail, the variability in septal spine development in a typical population being unknown. Further studies of this group may indicate that, as in *Cystiphyllum*, degree of spine development is not of great taxonomic significance.

Cystiphyllum fruticosum Nicholson (1875a, Pl. 1, figs. 3, 3a; figures republished in Nicholson, 1875b, Pl. 1) was regarded as a synonym of *C. aggregatum* by Stumm (1961). The repository of Nicholson's types is unknown, but a specimen in the GSC collections (GSC 3401) from Lot 1, Conc. 1, Port Colborne, Ontario, labelled "*Cystiphyllum fruticosum* Nich., Corniferous, Ontario", conforms generally to Nicholson's description of the species. The GSC specimen, while lacking adequate locality data, shows typical Bois Blanc preservation and matrix lithology. Sections of this specimen (Pl. 3, figs. 1, 3) show no major internal differences to forms of *C. aggregatum* which have an almost total lack of septa. However, the considerably smaller corallite diameter of *C. fruticosum* (average 7-8 mm, as compared to 15-22 mm in *C. aggregatum*) suggests that a distinction may be made between the two forms. Consequently, *"Cystiphyllum" fruticosum* is regarded here as a distinct species of *Cystiphylloides*.

Two colonial species of *Cystiphylloides* described by Stumm (1962) from the Givetian Traverse Group of Michigan, *C. petoskeyense* and *C. phacelliforme* show close similarities to *C. aggregatum* in growth form and weak septal development. Their average corallite diameter (25-30 mm) is slightly larger than that of the ?Bois Blanc specimens, but lies within the range of variation of that material. They are regarded here as possible synonyms of *C. aggregatum*.

Cystiphylloides compositum (Soshkina, 1949) from the ?Biya Beds (late Eifelian) of the Urals differs from *C. aggregatum* in its generally smaller corallite diameter (which still, however, lies within the range of variation of that of *C. aggregatum*), somewhat greater septal development (although this also seems quite variable, *see* Soshkina, 1949, Pl. 12, figs. 1a-c) and generally coarser and more elongate dissepiments. Again, data on variability are lacking, but the species is provisionally considered as being distinct from *C. aggregatum*.

"Pseudomicroplasma" fasciculata Ivaniya, 1965, from the Chielev Beds (late Givetian) of the Mountainous Altai, has septal spines and crusts developed on the dissepiments, although these are not clear in the illustrations (Ivaniya, 1965, p. 53, Pl. 18, fig. 83, Pl. 19, fig. 84). The species is referred to *Cystiphylloides*, but lack of adequate illustration does not allow closer comparison with *C. aggregatum*.

Cystiphylloides macrocystis (Schlüter, 1889)

Plate 1, figures 6-9, Plate 3, figures 6-9,
Plate 4, figures 1-13, Plate 5, figures 1-8

Cystiphyllum macrocystis Schlüter, 1889, p. 88, Pl. 3, fig. 10.
Lytophyllum crassicaulum Wedekind and Vollbrecht, 1931, p. 104, Pl. 29, figs. 1-5.
Lytophyllum mirabile Wedekind and Vollbrecht, 1931, p. 104, Pl. 32, figs. 1-6.
Lytophyllum cf. *mirabile* Wedekind and Vollbrecht, 1931, Pl. 31, figs. 1-5.
Lythophyllum striatum Wedekind; Soshkina, 1952, p. 81, 112, Figs. 109a-b (non Wedekind, 1925).
Lythophyllum mirabile Wedekind and Vollbrecht; Bulvanker, 1958, p. 58, Pl. 20, figs. 1a-d, Pl. 21, figs. 1, 2.
Nardophyllum acutum Wedekind and Vollbrecht; Bulvanker, 1958, p. 31, Pl. 8, figs. 1a-b.
?*Nardophyllum marginatum* (Wedekind); Spasskiy, 1960, p. 33, Pl. 13, figs. 2-5, Pl. 14, figs. 1-3.
Plasmophyllum (Plasmophyllum) macrocystis (Schlüter); Birenheide, 1964, p. 33, Pl. 9, fig. 46, Pl. 10, figs. 47, 48, Pl. 17, fig. 80, Pl. 19, fig. 93, Pl. 24, fig. 119, Pl. 25, fig. 120, Pl. 26, fig. 128 (cum syn.).
?*Cystiphylloides wedekindi* Bulvanker *in* Kravtsov, 1965, p. 117, Pl. 1, fig. 3, Pl. 2, fig. 1
?*Cystiphylloides oblitterum* Kravtsov, 1966, p. 48, Pl. 10, figs. 1a-b, 2a-b.
?*Cystiphylloides originale* Kravtsov, 1966, p. 49, Pl. 10, figs. 3a-v.
Nardophyllum marginatum (Wedekind); Ulitina, 1968, p. 57, Pl. 5, figs. 2a-b, 3a-v, Pl. 6, fig. 2.
Cystiphylloides cuneiforme (Wedekind); Tsien, 1969, p. 79, Pl. 17, figs. 1-3, Pl. 30, figs. 3, 4, Pl. 33, fig. 1
Nardophyllum marginatum (Wedekind); Brice, 1970, p. 298, Pl. 19, fig. 4.
?non *Nardophyllum marginatum* (Wedekind); Kaplan, 1969, p. 28, Pl. 2, figs. 5, 6.

Material. GSC 44800-44805, GSC loc. C-2522, Carnwath River; GSC 44806-8, GSC loc. C-3871, Powell Creek; GSC 44809, GSC loc. C-25839, Bell Creek. Additional material tentatively referred to this species: GSC 44810-1, GSC loc. C-3871, Powell Creek; GSC 44812, GSC loc. C-3872, Powell Creek; GSC 44813, GSC loc. C-25841, Bell Creek; GMUS Cr 1, south limb of Imperial Anticline; GMUS Cr 2, Powell Creek.

Diagnosis. Solitary *Cystiphylloides*, typically with markedly asymmetrical axis of growth. Septal crusts are well developed and most pronounced on side of axis nearer corallite wall. Crusts may be vertically fused to varying extent in early stages of growth. Short, discontinuous septal crests may be developed, mainly near corallite periphery in ephebic stage. Dissepimental layers generally are steeply inclined.

Description. Corallum solitary, ceratoid to trochoid, frequently showing rejuvenescence. Curvature of corallum is moderate to slight. Calice has moderate depth with steep sides and an eccentric axis. Degree of septal development in calice is highly variable, ranging from being barely apparent (e.g. GSC 44806) to coarse, dilated, incomplete crests in forms becoming transitional to *Digonophyllum powellense* sp. nov. (e.g. GSC 44811). Maximum corallite diameter ranges from 20 to 35 mm, with height up to at least 80 mm.

Septa generally are developed as crusts composed of dilated trabeculae in lateral contact. Septal development is extremely variable, ranging from thin crusts, largely in axial region, to thick, dilated crusts with sparse development of short, discontinuous crests largely in peripheral regions. Crusts always show greater development on side of axis nearer corallite wall (i.e. convex side of corallite) and usually are best developed in early growth stages, where they may fill a considerable portion of corallite interior. Several forms tentatively included in this species are transitional to *Digonophyllum powellense* sp. nov., in having extensive early septal dilation, which breaks down to weak crests in the ephebic stage. Trabeculae typically are coarse and fused, but may be discrete.

Dissepiments vary greatly in size, but tend to be elongate and are steeply inclined peripherally. Axial tabellae form narrow zone, tend to occur in sagging layers and generally are considerably larger than dissepiments.

Remarks. The interpretation of *C. macrocystis* followed here is basically that of Birenheide (1964). Variation within the species is well shown by illustrations of species (Wedekind, 1925; Wedekind and Vollbrecht, 1931) considered as synonyms of *C. macrocystis* by Birenheide (*op. cit.*, p. 33, 34). The variation within the Hume Material suggests, however, that Birenheide's interpretation may be extended slightly to include forms with extensive early septal dilation and incipient development of septal crests in the ephebic stage (including forms in the Hume fauna transitional to *Digonophyllum powellense*; *see* discussion of that species below, and Pl. 3, figs. 6, 7, Pl. 5, figs. 3, 4). *Lytophyllum crassicaulum* Wedekind and Vollbrecht, 1931 and *Lytophyllum mirabile* Wedekind and Vollbrecht, 1931 represent similar forms in the Eifel fauna.

Schlüter's original material is from the Ahbach to Loogh Beds of the Sötenicher Mulde in the Eifel and the total range of the species in the Eifel is Junkerberg to Dreimühlen Beds (late Eifelian-early Givetian) according to Birenheide (1964). It is represented widely in strata of Eifelian to Givetian age, with records from the Shandin Beds (Eifelian) of the Kuznets Basin (Bulvanker, 1958), Horizons Co1e-Co2d (Eifelian) of the Dinant Basin (Tsien, 1969) and the Givetian of the Urals (Soshkina; 1936, 1952; Tsyganko, 1971), Morocco (Le Maître , 1947), Afghanistan (Brice, 1970) and the Transcaucasus (Ulitina, 1968). There is also a possible occurrence of the species in the Strizhkov Beds (Givetian) of the Rudniy Altai (Spasskiy, 1960) and in the Valnev Horizon (Pragian) of Novaya Zemlya (Kravtsov, 1965, 1966). The latter occurrence is considerably older than other known records, but the species concerned (*see* synonymy above) do not appear to show marked differences from *C. macrocystis*.

Cystiphylloides pumilum sp. nov.

Plate 1, figures 10, 11, Plate 5, figures 9-15,
Plate 6, figures 1, 2

Material. Holotype GSC 44814, GSC loc. C-3871, Powell Creek. Paratypes GSC 44815-7, same locality; GSC 44818, GSC loc. C-3872, Powell Creek; GSC 44819, GSC loc. C-2521, Carnwath River. Additional specimen tentatively referred to this species: GSC 44820, GSC loc. C-3871, Powell Creek.

Diagnosis. Small *Cystiphylloides* characterized by extensive early septal dilation, usually filling considerable portion of corallite, with septa reduced to irregularly developed short, discontinuous crests in ephebic stage.

Description. Corallum solitary, ceratoid, with curvature slight to strong and frequently showing rejuvenescence. Epitheca shows pronounced growth rings and faint septal striae. Calice is smoothly bowl-shaped, lacking peripheral platform. Incomplete septal crests in calice range from being rather faint to strongly developed (e.g. holotype, GSC 44814; Pl. 1, fig. 10). Maximum corallite diameter ranges from 9 to 18 mm with height up to 35 mm.

Septa are strongly dilated in neanic stage, filling almost all of corallite interior for up to 70 per cent of corallite height, with only sparse, small dissepiments present. In ephebic stage, septa are reduced to thick, irregularly developed, short crests, usually dilated to be in lateral contact peripherally, where rather short minor septa can be distinguished in some cases, major septa numbering 35 (GSC 44819; Pl. 6, fig. 1). In axial region, weakly differentiated septal crusts commonly are developed.

Dissepiments are small, both globose and elongate, in gently inclined layers in ephebic stage although steeper where apparent in earlier stages. Axial tabellae are generally large and strongly elongate.

Remarks. This species shows similarities to juvenile specimens of *Digonophyllum rectum* (Meek), described below. However, in the latter, incomplete septal crests are not developed in late stages of growth. *Cystiphylloides pumilum* is generally smaller than other described species of *Cystiphylloides* that show strong early septal dilation (mainly those previously referred to *Pseudozonophyllum* Wedekind; *see* list of species referred to *Cystiphylloides* above). Birenheide (1964, 1974) considered *Pseudozonophyllum* a synonym of *Cystiphylloides* on the basis of variability within the Eifel faunas and comparable variation in the Hume fauna confirms this view.

Genus *Microplasma* Dybowski, 1874

Microplasma Dybowski, 1874, p. 508.
Pseudomicroplasma Soshkina, 1949, p. 53.
?*Cystiplasma* Taylor, 1951, p. 195
Nardoplasma Spasskiy and Kravtsov *in* Spasskiy *et al.*, 1974, p. 171.

Type species. *Microplasma gotlandicum* Dybowski, 1874. ?Slite Beds, Stora Karlsö, Gotland.

Diagnosis. Corallum phaceloid or solitary. Septa, where apparent, represented as sparse, short spines confined to a thin peripheral stereozone or rarely developed on peripheral dissepiments.

Discussion. Understanding of the genus *Microplasma* has been hampered by lack of adequate illustrations of topotype material of the type species. The genus has been regarded generally as a branching form of *Cystiphyllum* (Lang and Smith, 1927; McLean, 1974). However, study of probable topotypic specimens of *M. gotlandicum* from the Slite Beds (Wenlock) of Lerberget, Stora Karlsö Island, has indicated that a useful distinction between the two genera may be drawn on the basis of the relative distribution of the septal spines. In *M. gotlandicum*, the septal spines, where apparent, are short and randomly distributed in a thin peripheral stereozone of "lamellar" sclerenchyme (Pl. 6, figs. 9, 11). Spines are very rare or absent on the dissepimental (or tabular) surfaces, although thin layers of sclerenchyme may be developed on these surfaces. The peripheral stereozone was not observed to be as thick nor the septa as dilated as in the example illustrated diagrammatically by Dybowski (1874, Pl. 5, fig. 5d). A septal structure comparable to that in the Stora Karlsö material has been illustrated by Ivanovskiy (1967, Fig. 10zh, e) for *M. gotlandicum* from the Jaagarahu Beds (late Wenlock) of Estonia. Thus, the major difference between *Microplasma* and *Cystiphyllum* appears to lie in the more pronounced septal development at the corallite periphery of the former, as opposed to the random distribution in *Cystiphyllum* (*see also* discussion of *Cystiphyllum* above).

It is clear that, in the Devonian species of *Microplasma* from the Hume Formation, both fibrous and "lamellar" tissue are present in the peripheral stereozone (Pl. 7, figs. 5, 8). As mentioned above, it now is regarded generally that lamellar tissue in Rugosa is a secondary feature and hence many Devonian forms with the same basic septal structure as *M. gotlandicum*, but having fibrous or both lamellar and fibrous microstructure, should be included in *Microplasma*. The structure of the septal spines in Devonian *Microplasma* is largely undescribed. The Hume specimens exhibit structureless holacanths as in *M. gotlandicum* but, as a monacanthine structure is easily recrystallized to form holacanths, it is felt that the presence or absence of monacanths here cannot be regarded as having taxonomic significance.

Some Silurian species of *Microplasma* were discussed by McLean (1974, p. 18, 19). Examination of material of *Cystiphyllum fasciculatum* Swartz, 1913 from the lower part of the Keyser Limestone (Pridolian) of Virginia, has indicated that it is also a representative of *Microplasma*, having a peripheral stereozone of "lamellar" sclerenchyme in which sparse holacanths may be distinguished with difficulty. Devonian forms included in *Microplasma* are listed below.

Colonial species:

Cystiphyllum impunctum Lonsdale, 1845, revised by Gorianov *in* Fedorowski and Gorianov (1973). Lower and middle parts of Petropavlovsk Suite, ?late Pridolian-Lochkovian, Northern Urals.
Cystiphyllum caespitosum Schlüter, 1882. ?Loogh Beds, early Givetian, the Eifel.
Michelinia ronensis Mansuy, 1913, revised by Fontaine (1961). ?Emsian or Eifelian, Viet Nam and Laos.
"Cystiphyllum" conjunctum Hill, 1942c. Garra Formation, ?late Lochkovian-Pragian, New South Wales.
Pseudomicroplasma compacta Kravtsov, 1963. Daksan Beds, Pragian, Central Taimyr.
Microplasma magna (Chernyshev *in* Kravtsov, 1963) sensu Besprozvannykh *et al.*, 1975 (?non Chernyshev). Early Devonian, Selennyakh Range, northeastern U.S.S.R.
Pseudomicroplasma ramificata Kravtsov *in* Besprozvannykh *et al.*, 1975. Daksan Beds, Pragian, Central Taimyr.
Microplasma hadron, sp. nov. Hume Formation, late Eifelian, District of Mackenzie.

Solitary species:

Microplasma fractum Schlüter, 1882, revised by Cheng (1971). "Middle Devonian", the Eifel. ?=*Cyathophyllum antilimbatum* Quenstedt, 1879 [non *Plasmophyllum (P.) antilimbatum* (Quenstedt) sensu Birenheide, 1964].
Cystiphyllum salairicum Peetz, 1901, revised by Bulvanker (1958). Upper Krekov Beds, Pragian, Kuznets Basin.
Microplasma schlueteri Wedekind, 1922. ?Oberhonsel Beds, Givetian, Sauerland.
Microplasma fongi Yoh, 1937. Middle Tungkangling Stage, ?middle Givetian, Kwangsi.
Microplasma flabelliforme Wang, 1948. Tungkangling Stage, Givetian, Yunnan.
Pseudomicroplasma triplex Spasskiy, 1955. *Calceola* Beds, late Eifelian, Central Urals.
Pseudomicroplasma subsiluriense Bulvanker, 1958. Shandin Beds, Eifelian, Kuznets Basin.
Pseudomicroplasma parakuznetskiensis Bulvanker *in* Bulvanker *et al.*, 1960. "Givetian", Novaya Zemlya.
Pseudomicroplasma magna Chernyshev *in* Kravtsov, 1963. Daksan Beds, Pragian, Central Taimyr.
Pseudomicroplasma momentaria Kravtsov, 1963. Daksan Beds, Pragian, Central Taimyr.
Pseudomicroplasma polarica Kravtsov, 1966. Upper Valnev Horizon, late Pragian, Novaya Zemlya.
Pseudomicroplasma bulvankerae Cherepnina, 1967. Shivertin Beds, late Eifelian, Mountainous Altai
Pseudomicroplasma vesiculosum (Goldfuss) sensu Ulitina, 1968 (non Goldfuss, 1826). Givetian, Transcaucasus.

Pseudomicroplasma imatchensis Spasskiy, 1969. Imachin Suite, ?late Emsian or Eifelian, Amur Basin.
Pseudomicroplasma grandis Shurygina, 1972. Givetian, eastern slopes of northern Urals.
Pseudomicroplasma tarejensis Kravtsov *in* Besprozvannykh *et al.*, 1975. Daksan Beds, Pragian, Central Taimyr.

Doubtfully included species:

Cystiphyllum cylindricum var. *laticystis* Regnéll, 1941 and *C. corniculum* Regnéll, 1941. ?Early Devonian, Eastern Tien-Shan.
Diplochone tungshanense Wang, 1948. Upper Tungkangling Stage, late Givetian, Yunnan.
Cystiplasma thomasi Taylor, 1951. Plymouth Limestone, Eifelian, England.
Cystiphylloides? amalgamatum Stumm, 1962. Potter Farm Formation, late Givetian, Michigan.
Pseudomicroplasma stasinskae Rozkowska, 1969. Famennian, Holy Cross Mountains, Poland.

The genus *Pseudomicroplasma* was erected by Soshkina (1949) and characterized by a thick peripheral stereozone of closely packed septa appearing wedge-shaped in transverse section (Soshkina, 1949, p. 53). However, the designated type species, *Microplasma fractum* Schlüter, 1882, has been shown to be almost totally lacking in septa (Birenheide, 1964; Cheng, 1971). The septa, where present, form only a very thin peripheral stereozone, apparently with sparse spines (Cheng, 1971, Pl. 1, fig. 16). Consequently, *M. fractum* is here retained in *Microplasma* although, if solitary and colonial species of *Microplasma* were separated, *Pseudomicroplasma* would be available for the solitary forms. The name *Loboplasma* Spasskiy *et al.*, 1974, based on *Pseudomicroplasma multilobata* Spasskiy *in* Bulvanker *et al.*, 1968, is available for species which have septal structure of the type ascribed to *Pseudomicroplasma* by Soshkina. In this category are: *Pseudomicroplasma uralica* Soshkina, 1949; *P. nesterowskii* (Peetz, 1901) as revised by Bulvanker (1958); *P. sosvaensis* Spasskiy, 1959; *P. neclavica* Sytova, 1968; *Cystiphyllum australe* Etheridge, 1892, as revised by Strusz (1969); *Cystiphylloides breviseptatum* Tsien, 1969; and *Dialythophyllum crassum* Yü and Liao (*in* Wang *et al.*, 1974). Other species probably representative of *Loboplasma*, but lacking adequate illustration or information about variability, include: *Pseudomicroplasma talicensis* Soshkina, 1952; *P. cylindrica* Kravtsov, 1966; *P. minima* Gorianov (*in* Bulvanker *et al.*, 1968) (non Cherepnina, 1967); and *Microplasma devonica* Soshkina, 1937. The only Canadian species of *Loboplasma* currently known is from upper Lochkovian strata. It is currently being described by Pedder and McLean (in prep.). *Loboplasma* apparently is not represented in the fauna of the Hume Formation.

Some specimens of *Cystiphylloides aggregatum* with weak septal development on the dissepiments are morphologically close to *Microplasma*. If sufficient specimens of *Microplasma* are available, however, it can always be seen that septal spines have greater development on the corallite wall than the dissepiments, whereas the reverse is true for *C. aggregatum*.

Microplasma caespitosum (Schlüter, 1882)

Plate 7, figures 1-9, Plate 8, figures 1, 2, 3, 5;
Plate 9, figures 1, 2

Cystiphyllum caespitosum Schlüter, 1882, p. 209.
Cystiphyllum caespitosum Schlüter (part); Schlüter, 1889, p. 86, Pl. 8, figs. 1-3.
?"*Cystiphyllum*" *conjunctum* Hill, 1942c, p. 185, Pl. 5, figs. 3a, b.
Microplasma cf. *fongi* Yoh; Lenz, 1961, p. 511, Pl. 1, figs. 3, 4.
Plasmophyllum (P.) caespitosum (Schlüter); Birenheide, 1964, p. 35, Pl. 10, figs. 51a, b.
Cystiphylloides caespitosum (Schlüter); Flügel, 1971, p. 78, Figs. 1, 2.

Material. GSC 44821, GSC loc. 49148, Anderson River; GSC 44822, GSC loc. 49148, Anderson River; GSC 44823, GSC loc. 49212, Anderson River; GSC 44824, Lenz collection, Anderson River; GSC 44825, GSC loc. C-2521, Carnwath River; GSC 44826, GSC loc. C-2522, Carnwath River; GSC 44827, GSC loc. C-3861, Powell Creek; GSC 44828, GSC loc. C-3869, Powell Creek; GSC 44829, GSC loc. 49101, tributary of Bosworth Creek; GSC 44830, GSC loc. C-166, Flyaway Creek; GSC 44831, GSC loc. C-24640, type section of Hume Formation; GSC 44832, GSC loc. C-12120, Prohibition Creek; GSC 44833, GSC loc. C-1803a, Prohibition Creek. Additional specimen tentatively referred to this species: GSC 44834, GSC loc. C-2535, Sam MacRae Lake.

Diagnosis. Phaceloid *Microplasma* with corallite diameter ranging from about 8 to 30 mm. Septa developed as sparse, short spines in a thin peripheral stereozone. Dissepiments are generally small, globose to moderately elongate.

Description. Corallum is phaceloid with long, sinuous, cylindrical corallites that may be adjoined and distorted. Corallite spacing is highly variable within a colony, although usually some corallites are tightly appressed. Fine growth rings are well developed on epitheca. Increase is apparently both lateral and calicinal. Corallite diameter typically ranges from 8 to 20 mm, with average value varying considerably between coralla (Table 2). Corallites in one specimen (GSC 44834) have diameters of as much as 27 mm; this specimen is only doubtfully included in the species.

Septa are very weakly developed with a thin peripheral stereozone of sclerenchyme occasionally showing irregularly distributed, short, holacanthine septal spines. In some cases with stronger recrystallization, pseudolamellar structure is developed in stereozone, "wrapping" around spines (Pl. 7, figs. 5, 8). Spines may be developed rarely on peripheral dissepiments.

Dissepiments are extremely variable in size, generally globose to weakly elongate, moderately inclined peripherally. Axially large tabellae form gently sagging series. One specimen (GSC 44831) shows somewhat stronger differentiation of dissepiments and tabellae, the latter tending to be very elongate and approaching tabular structure (Pl. 7, fig. 3). For lack of additional material, this specimen also is referred to *M. caespitosum*. Where

GSC NUMBER	COMMON MATURE Dc (mm)
44822	8
44821	8-9
44823	9
44825	10-11
44826	12
44828	12-13
44824	13-14
44829	14
44827	13-15
44832	15
44831	15-16
44830	17
44833	20-21

GSC

TABLE 2. Mean corallite diameter in specimens of *Microplasma caespitosum* from the Hume Formation

corallites are in contact, walls may break down in places and dissepiments often pass continuously between corallites (Pl. 7, figs. 4, 6).

Remarks. In redescribing Schlüter's material of *"Cystiphyllum" caespitosum*, probably from the lower Givetian Loogh Beds of the Eifel, Birenheide (1964, p. 35) mentioned that rudimentary septa and lamellar "stereoplasm cones" were rare. However, unpublished photographs taken of Schlüter's holotype by D.J. McLaren clearly show short, sparse septal spines set in the narrow peripheral stereozone (Pl. 6, fig. 12). In growth form, corallite dimensions, and septal structure, the Hume specimens agree closely with those from the Eifel. There is a greater range of variation in the horizontal skeletal elements of the Hume material but, as only one longitudinal section of the Eifel form has been illustrated (Schlüter, 1889, Pl. 8, fig. 3; Birenheide, 1964, Pl. 10, fig. 51b; this report, Pl. 6, fig. 12), the variation in the latter material cannot be ascertained.

Birenheide (1964, p. 35) suggested that *"Cystiphyllum" conjunctum* Hill, 1942c, from the Pragian Garra Formation of New South Wales, may be a synonym of *M. caespitosum*. Photographs of the holotype of *"C." conjunctum* provided by B.D. Webby, together with examination of an additional specimen loaned by A.E.H. Pedder, indicate that such a synonymy is likely. However, the Pridolian *Cystiphyllum fasciculatum* Swartz, 1913 (*see* above and Pl. 6, figs. 8, 13), also tentatively regarded as a synonym by Birenheide (1964), shows distinctive, large, elongate peripheral dissepiments and is regarded here as a separate species of *Microplasma*.

Microplasma ronense (Mansuy, 1913) from the ?Emsian or Eifelian of Viet Nam and Laos shows close similarities to *M. caespitosum*, but probably may be distinguished by its generally broader peripheral stereozone (Mansuy, 1913, Pl. 1, fig. 12a; Fontaine, 1961, Pl. 33, fig. 9).

Cystiphylloides? amalgamatum Stumm, 1962 from the upper Givetian Potter Farm Formation of Michigan may well be a species of *Microplasma*, but the nature of any septal development at the corallite periphery was not described. It shows similarities, however, to *M. caespitosum* from the Hume Formation in that some corallites have breakdown of the wall when in contact (Stumm, 1962, Pl. 3, fig. 8). Flügel (1971) has placed it in synonymy with *M. caespitosum*, but *C.? amalgamatum* may be distinguished by its steeply inclined dissepimental layers and subcerioid growth form.

Microplasma hadron sp. nov.

Plate 8, figure 4, Plate 9, figures 3, 8

Material. Holotype GSC 44835, GSC loc. C-24639, type section of Hume Formation.

Diagnosis. Phaceloid *Microplasma* with exceptionally large corallites (diameter at least 45 mm), tightly packed and in many cases distorted when in contact. Dissepiments small.

Description. Corallum is phaceloid with closely spaced, cylindrical corallites, varying to subcerioid with prismatic or subprismatic corallites. Diameter of cylindrical corallites range from 45 to 50 mm.

Septa are well developed irregularly as short spines on corallite wall in very thin peripheral stereozone and also very rarely as short, discrete spines on dissepiments. In many cases, corallite wall breaks down when corallites are in contact and dissepiments may be continuous through gaps in wall. Dissepiments are small, globose to weakly elongate, in moderately inclined series. Axial tabellae are generally larger, in sagging series.

Remarks. Although only one specimen was available for study, it can be distinguished from *M. caespitosum* of the Hume Formation by its considerably larger corallite diameter and proportionately smaller dissepiments. These features also clearly distinguish it from other described colonial species of *Microplasma*.

Genus *Zonophyllum* Wedekind, 1924

Zonophyllum Wedekind, 1924, p. 12 (part).
Legnophyllum Wedekind, 1924, p. 19.
Cystiphylloides Yoh, 1937, p. 50, 53 (non Chapman, 1893)
Neozonophyllum Ulitina, 1968, p. 52 (part).

Type species. *Zonophyllum duplicatum* Wedekind, 1924. Lower Nohn Beds (early Eifelian) of the Eifel.

Diagnosis. Corallum solitary. Septal spines are generally long, usually fused radially to some degree to form weak crests, but not to the extent of consistently producing complete, radial septa in transverse section. Some dilation of trabeculae to form crusts may occur, but is subordinate to formation of discrete spines and weak crests.

Discussion. In proposing the genus *Zonophyllum*, Wedekind (1924) erected a number of new species, all from the Lower Nohn Beds (early Eifelian) of the Eifel. *Zonophyllum solidum* and *Z. zentrale* show well-defined, radial septa in the ephebic stage and are assigned here to *Lekanophyllum* Wedekind. *Zonophyllum rauffi* apparently has thick septal crusts and is referred to *Cystiphylloides*. However, there is some problem in the interpretation of the type species, *Z. duplicatum*. The lectotype (designated by Birenheide, 1968) is known only from an ephebic transverse section (Wedekind, 1924, p. 15, Fig. 8). This section appears similar to ephebic sections of both *Z. primum* and *Z. cylindricum* (Wedekind, *op. cit.*, p. 13, Figs. 4, 5). From photographs of sections kindly provided by R. Birenheide, earlier ontogenetic stages of *Z. cylindricum* are comparable to those of *Z. primum* (Wedekind, *op. cit.*, p. 13, Figs. 1-3). The specimen designated as "paratypoid" of *Z. duplicatum* by Birenheide (1968) shows well-developed septal crusts (Wedekind, *op. cit.*, p. 14, Figs. 6, 7) and is hence referred to *Cystiphylloides*. It is probable that *Z. primum* and *Z. cylindricum* are synonymous and it is reasonable that they are conspecific with *Z. duplicatum*, as suggested by Birenheide (1964, p. 21). Hence, *Z. duplicatum* is interpreted here also in terms of Wedekind's illustrations of *Z. primum* and *Z. cylindricum*.

Zonophyllum duplicatum was regarded by Birenheide (1964, p. 21) as being synonymous with *Cyathophyllum antilimbatum* Quenstedt, 1879. However, the type of the latter unfortunately has not been illustrated in thin section and, since a number of species listed as synonyms of *Z. duplicatum* by Birenheide (*op. cit.*) are regarded here as distinct (e.g. *Microplasma fractum* Schlüter, *"Pseudozonophyllum" halli* Wedekind), the species name *duplicatum* is preferred for the present.

Forms here regarded as representative of *Zonophyllum* are listed as follows:

Zonophyllum duplicatum Wedekind, 1924, with synonyms *Z. primum* Wedekind, 1924 and *Z. cylindricum* Wedekind, 1924. Lower Nohn Beds, early Eifelian, the Eifel.
Arcophyllum parvum Markov, 1926, with synonym *A. uralicum* Bulvanker, 1934. *Calceola* Beds, late Eifelian, Urals.
Atelophyllum (Cystiphylloides) kwangsiense Yoh, 1937. Tungkangling Stage, Givetian, Kwangsi.
Pseudomicroplasma tchumyshensis Bulvanker, 1958. Shandin Beds, Eifelian, Kuznets Basin.
Zonophyllum breviculum Kravtsov, 1963 and *Z. septentrionarium* Kravtsov, 1963. Daksan Beds, Pragian, Central Taimyr.
Zonophyllum longispinosum Ulitina, 1963b and *Z. arpaense* Ulitina, 1963b. Late Givetian, Transcaucasus.
Cystiphylloides spinosum McLaren, 1964. Horn Plateau Formation, Givetian, District of Mackenzie.
Pseudomicroplasma aff. *P. nesterowskii* (Peetz) of Bulvanker (1965). "Lower Devonian", northeastern U.S.S.R.
Cystiphylloides bulvankerae Kravtsov, 1966. Lower Valnev Horizon, Pragian, Novaya Zemlya.
Zonophyllum directum Kravtsov, 1966. Lower Valnev Horizon, Pragian, Novaya Zemlya.
Zonophyllum caecum Kravtsov, 1966. Upper Valnev Horizon to *Favosites regularissimus* zone, late Pragian-late Emsian, Novaya Zemlya.
Zonophyllum petilum sp. nov. Hume Formation, late Eifelian, District of Mackenzie.

Species doubtfully included:

Zonophyllum cylindricum Wedekind sensu Soshkina, 1936 (?non Wedekind, 1924). *Calceola* Beds, late Eifelian, Northern Urals.
Lythophyllum tabulatum Wedekind sensu Soshkina, 1937 (non Wedekind, 1925). *Calceola* Beds to Biya Beds, late Eifelian, Northern Urals.
"Cystiphyllum" multitrabeculatum Hill, 1942b. Moore Creek Limestone (A.E.H. Pedder, pers. com., 1975), late Eifelian, New South Wales.
Hedstroemophyllum distinctum Nikolaeva, 1949, revised by Ivanovskiy and Shurygina (1975). Bobrov Horizon, early Pridolian, Northern Urals.
Pseudomicroplasma lobvaensis Shurygina, 1968. ?Lochkovian, Northern Urals.
Cystiphylloides iddingsi Merriam, 1973. Nevada Formation, Devonian coral zone F, late Eifelian, Nevada.
Zonophyllum haguei Merriam, 1974. Nevada Formation, Devonian coral zone D_2, late Emsian, Nevada.

The writer has examined the type material of *Cystiphylloides spinosum* McLaren, 1964 and it appears to be a particularly variable species, intermediate in character between *Cystiphylloides* and *Zonophyllum*. However, with a predominance of rather long septal spines (McLaren, 1964, Pl. 9, figs. 1, 2), it is perhaps better regarded as a representative of the latter. One of the specimens illustrated as *Lekanophyllum* cf. *punctatum* Wedekind from the same locality and horizon (McLaren, 1964, Pl. 8, fig. 4) appears to be conspecific with *"C." spinosum* and should certainly be included in *Zonophyllum*.

Pseudomicroplasma lobvaensis Shurygina, 1968 (eastern slopes of Northern Urals, ?Lochkovian) seems intermediate in structure between *Loboplasma* and *Zonophyllum*, having long, largely discrete spines in some specimens (Shurygina, 1968, Pl. 54, fig. 2), while in others the spines become partly fused laterally, forming a peripheral stereozone (Shurygina, *op. cit.*, Pl. 54, fig. 3). Similar variation in this species has been described by Sytova (1970) in material from the Greben Horizon (Pridolian) of Vaygach Island. On the basis of the preponderance of discrete spines, this species is perhaps best placed in *Zonophyllum*.

Hedstroemophyllum distinctum Nikolaeva, 1949, revised by Ivanovskiy and Shurygina (1975) and stated to be from the Bobrov Horizon (early Pridolian) of the eastern slopes of the Northern Urals, shows quite extensive fusion of the septal spines (Ivanovskiy and Shurygina, 1975, Pl. 19, fig. 4v) and is probably a representative of *Zonophyllum*. If so, it would represent the earliest known record of the genus.

Ulitina (1968, p. 52) separated the subgenus *Neozonophyllum* from *Zonophyllum* on the basis of the former having "septal cones" in the form of "cortices" (i.e. crusts undifferentiated into spines) in the early stages, splitting into spines peripherally in late stages. The extent of splitting of the "cones" into spines, however, is a highly variable character in all the species here referred to *Zonophyllum* and is not regarded as having supraspecific significance. Consequently, *Neozonophyllum* is considered here to be a junior synonym of *Zonophyllum*. Of the species referred to *"Neozonophyllum"* by Ulitina (1968), *Zonophyllum arpaense* Ulitina, 1963b and *Z. longispinosum* Ulitina, 1963b are both retained in *Zonophyllum*. *Zonophyllum (Neozonophyllum) credulum* Ulitina, 1968, however, shows particularly long spines which fuse sufficiently to produce significantly continuous radial septa (Ulitina, 1968, Pl. 5, fig. 1). It thus shows affinities with *Lekanophyllum* and is perhaps better included in that genus (*see also* discussion of *Lekanophyllum* below).

Several Silurian cystiphyllid genera resemble *Zonophyllum*. *Hedstroemophyllum* Wedekind, 1927 appears to differ only in lacking the partial fusion of trabeculae common in *Zonophyllum* (*see* Jell and Hill, 1970; McLean, 1974). *Gukoviphyllum* Sytova, 1968 differs primarily in the septal microstructure, which consists of a fan-shaped arrangement of fibres ("flabelliacanths" of Sytova, 1970). *Holmophyllia* Sytova, 1970, a possible synonym of *Gukoviphyllum* (*see* McLean, 1975, p. 186), also differs chiefly in the septal microstructure, possessing rhabdacanths.

Zonophyllum petilum sp. nov.

Plate 9, figures 4-7, Plate 10, figures 1-6

?Cystiphylloides kwangsiense? Yoh; Lenz, 1961, p. 512, Pl. 1, fig. 23.

Material. Holotype GSC 44836, GSC loc. 49212, Anderson River. Paratypes GSC 44837, GSC loc. C-24674, type section of Hume Formation; GSC 44838, GSC loc. C-12120, Prohibition Creek; GSC 44839, GSC loc. C-3871, Powell Creek; GSC 44840, GSC loc. C-2522, Carnwath River. Additional material tentatively referred to this species: GSC 44841, GSC loc. C-25839, Bell Creek; GSC 44842, Lenz collection, tributary of Bosworth Creek.

Diagnosis. *Zonophyllum* having rather short, sparse septal spines, that may be either discrete or weakly fused radially.

Description. Corallum is solitary, trochoid to subcylindrical with slight curvature. Epitheca is strongly rugose and rejuvenescence commonly is developed. Corallite diameter is highly variable, ranging from 25 to 40 mm. Two doubtfully included specimens (GSC 44841, 44842) have diameters of 15 and 21 mm, respectively.

Septa are sparsely developed as discrete spines piercing 2 or 3 dissepimental layers or, more commonly, as thin, short, discontinuous crests composed of radially, weakly fused trabeculae. Crests show greatest development in peripheral region of corallite. Thin peripheral stereozone may be present. Spines and crests may be lined with lateral dissepiments.

Dissepiments are very variable in size and shape, but generally are moderately elongate and steeply inclined peripherally. Axial tabellae are considerably larger, forming moderately to strongly sagging series.

Remarks. This species closely resembles *Z. kwangsiense* (Yoh, 1937) from the Tungkangling Stage (Givetian) of Kwangsi (fide Wang *et al.*, 1974). Distinction may be made on the basis of the generally more numerous, thicker and longer septal spines of *Z. kwangsiense*, which show a greater tendency to be discrete than those of *Z. petilum*. The material described by Lenz (1961) as *Cystiphylloides kwangsiense?* Yoh from the Hume Formation probably is representative of *Z. petilum*. Of Lenz's material, only a fragment of the poorly preserved specimen illustrated (Lenz, 1961, Pl. 1, fig. 23) was available for study (GSC 44842) and shows only very rare, discrete septal spines. However, Lenz's description (*op. cit.*, p. 513) suggests that the two forms are probably synonymous.

One specimen (GSC 44841), which is not typical of *Z. petilum*, shows similarities to *Z. parvum* (Markov, 1926) sensu Soshkina (1949), from the *Calceola* Beds (late Eifelian) of the Urals, particularly in its smaller corallite diameter (15 mm) and stronger development of septal spines (cf. Pl. 9, fig. 7, Pl. 10, fig. 3 and Bulvanker, 1934, Pl. 1, figs. 1-4; Soshkina, 1949, Pl. 16, figs. 1a-d, Pl. 17, figs. 1a-f, 2a-b). Since there is only one such specimen available from the Hume fauna, however, it cannot be certain whether it is simply a juvenile form of *Z. petilum* or is perhaps representative of *Z. parvum*. For the present, it is left as a possible representative of the former.

The only other species resembling *Z. petilum* is *Z. tchumyshense* (Bulvanker, 1958) from the Shandin Beds (Eifelian) of the Kuznets Basin. However, despite the similarity shown by the nature of the septal development, it can be distinguished by having markedly globose dissepiments and very coarse tabellae (Bulvanker, 1958, Pl. 11, figs. 1a-b, Pl. 12, figs. 1a-b).

Zonophyllum spinosum (McLaren, 1964) occurs in a younger horizon (Horn Plateau Formation, Givetian) of the District of Mackenzie. It is very closely comparable to *Z. kwangsiense*, the only significant difference being a smaller corallite diameter (maximum 27 mm, McLaren, *op. cit.*, p. 24), and Fontaine (1966, p. 79), in fact, regarded it only as a variety of *Z. kwangsiense*. *Zonophyllum spinosum* is further differentiated from *Z. petilum* by its smaller diameter, and thicker, more abundant, discrete septal spines.

Subfamily DIGONOPHYLLINAE Wedekind, 1923

Genus *Digonophyllum* Wedekind, 1923

Digonophyllum Wedekind, 1923, p. 27.

Type species. *Digonophyllum schulzi* Wedekind, 1923. Lower Nohn Beds (early Eifelian) of the Eifel.

Diagnosis. Corallum solitary. Trabeculae are strongly dilated, fused to a variable degree and frequently fill a large portion of the corallite in the neanic stage. Septal crests are strongly developed in the ephebic stage, forming largely complete, radial septa having dilation confined to the axial region. Peripheral discrete carinae are very sparse or more commonly absent.

Discussion. *Digonophyllum* is distinguished from *Mochlophyllum* Wedekind, 1923 (?=*Mesophyllum* Schlüter, 1889, *see* below) and its probable synonym *Uralophyllum* Soshkina, 1936, by having a general lack of peripheral discrete carinae.

Species included:

Zaphrentis recta Meek, 1867. Hume Formation, late Eifelian, District of Mackenzie.
Digonophyllum schulzi Wedekind, 1923 (?=*Actinocystis pseudoorthoceras* Schulz, 1883). Lower Nohn Beds, early Eifelian, the Eifel. (For synonymy, *see* Birenheide, 1964, p. 45, 46).
Actinocystis versiformis Markov, 1923. *Calceola* Beds, late Eifelian, western slopes of Urals.
Zonodigonophyllum stabile Vollbrecht, 1926. Lower Nohn Beds, early Eifelian, the Eifel.
Digonophyllum vollbrechti Soshkina, 1936. ?Late Eifelian, Northern Urals.
Arcophyllum bilaterale Soshkina, 1949. *Calceola* Beds, late Eifelian, Southern Urals.
Pseudozonophyllum halli Wedekind sensu Spasskiy, 1955 (non Wedekind, 1924). *Calceola* Beds, late Eifelian, Central Urals.
Digonophyllum elegans Cherepnina *in* Zheltonogova and Ivaniya, 1961. Losishin Beds, late Eifelian, Rudniy Altai.
Digonophyllum reductum Kravtsov, 1966. Upper Valnev Horizon, Pragian, Novaya Zemlya.
Digonophyllum occidentalis Merriam, 1973. Nevada Formation, Devonian coral zone F, late Eifelian, Nevada.
Pseudozonophyllum intermedium Yü, Liao and Cheng, 1974. Longdongshui Member, late Eifelian, Kweichow.
Pseudozonophyllum eletum Kravtsov *in* Besprozvannykh *et al.*, 1975. Yunkhod Beds, Pragian, Central Taimyr.
Digonophyllum powellense sp. nov. Hume Formation, late Eifelian, District of Mackenzie.

Doubtfully included species:

Digonophyllum bipartitum Wang, 1948 and *D. minor* Wang, 1948. Givetian, Yunnan
Pseudozonophyllum latum Soshkina sensu Spasskiy, 1955 (?non Soshkina, 1936). *Calceola* Beds to Biya Beds, late Eifelian, Central Urals.
Digonophyllum tenuiseptatum Bulvanker, 1958, *D. multiseptatum* Bulvanker, 1958 and *D. salairicum* Bulvanker, 1958. Safonov Beds, late Givetian, Kuznets Basin.
Pseudozonophyllum versiforme (Markov) sensu Zheltonogova and Ivaniya, 1961 (non Markov, 1923). Shandin Beds to Mamontov Beds, Eifelian, Salair.
Digonophyllum breviseptatum Ivaniya, 1965. Kerlegesh Beds, middle Givetian, Salair.
Digonophyllum bifurcum Kravtsov, 1966. Upper Valnev Horizon, late Pragian, Novaya Zemlya.
Hemicystiphyllum perseptatum Tsien, 1969. Horizon Co1c, early Eifelian, Dinant Basin.
Mesophyllum excentricum Tsien, 1969. Horizon Co2b early Eifelian, Dinant Basin.
Digonophyllum spiciferum Besprozvannykh *in* Besprozvannykh *et al.*, 1975. Boyakhsk Suite, Givetian, Omulevsk Mountains, northeastern U.S.S.R.

The affinities of the genus *Stereophyllum* Schlüter, 1889 are not clear. The material upon which Schlüter based the genus, and which he named *Mesophyllum? goldfussi* (Edwards and Haime, 1851), was regarded as a synonym of *Cyathophyllum limbatum* Quenstedt, 1879 by Birenheide (1964). Unfortunately, the lectotype of Quenstedt's species has not been illustrated in thin section. A polished surface (Birenheide, 1964, Pl. 23, fig. 105a) suggests that it may be a species of *Digonophyllum*, and its synonymy with Schlüter's material is not proven. The illustrated sections of *"Mesophyllum? goldfussi"* (Schlüter, 1889, Pl. 8, figs. 10-13) show strongly thickened septa throughout growth, with only weak development of dissepiments in the ephebic stage. In these features, it is closely comparable to *"Pseudozonophyllum" latum* Soshkina, 1936 and *"P." primitivum* Kravtsov, 1963. Such characters are found in the late neanic stage of some forms of both *Cystiphylloides* and *Digonophyllum* and hence the above species may represent juvenile individuals of either genus, although this is difficult to prove. It would seem possible, thus, that *Stereophyllum* could be a senior synonym of either *Cystiphylloides* or *Digonophyllum*, particularly the latter. However, on the present evidence, this would be difficult to prove and as *Stereophyllum* may well be a *nomen oblitum*, it is not used here.

Birenheide (1964, p. 45) regarded *D. schulzi* as a synonym of *Actinocystis pseudoorthoceras* Schulz, 1883. Unfortunately, Schulz's form has not been illustrated in thin section, but it is evident from the polished section shown by Birenheide (*op. cit.*, Pl. 28, fig. 140) that it is a representative of *Digonophyllum*, as here interpreted, although its synonymy with *D. schulzi* cannot be confirmed. Birenheide (*op. cit.*) also regarded the large number of species of *Digonophyllum* erected by Vollbrecht (1926) as synonyms of *D. schulzi* and this viewpoint seems most logical. Vollbrecht (1926) also erected the genus *Zonodigonophyllum* to include forms differing from *Digonophyllum* in having weaker development of minor septa. However, this appears to be a highly variable feature and not of generic significance in this group of corals. Of Vollbrecht's species, the type species *Z. primum* has only very weak ephebic axial dilation of the septa (Vollbrecht, 1926, Pl. 8, figs. 1a-h) and is perhaps better included in *Lekanophyllum* (*see* below). The other species tend to show stronger ephebic axial dilation of the septa and are referred to *Digonophyllum*.

Digonophyllum rectum (Meek, 1867)

Plate 1, figures 12-15, 17-21, Plate 10, figures 7-15, Plate 11, figures 2, 3, 5, 6, Plate 12, figure 9, Plate 14, figures 1-7

Zaphrentis recta Meek, 1867, p. 82, Pl. 11, figs. 1, 1a-c.

Cysteophyllum americanum var. *arcticum* Meek, 1867, p. 80, Pl. 11, figs. 6, 6a-b.

?*Actinocystis versiformis* Markov, 1923 (part), p. 35, Pl. 6, figs. 1-8, 10-12 (non fig. 9).

?*Pseudozonophyllum versiforme* (Markov); Soshkina, 1949, p. 65, Pl. 22, figs. 1-8, Pl. 24, fig. 1.

?*Pseudozonophyllum versiforme* (Markov); Soshkina, 1952, p. 79, Pl. 13, fig. 50.

?*Pseudozonophyllum halli* Wedekind; Spasskiy, 1955, p. 109, Pl. 10, figs. 1a-e (non Wedekind, 1924).

Grypophyllum rectum (Meek); Warren and Stelck, 1956, Pl. 3, fig. 2.

Grypophyllum sp. Warren and Stelck, 1956, Pl. 1, fig. 6.

?*Pseudozonophyllum versiforme* (Markov); Bulvanker, 1958, p. 54, Pl. 18, figs. 1a-b, Pl. 19, figs. 1a-b.

Digonophyllum rectum (Meek); Lenz, 1961, p. 511, Pl. 2, figs. 8-10.

?*Cystiphylloides? americanum arcticum* (Meek); Lenz, 1961, p. 512, Pl. 2, figs. 11, 12.

?*Zonodigonophyllum* cf. *Z. simplex* Wedekind; Lenz, 1961, p. 512, Pl. 2, figs. 6, 7.

Digonophyllum rectum (Meek); McLaren *et al.*, 1962, p. 8, Pl. 3, figs. 1-4.

?*Pseudozonophyllum versiforme* (Markov); Bulvanker, 1965, Pl. 13, figs. 2a-d.

Mesophyllum (Digonophyllum) rectum (Meek); McLaren *et al.*, 1970, p. 618, Pl. 9, figs. 11, 12.

?*Pseudozonophyllum intermedium* Yü, Liao and Cheng, 1974, p. 228, Pl. 106, figs. 3-10.

?non *Pseudozonophyllum versiforme* (Markov); Kravtsov, 1963, p. 34, Pl. 12, figs. 2a-g.

?non *Pseudozonophyllum versiforme* (Markov); Ermakova, 1964, p. 100, Pl. 2, figs. 5-7.

non *Pseudozonophyllum versiforme* (Markov); Spasskiy, 1960, p. 35, Pl. 4, figs. 3-5, Pl. 5, figs. 3-5, Pl. 6, figs. 1, 2.

non *Pseudozonophyllum versiforme* (Markov); Zheltonogova and Ivaniya, 1961, p. 396, Pl. D-51, figs. 1a-b.

non *Pseudozonophyllum versiforme* (Markov); Ivaniya, 1965, p. 59, Pl. 4, fig. 22, Pl. 5, fig. 23, Pl. 20, figs. 90-93, Pl. 21, figs. 94, 95, Pl. 22, fig. 96.

non *Pseudozonophyllum versiforme* (Markov); Ulitina, 1968, p. 89, Pl. 20, figs. 1a-e.

Material. Lectotype (here chosen) USNM 1175 (a), specimen figured by Meek (1867, Pl. 11, figs. 1, 1a), Hume Formation, Anderson River. Additional material: USNM 14546 (b), lectotype (here chosen) of *Cystiphyllum americanum* var. *arcticum* Meek, specimen illustrated by Meek (1867, Pl. 9, fig. 6), Hume Formation, "Onion River" (locality unknown); GSC 44843-44859, GSC loc. C-3871, Powell Creek; GSC 44860-44862, GSC loc. C-3872, Powell Creek; GSC 44863, GSC loc. C-149, Gayna River; GSC 44864-44865, GSC loc. C-25838, Gayna River; GSC 44866-44867, GSC loc. C-25839, Bell Creek; GSC 44868, GSC loc. C-25841, Bell Creek; GSC 44869-44871, GSC loc. 24674, type section of Hume Formation; GSC 44872, GSC loc. C-1830, Anderson River; GSC 44873-44875, GSC loc. 49174, Anderson River. Material tentatively referred to this species: GSC 44876, GSC loc. C-2538, Hare Indian River; GSC 44877, Lenz collection, Gayna River; GMUS Cr 3, Powell Creek. Possible juvenile specimens of *D. rectum*: GSC 44878, GSC loc. C-3871, Powell Creek; GSC 44879, GSC loc. C-3872, Powell Creek; GSC 44880, GSC loc. C-2536, Sam MacRae Lake.

Diagnosis. Small *Digonophyllum* with extensive neanic septal dilation, strong axial dilation of septa in ephebic stage, well-developed minor septa and weak development of presepiments. Discrete carinae lacking.

Description. Corallum solitary, ceratoid or more rarely trochoid, either straight or slightly curved. Calice is shallow to deeply conical, generally with only weakly developed peripheral platform. Epitheca shows fine, closely spaced growth lines and rejuvenescence is common. Mature corallite diameter ranges from 16 to 51 mm in available material, with an average of 20 to 35 mm, although smaller, juvenile specimens are not uncommon. Corallite height ranges from 40 to 60 mm.

Septa are well developed throughout ontogeny, generally dilated so as to be in lateral contact and filling most of corallite in the neanic stage. In the ephebic stage, septal crests are well developed, producing mainly radially complete or slightly incomplete septa. Thickness of septa is variable in ephebic stage, depending on vertical spacing of crests: septa are thicker if crests are numerous and closely spaced (e.g. GSC 44864; Pl. 10, fig. 10). Axial dilation of septa generally persists through ephebic stage although, in some cases, it may be weak in latest growth levels. Dilation is generally greater on counter side of corallite. Septal fossula is clearly developed in the ephebic stage, with cardinal septum short and usually discontinuous. Counter septum is flanked by two long major septa with minor septa absent. Major septa commonly range in number from 40 to 53 but reach 61 in largest specimen (GSC 44843). They generally extend near to corallite axis, although the level of intersection of section with the crests determines the apparent septal length. Crests are usually well developed in axial region in the ephebic stage, although best development is near the margin of dissepimentarium and tabularium, corresponding to zone of dilation of septa in transverse section. Trabeculae are closely packed in crests; discrete trabeculae are uncommon and usually only developed in peripheral regions. Most septa extend to or almost to the corallite wall, with only sparse development of presepiments. Development of minor septa is variable: they may be clearly developed and extend up to 0.5 of length of major septa (e.g. GSC 44856) or, more frequently, are short and intermittently developed crests that in many sections may not be apparent much beyond the corallite periphery. Again, the orientation of section and position of intersection with crests can determine their apparent length. Discrete carinae apparently are absent.

Dissepiments are small, globose to moderately elongate, steeply inclined peripherally. Axial region is occupied by sagging series of coarse tabellae or widely spaced complete and incomplete tabulae. Lateral dissepiments are uncommon and generally found only in larger specimens. Horizontal skeletal elements are only very rarely developed in neanic stage.

Remarks. *Digonophyllum rectum* is the most common cystiphyllid element of the Hume fauna. Several specimens are only doubtfully referred to this species for want of more material. They include

GSC 44876 and GMUS Cr 3, which are larger forms having generally weaker peripheral septal crest development in the late ephebic stage and consequent abundant presepiments (Pl. 11, figs. 2, 3). They show similarities to *D. elegans* Cherepnina (*in* Zheltonogova and Ivaniya, 1961) from the Losishin Beds (?late Eifelian) of the Rudniy Altai, although the latter species is slightly smaller, with a more sharply defined tabularium (Zheltonogova and Ivaniya, 1961, Pl. D-50, figs. 3a-b).

A number of smaller specimens are considered here as possible juvenile representatives of *D. rectum* (e.g. GSC 44878). They show the neanic characteristics of *D. rectum* in their latest growth stages, with rare or absent horizontal skeletal elements. Comparable forms have been described as species of *"Pseudozonophyllum"* Wedekind (=*Cystiphylloides*) by Soshkina (1936) and Kravtsov (1963), as discussed above, although some of these species (e.g. *"P." latum* Soshkina, *"P." elegans* Kravtsov) also may be representatives of *Digonophyllum* in which dissepiments were not strongly developed in the ephebic stage. The Hume forms show similarities to the neanic stages of *Cystiphylloides pumilum* sp. nov. described above. However, while the latter is also a small species, at comparable corallite size, it has well-developed dissepiments and weak septal crests (Pl. 5, figs. 9, 13).

The specimen described as *Zonodigonophyllum* cf. *Z. simplex* Wedekind by Lenz (1961, Pl. 2, fig. 7) is probably a large form of *D. rectum*, although it generally has better development of lateral dissepiments than is common for *D. rectum*. Unfortunately, the specimen was not available for restudy, but the locality from which it was obtained (Dal Lake) is considerably farther south than the main outcrops of the Hume Formation and the writer had no further material from that area available for comparison.

Actinocystis versiformis Markov, 1923 from the *Calceola* Beds (late Eifelian) of the western slopes of the Urals is very similar to *D. rectum* and probably synonymous with it. Markov's (1923, Pl. 6, figs. 3-5) illustrations show no significant differences, except perhaps, for the greater irregularities in length of the major septa in the specimen illustrated in transverse section. The discoid corallum illustrated by Markov (*op. cit.*, Pl. 6, fig. 9) is probably congeneric with *"Glossophyllum" discoideum* Soshkina, 1936 (also from the *Calceola* Beds of the Urals) and not a representative of *A. versiformis*. Comparable discoid forms are found in the Hume Formation and are regarded as belonging to a new cystiphyllid genus. Subsequent Soviet workers have included *A. versiformis* in the genus *Pseudozonophyllum* (=*Cystiphylloides*). The material referred to *P. versiforme* by Soshkina (1949, 1952; *Calceola* Beds, Urals) and Bulvanker (1958; Mamontov Beds, late Eifelian, Kuznets Basin) may be representative of *D. rectum*, although there appears to be a greater tendency for development of large presepiments (Soshkina, 1949, Pl. 22, fig. 6; Bulvanker, 1958, Pl. 18, fig. 1a). The specimen illustrated by Ermakova (1964, Pl. 2, figs. 5-7) from the "Eifelian" of the Russian Platform has virtually no development of dissepiments and could represent an immature form of *D. rectum*. The small form illustrated by Bulvanker (1965, Pl. 13, fig. 2) from the Eifelian of the River Kolyma area of northeastern U.S.S.R. also may be a juvenile form of *D. rectum*. Kravtsov (1963) referred a specimen from the Yunkhod Beds (Pragian) of the Central Taimyr to *P. versiforme*, but it has somewhat fewer septa than *D. rectum* and may belong to a different species. A number of other forms referred to *P. versiforme* would appear not to be conspecific. In this category is the material of Ulitina (1968) from the late Eifelian of the Transcaucasus, which has weakly developed septa; that of Spasskiy (1960) from the Losishin Beds (late Eifelian) of the Rudniy Altai, having short septa, weakly dilated axially and a tendency towards colonial growth; and that of Zheltonogova and Ivaniya (1961) and Ivaniya (1965) from the Shandin Beds (Eifelian) of the Kuznets Basin, which has greater presepiment development and more discontinuous septa.

There appear to be no significant differences between *D. rectum* and *Pseudozonophyllum intermedium* Yü, Liao and Cheng, 1974 from the Longdongshui Member of the Houershan Formation (late Eifelian) of Kweichow, southwestern China, and the the species are regarded as probably synonymous.

Digonophyllum powellense sp. nov.

Plate 1, figure 16, Plate 11, figures 1, 4, 7,
Plate 12, figures 1-8, Plate 13, figures 1-7

Material. Holotype GSC 44881, GSC loc. C-3871, Powell Creek; paratypes GSC 44882-44885, GSC loc. C-3871, Powell Creek; GSC 44886, GSC loc. C-3872, Powell Creek; GSC 44887, GSC loc. C-25838, Gayna River; GSC 44888, GSC loc. C-24674, type section of Hume Formation; GMUS Cr 4-7, Hume River.

Diagnosis. Digonophyllum with extensive neanic septal dilation and septa strongly withdrawn from axis in ephebic stage where they show pronounced dilation in counter half of corallum.

Description. Corallum solitary, usually ceratoid with slight curvature. Rejuvenescence is common and epitheca shows fine growth lines. Calice has variable depth, often with slightly flattened marginal platform. Septal crests are generally clearly evident on calical walls. Maximum corallite diameter ranges from 32 to 58 mm in available material, with approximate height ranging from 50 to 120 mm.

Septa are strongly dilated in neanic stage, which may extend up to 0.8 of corallite height. In ephebic stage, dilation of septa is considerably more pronounced in counter half (convex side) of corallum, particularly opposite cardinal fossula, which is clearly marked. Septa tend to become radially discontinuous in the late ephebic stage and are strongly withdrawn from corallite axis and to varying extent from periphery. Sparse, short septal crests may occur in axial region. Counter septum is generally shorter than adjacent major septa, interstitial minor septa being absent. Cardinal septum in fossula is usually very short and radially discontinuous, frequently reduced to a few short crests. Major septa are generally thin in peripheral regions in ephebic stage and range in number from 48 to 74, although this is difficult to determine due to their radial discontinuity. Minor septa are, in many cases, only apparent near corallite periphery; they are typically very short and radially discontinuous. Trabecular structure is comparable to that of *D. rectum*.

Dissepiments are of moderate size, globose to more commonly rather elongate. Presepiments are well developed but lateral dissepiments are uncommon. Tabellae typically are considerably larger than dissepiments and frequently complete and incomplete tabulae may be developed, usually flat or sagging and widely spaced. Horizontal skeletal elements are usually rare in neanic stage.

Remarks. This species is distinguished from *D. rectum* by its generally larger size and ephebic axial withdrawal of septa, more consistent development of presepiments and considerably more pronounced axial dilation of the septa on the counter side of the corallum. With septal reduction, forms transitional to *Cystiphylloides macrocystis* exist, as discussed previously. The combination of characteristics noted above also clearly distinguishes *D. powellense* from all other described species of the genus.

Digonophyllum sp.

Plate 14, figures 8, 9, Plate 15, figures 3-5

Material. GSC 44889, GSC loc. C-2522, Carnwath River; GSC 44890, GSC loc. C-2537, Sam MacRae Lake.

Remarks. These specimens show internal characteristics of both *D. rectum* and *D. powellense*, but are distinguished by their considerably greater diameter, as much as 100 mm, and height of at least 200 mm. Major septa number as many as 84. The septa are generally more complete than in *D. powellense*, but there is better development of presepiments and septal dilation on the counter side than in *D. rectum*. In addition, there is a proportionally much smaller region of the proximal end of the corallite filled by dilated septa than in either of these species. Hence the affinities of this large form are not clear at present; it should probably be regarded as a new species if more material shows these differences to be consistent.

Lekanophyllum Wedekind, 1924

Lekanophyllum Wedekind, 1924, p. 29 (part).
Hemicystiphyllum Wedekind, 1925, p. 28.
Atelophyllum Wedekind, 1925, p. 37.
Dialytophyllum Amanshauser *in* Wedekind, 1925, p. 40.
?*Zonodigonophyllum* Vollbrecht, 1926, p. 240 (part).
?*Pseudodigonophyllum* Spasskiy, 1960, p. 39.
?*Asperophyllum* Spasskiy *in* Dubatolov and Spasskiy, 1964, p. 132.
?*Aculeatophyllum* Zhavoronkova *in* Strelnikov and Zhavoronkova, 1972, p. 94.
Scissoplasma Spasskiy and Kravtsov *in* Spasskiy *et al.*, 1974, p. 171.

Type species. *Lekanophyllum punctatum* Wedekind, 1924. Junkerberg Beds (middle Eifelian) of the Eifel.

Diagnosis. Solitary or branching coralla. Septal crests are commonly well developed throughout, particularly in ephebic stage where they form largely complete radial septa whose axial trabeculae lack significant dilation. Dilation of septa may occur to a minor extent in neanic stage, but never to the extent of producing fusion of crests to entirely fill the corallite. Peripheral discrete carinae are very rare or lacking.

Discussion. *Lekanophyllum* is distinguished from *Digonophyllum* on the basis of the absence or only weak development of septal dilation in the neanic stage, together with the general lack of axial septal dilation in the ephebic stage. It appears to be possible to separate *Lekanophyllum* from *Mesophyllum* Schlüter, 1889 (which includes the type species of *Arcophyllum* Markov, 1926, *Hemicosmophyllum* Wedekind and Vollbrecht, 1931 and possibly *Pseudocosmophyllum* Wedekind and Vollbrecht, 1931, *Cosmophyllum* Vollbrecht, 1922, *Mochlophyllum* Wedekind, 1923 and *Uralophyllum* Soshkina, 1936) on the basis of extensive development of peripheral discrete carinae in *Mesophyllum*. There appear to be a considerable number of forms which lack these carinae (*see* below) and they are absent most commonly in the forms described below from the Hume Formation. On this basis, it would seem worthwhile separating the two genera.

There are a number of other genera, however, which it would seem advisable to merge with *Lekanophyllum*. *Dialytophyllum* Amanshauser *in* Wedekind, 1925, on the basis of the type species *D. complicatum* Amanshauser *in* Wedekind, 1925, appears to differ from *Lekanophyllum* only in having more dilated major septa, which may extend to the corallite wall (Wedekind, 1925, Pl. 10, fig. 63). However, the extent to which presepiments are developed is a highly variable characteristic, even in one corallite, in forms of this type (e.g. *Lekanophyllum andersonense*, Pl. 22, figs. 1-4). It thus cannot be used as a criterion for generic distinction.

Hemicystiphyllum Wedekind, 1925 also has weakly developed presepiments, together with considerable axial dilation of septa in the neanic stage (*H. frechi* Wedekind, 1925, Pl. 17, figs. 100-102). No ephebic axial dilation of the septa is apparent, however, and the neanic dilation does not cause the septa to completely fill the corallite. Hence, while this form is perhaps intermediate in character between *Lekanophyllum* and *Digonophyllum*, it appears to be closer to the former and is placed in synonymy with it.

Atelophyllum Wedekind, 1925, on the basis of the type species *Mesophyllum emsti* Wedekind, 1922 (=*Actinocystis annulifer* Schlüter, 1885; *see* Birenheide, 1964, p. 40), shows no significant differences from *Lekanophyllum* (Wedekind, 1922, Pl. 2, figs. 1a, b). The writer follows Birenheide (1964) in placing *Mesophyllum frankei* Wedekind, 1922 and *M. stillei* Wedekind, 1922 in synonymy with *A. annulifer* and includes the species in *Lekanophyllum*.

Pseudodigonophyllum Spasskiy, 1960 is characterized by peripheral dilation of the septa according to Spasskiy (1960, p. 39). But this thickening is so weakly developed in the type species (*P. macroseptatum* Spasskiy, 1960, Pl. 6, figs. 7, 8, Pl. 8, fig. 1) that the genus probably is best regarded as synonymous with *Lekanophyllum*.

Asperophyllum Spasskiy *in* Dubatolov and Spasskiy, 1964 and *Aculeatophyllum* Zhavoronkova *in* Strelnikov and Zhavoronkova, 1972 have inadequate illustration of ontogeny and variability, but may be additional synonyms of *Lekanophyllum*. *Asperophyllum* appears to have rather incomplete septa and is perhaps intermediate between *Zonophyllum* and *Lekanophyllum* (*A. armatum* Spasskiy *in* Dubatolov and Spasskiy, 1964, Pl. 11, figs. 1a-g). *Aculeatophyllum*, from the illustrations of the type species (*A. uralicum* Zhavoronkova *in* Strelnikov and Zhavoronkova, 1972, Pl. 27, figs. 2a, b), may be a *Lekanophyllum* with rather coarse septa.

Spasskiy and Kravtsov (*in* Spasskiy *et al.*, 1974) proposed the new genus *Scissoplasma* for branching forms of *Lekanophyllum*, with *Atelophyllum nebracis* McLaren, 1964 as type species. The majority of workers in the past have tended to group in the one genus solitary and branching forms of Devonian cystiphyllids with the same internal morphology and this policy is followed here. Moreover, "*A.*" *nebracis* is not certainly colonial (McLaren, *op. cit.*, p. 26) although corallites tend to grow adjacent to each other. For these reasons, *Scissoplasma* is better regarded as a synonym of *Lekanophyllum*.

Species included:

Actinocystis cylindrica Schlüter, 1882, revised by Birenheide (1964), with synonyms *Zonophyllum zentrale* Wedekind, 1924 and *Z. solidum* Wedekind, 1924. Lower Nohn Beds, early Eifelian, the Eifel.

Actinocystis annulifer Schlüter, 1885, revised by Birenheide (1964), with synonyms *Mesophyllum emsti* Wedekind, 1922, *M. frankei* Wedekind, 1922, and *M. stillei* Wedekind, 1922. Oberhönsel Beds, Givetian, Sauerland.

Actinocystis? cornubovis Etheridge, 1899, revised by Hill (1942b). Moore Creek Limestone, late Eifelian, New South Wales.

Cyathophyllum annulatum Peetz, 1901, revised by Bulvanker (1958). Safonov Beds, late Givetian, Kuznets Basin.

Mesophylloides aubergensis Wedekind, 1922. Junkerberg Beds, middle Eifelian, the Eifel.

Lekanophyllum punctatum Wedekind, 1924. Junkerberg Beds, middle Eifelian, the Eifel.

Dialytophyllum complicatum Amanshauser *in* Wedekind, 1925, with synonym *D. secundum* Amanshauser *in* Wedekind, 1925. Schwelmer Limestone or Oberhönsel Beds, Givetian, Sauerland.

Hemicystiphyllum frechi Wedekind, 1925. Loogh Beds, early Givetian, the Eifel.

Atelophyllum elongatum Kettnerova, 1932. Givetian, Moravia.

Lythophyllum cylindricum (Schlüter) sensu Soshkina, 1936 (?non Schlüter, 1882). ?Late Eifelian, Northern Urals.

Atelophyllum multiseptatum Yoh, 1937 and *A. peimanense* Yoh, 1937. "Beimar Shale", Eifelian, Kwangsi.

Mesophyllum collare Hill, 1942a. Fanning River Group, Givetian, North Queensland.

Dialytophyllum fultum Hill, 1942a. Fanning River Group, Givetian, North Queensland.

Dialytophyllum vilvense Soshkina, 1949. Cheslav and Chusov Horizons, late Givetian, Northern Urals.

Atelophyllum cylindricum (Schlüter) sensu Bulvanker, 1958 (non Schlüter, 1882). Shandin Beds to Safonov Beds, Eifelian-Givetian, Kuznets Basin.

Dialytophyllum yavorskii Bulvanker, 1958, *D. tenuiseptatum* Bulvanker, 1958 and *D. crassiseptatum* Bulvanker, 1958. Safonov Beds, late Givetian, Kuznets Basin.

Digonophyllum bilaterale (Soshkina) sensu Spasskiy, 1959 (non Soshkina, 1949). *Calceola* Beds, late Eifelian, Urals.

Dialytophyllum zaretchnaiensis Ivaniya *in* Zheltonogova and Ivaniya, 1961. Safonov Beds, late Givetian, Kuznets Basin.

Pseudodigonophyllum aequivesiculatum Ulitina, 1963b. Late Givetian, Transcaucasus.

Atelophyllum nebracis McLaren, 1964. Horn Plateau Formation, Givetian, District of Mackenzie.

Dialytophyllum astraeiforme Ivaniya, 1965 and *D. longiseptatum* Ivaniya, 1965. Safonov Beds, late Givetian, Kuznets Basin.

Dialytophyllum astraeiforme kerlegeshicum Ivaniya, 1965, *D. yavorskii* Bulvanker sensu Ivaniya, 1965 (non Bulvanker, 1958) and *D. kerlegeshicum* Ivaniya, 1965. Kerlegesh Beds, middle Givetian, Kuznets Basin.

Zonophyllum longiseptatum Kravtsov, 1966. Upper Valnev Horizon, Pragian, Novaya Zemlya.

Pseudomicroplasma bizonata Kravtsov, 1966. Lower Valnev Horizon, Pragian, Novaya Zemlya.

Dialytophyllum insignis Tsyganko, 1967. Cheslav Horizon, late Givetian, Northern Urals.

Dialytophyllum parvedivisum Tsyganko, 1967. Afonin Horizon, early Givetian, Northern Urals.

Atelophyllum subtile Ulitina, 1968. Late Eifelian, Transcaucasus.

Zonophyllum (Neozonophyllum) credulum Ulitina, 1968. Late Givetian, Transcaucasus.

Pseudozonophyllum versiforme (Markov) sensu Ulitina, 1968 (non Markov, 1923). ?Late Eifelian, Transcaucasus.

Mesophyllum arcuatum Tsien, 1969. Horizon Co1c, early Eifelian, Dinant Basin.

Zonodigonophyllum multiseptatum Tsien, 1969. Horizon Co2c, middle-late Eifelian, Dinant Basin.

Hemicystiphyllum periseptatum Tsien, 1969. Horizon Co1c, early Eifelian, Dinant Basin.

Mochlophyllum alhambraensis Merriam, 1973. Woodpecker Limestone Member, Devonian coral zone G, Givetian, Nevada.

Atelophyllum graciliseptatum Liao *in* Wang *et al.*, 1974. Laohuling Member, late Eifelian, Kwangsi.

Pseudodigonophyllum trabeculum Kravtsov *in* Besprozvannykh *et al.*, 1975. Daksan Beds, Pragian, Central Taimyr.

Lekanophyllum ellipticum sp. nov., *L. mediale* sp. nov., *L. andersonense* sp. nov., *L. andersonense* var. *major* var. nov. and *L. vescum* sp. nov. Hume Formation, late Eifelian, District of Mackenzie.

Doubtfully included species:

Lekanophyllum kayseri Wedekind, 1924. Junkerberg Beds, middle Eifelian, the Eifel.

Zonodigonophyllum primum Vollbrecht, 1926. Lower Nohn Beds, early Eifelian, the Eifel.

Atelophyllum tungkanlingense Yoh, 1937. Tungkangling Stage, Givetian, Kwangsi.

Mesophyllum yunnanense Wang, 1948. Givetian, Yunnan.
Pseudodigonophyllum macroseptatum Spasskiy, 1960 and *P. bizonatum* Spasskiy, 1960. Losishin Beds, late Eifelian, Rudniy Altai.
Atelophyllum subcylindricum Stumm, 1962. Bell Shale, Givetian, Michigan.
Atelophyllum magnum Stumm, 1962. Four Mile Dam Limestone, middle Givetian, Michigan.
Asperophyllum armatum Spasskiy *in* Dubatolov and Spasskiy, 1964. *Calceola* Beds equivalents, late Eifelian, Western Urals.
Pseudodigonophyllum paralimitare Gorianov *in* Bulvanker *et al.*, 1968. Talbulak Formation, Pragian, Zeravshan Range, Tadzhikistan.
Mesophyllum giganteum Tsien, 1969. Horizon Co2d, late Eifelian, Dinant Basin.
Mesophyllum pseudocystiphylloides Tsien, 1969. Horizon Co2c, middle-late Eifelian, Dinant Basin.
Pseudodigonophyllum notabilis Tsyganko, 1970. "Coblentzian" (fide Tsyganko, 1971) =?late Pragian, Northern Urals.
Aculeatophyllum uralicum Zhavoronkova *in* Strelnikov and Zhavoronkova, 1972. "Early Eifelian" (fide Tsyganko, 1971) =?late Emsian or early Eifelian, western slopes of Southern Urals.
Zonodigonophyllum guizhouense Yü, Liao and Cheng, 1974. Longdongshui Member, late Eifelian, Kweichow.
Pseudozonophyllum elaboratum Besprozvannykh *in* Besprozvannykh *et al.*, 1975. Khobochalin Suite, Eifelian, Tas-Khayakhtakh Range, northeastern U.S.S.R.

Lekanophyllum ellipticum sp. nov.

Plate 15, figures 1, 2, Plate 16, figures 1-4, Plate 17, figure 1

Material. Holotype GSC 44891, GSC loc. C-2522, Carnwath River. Paratypes GSC 44892, GSC loc. C-2538, Hare Indian River; GMUS Cr 8, Hume River.

Diagnosis. Large, solitary *Lekanophyllum* with strongly elliptical ephebic cross-section. Septa short, dilated, composed of coarse trabeculae giving a ragged appearance to their lateral edges in transverse section.

Description. Corallum solitary, mainly cylindrical in holotype, turbinate in shorter, possibly immature paratype; expanding rapidly to maximum diameter in the proximal 8 cm approximately of growth. Cross-section is strongly elliptical, elongated in counter-cardinal plane. Calical platform broad, with deep, elongate calical pit showing tendency to form slight axial boss. Depth of calice reaches approximately 25 mm. Epitheca is strongly rugose. Maximum corallite diameter ranges from 95 to 103 mm along the long axis by 60 mm along the short axis. Corallite height is at least 32 cm in holotype despite lack of proximal tip, but paratypes have height of only approximately 9 cm.

Cardinal fossula generally is clearly marked. Number of major septa ranges from about 85 to 95 in ephebic stage, although minor septa are very irregularly developed and cannot always be distinguished easily from major septa. Septa extend to corallite wall in some cases but more commonly break down to discrete trabeculae and sparse, irregularly shaped discrete carinae near periphery (Pl. 15, fig. 2). Axially, septa are strongly withdrawn and major septa generally do not extend beyond 0.5 of corallite radius. Thickness of septa in transverse section is highly variable, septa generally tapering axially and peripherally, but quite dilated centrally. Septa usually show development of coarse trabeculae which give them a ragged lateral edge, sometimes developing into distinct carinae. Carinae are more pronounced peripherally. Minor septa, where apparent, are more discontinuous radially, usually more slender and, at maximum development, shorter than major septa. In early stages of growth, septa are weakly developed as sparse, short, thick crests.

Dissepiments generally are small, globose to moderately elongate, in steeply sloping peripheral zone. Axial tabellae generally are larger, usually globose and occur in broad, flat or moderately arched zone. Occasionally large, widely spaced complete and incomplete tabulae may be developed.

Remarks. This species is distinguished clearly from all other described species of *Lekanophyllum* by its growth form and distinctive septal structure.

The two paratypes have a distinctly smaller corallum height than the holotype, but their close similarity in ephebic diameter and internal structure indicates that they are conspecific and differences may be due to ecological factors or immaturity of the shorter specimens.

Lekanophyllum mediale sp. nov.

Plate 17, figures 2-8, Plate 18, figures 3, 4. Plate 19, figures 3-7, Plate 20, figure 4

Material. Holotype GSC 44893, GSC loc. C-1828, Anderson River. Paratypes GSC 44894, GSC loc. C-1826, Anderson River; GSC 44895, GSC loc. 49148, Anderson River; GSC 44896-44897, GSC loc. C-2521, Carnwath River; GSC 44898-44899, GSC loc. C-3871, Powell Creek. Additional material tentatively referred to this species: GSC 44900, GSC loc. 49212, Anderson River; GSC 44901, GSC loc. C-2522, Carnwath River.

Diagnosis. Small, solitary *Lekanophyllum* with short septa strongly dilated peripherally, tapering toward axis where they are developed as discontinuous low crests or spines. Dissepiments are very small and strongly globose.

Description. Corallum is generally ceratoid, varying to turbinate in smaller forms. Corallum may be strongly distorted in early stages to form holdfasts (e.g. GSC 44893, 44898; Pl. 18, fig. 4, Pl. 19, fig. 3). Coralla generally show only weak curvature. Exterior is strongly rugose with pronounced growth lines. Calice is commonly deep with steep sides and clearly developed thin septal ridges. Maximum corallite diameter varies from 15 to 25 mm, with most specimens ranging from 18 to 23 mm. Maximum corallite height is unknown as largest specimens are fragmentary.

Septal fossula is usually well developed in ephebic stage. Septa predominantly extend to corallite periphery, with sparse and irregular development of presepiments in ephebic and late neanic stages. In early neanic stage, septa are represented as sparse spines and crests or sclerenchymal coating on dissepiments. Minor septa generally are not apparent; very rarely short spines can be detected between major septa. Septal number ranges from 62 to 78 in material with most complete septa. Septa taper in thickness considerably toward axis and as crests become lower; discrete trabeculae are developed also, and tend to break up into what appear to be short spines axially in transverse section. Trabeculae are long peripherally, rather dilated, both radially fused and discrete. They commonly pierce 2 to 6 dissepiments. In 2 specimens (GSC 44900, 44901), crests are low and discrete spines are predominant; hence clear radial septa are not apparent in transverse section. Apparent length of complete septa varies greatly owing to length of trabeculae and orientation of section, but maximum ranges from 0.4 to 0.6 of corallite radius. Dissepiments are very small, strongly globose peripherally and steeply inclined. Tabellae are also globose but considerably larger, forming strongly sagging series.

Remarks. In its variability, this form shows some transitional characteristics between *Zonophyllum* and *Lekanophyllum*. The two specimens with weakly developed crests mentioned above could be regarded as representatives of *Zonophyllum* but their overall similarities to the other specimens which comprise the main stock of the species suggests that they are most probably extreme variants and not a separate species. The predominance of complete septa in the ephebic stage in the bulk of the material indicates that the species on the whole has closer affinities with *Lekanophyllum*.

The only described species closely resembling *L. mediale* is *L. subtile* (Ulitina, 1968, p. 80, Pl. 14, figs. 1a-z) from the late Eifelian of the Transcaucasus. The similarity shows in the comparable growth form, size, relatively weak septal development and nature of the horizontal skeletal elements. However, although it is not apparent in the illustrations, Ulitina states that discontinuous minor septa are developed in *L. subtile*, whereas in *L. mediale* only very rare spines have been observed between the major septa. Trabeculae also appear to be longer in *L. mediale* (commonly 1-2 mm, as opposed to an average of 0.4 mm, maximum 1 mm, in *L. subtile*). Unfortunately, *L. subtile* is known from only one specimen and its variability cannot be assessed. More material may show the differences to be insignificant but, until this is demonstrated, it is better to regard the Hume form as a separate species.

Lekanophyllum andersonense sp. nov.

Plate 17, figures 9, 10, Plate 18, figures 5, 6,
Plate 19, figures 1, 2, 8-10, Plate 20, figure 3,
Plate 21, figures 3-6, Plate 22, figures 1-4

Atelophyllum fultum (Hill); Lenz, 1961, p. 613, Pl. 2, figs. 3, 13 (non Hill, 1942a).

Material. Holotype GSC 44902, GSC loc. 49148, Anderson River. Paratypes GSC 44903, Lenz collection, Canyon Creek; GSC 44904, GSC loc. C-3077, Anderson River; GSC 44905, 44906, GSC loc. C-2522, Carnwath River; GSC 44907, GSC loc. C-3871, Powell Creek; GSC 44908, GSC loc. C-2538, Hare Indian River; GMUS Cr 9, Carnwath River. Additional material tentatively referred to this species: GSC 44909, GSC loc. C-2522, Carnwath River; GMUS Cr 10, Hume River; GMUS Cr 11, south limb of Imperial Anticline.

Diagnosis. *Lekanophyllum* with weakly developed presepiments, slightly dilated septa, long minor septa and generally well-developed lateral dissepiments.

Description. Corallum solitary, trochoid to subcylindrical, with generally broad calical platform and shallow calical pit with well-marked septal fossula. Epitheca strongly rugose. Maximum corallite diameter varies from 30 to 60 mm, but usually falls within the range of 38 to 50 mm. Material is mainly incomplete but maximum corallite height is at least 12 cm.

Septa are slightly dilated, generally extending to corallite periphery or interrupted by occasional presepiments. Septa taper toward axis leaving broad zone free of septa and a clearly marked septal fossula. Counter septum is flanked by two major septa, with minor septa absent. Major septa are no more than 0.7 of corallite radius in length and vary in number from 32 to 48. Minor septa generally are well developed, with a length of as much as 0.8 of that of major septa, although the location of the transverse section determines their apparent length. Minor septal crests are thinner, lower and radially more discontinuous than those of the major septa. In the region of presepiments, septa may break down to very rare discrete carinae or discrete trabeculae, but carinae are developed rarely on septa. Trabeculae are rather short, slender, piercing 1 to 3 dissepimental layers, generally fused to a large extent radially, forming continuous crests. In early growth stages, minor dilation of trabeculae may occur, but not so as to fill a significant portion of the corallite.

Dissepiments are typically small, globose, in steeply inclined layers. Broad axial zone contains gently to strongly sagging series of tabellae, generally considerably larger than dissepiments. In some places, widely spaced tabulae may be present. Thin sclerenchymal coating may occur on tabellae and axial ends of septa.

Remarks. This species is particularly variable in regard to corallite diameter and development of septa, presepiments and lateral dissepiments. Two specimens in particular (GSC 44909 and GMUS Cr 10) are only doubtfully included, the former having greater development of presepiments than is common and the latter having weaker development of minor septa. There is insufficient material, however, to determine whether they should be separated taxonomically from *L. andersonense*. GSC 44906 has considerably greater corallite height and more steeply sagging series of tabellae than is common for *L. andersonense* but, for lack of further material, also is grouped with this species. Rare forms also may show degeneration of septa into weak crests and spines in the late ephebic stage (e.g. GMUS Cr 11; Pl. 17, figs. 9, 10). They are discussed below in relation to *L. vescum* sp. nov.

Several previously described species show close similarities to *L. andersonense*. *Lekanophyllum fultum* (Hill, 1942a), from the Fanning River Group (Givetian) of North Queensland, has perhaps most resemblance to the Hume form, but has more numerous major septa (50 at corallite diameter of 40 mm), which are generally a little thinner than those of *L. andersonense*, and somewhat shorter minor septa. *Lekanophyllum tenuiseptatum* (Bulvanker, 1958), from the Safonov Beds (late Givetian) of the Kuznets Basin, has generally thicker septa which, apparently, are more carinate peripherally and show greater degeneration into discrete trabeculae in the region of presepiments (Bulvanker, *ibid.*, Pl. 34, figs. 1a, b). *Lekanophyllum zaretchnaiense* (Ivaniya, 1961), also from the upper Givetian Safonov Beds, appears to have somewhat longer major septa than *L. andersonense* (Zheltonogova and Ivaniya, 1961, Pl. D-49, fig. 4b), while the dissepimental layers appear rather flattened peripherally (*ibid.*, Pl. D-50, fig. 1). *"Zonodigonophyllum" guizhouense* Yü, Liao and Cheng, 1974 from the upper Eifelian Longdongshui Member of the Houershan Formation of Kweichow shows similarities to forms of *L. andersonense* with stronger axial dilation of the septa and greater development of presepiments (e.g. GSC 44908, Pl. 22, figs. 1-4). However, the Chinese species is generally larger and lacks the common lateral dissepiments of the Hume form (Yü *et al.*, 1974, Pl. 107, figs. 1-5).

Lekanophyllum aff. *L. andersonense* sp. nov.

Plate 18, figures 1, 2

Material. GSC 44910, GSC loc. 49212, Anderson River.

Remarks. This specimen differs from typical *L. andersonense* in having very slender septa, which are considerably more numerous (number of major septa approximately 58 at corallite diameter 46 mm). There is insufficient material, however, for it to be compared further.

Lekanophyllum andersonense var. *major* var. nov.

Plate 20, figures 1, 2, Plate 21, figures 1, 2

Material. Holotype GSC 44911, GSC loc. C-2522, Carnwath River. Paratype GSC 44912, same locality. Specimen tentatively referred to this variety: GSC 44913, same locality.

Diagnosis. *Lekanophyllum andersonense* with maximum corallite diameter 80 to 90 mm.

Remarks. This form differs from typical *L. andersonense* only in its exceptionally large size. Internal features generally show no significant differences, although one specimen (GSC 44913), doubtfully included, has considerably more incomplete septa in the late ephebic stage and greater development of presepiments (*see also* discussion of *L. vescum* sp. nov. below).

Lekanophyllum vescum sp. nov.

Plate 22, figures 5, 6, Plate 23, figures 1-6

Material. Holotype GSC 44914, GSC loc. C-3866, Powell Creek. Paratype GSC 44915, GSC loc. C-3867, Powell Creek. Specimen tentatively referred to this species: GSC 44916, GSC loc. C-2522, Carnwath River.

Diagnosis. Large *Lekanophyllum* with weak, very thin septa developed throughout ontogeny as short, discontinuous crests and discrete spines.

Description. Corallum solitary, trochoid with tendency to develop elliptical cross-section in early stages of growth. Epitheca strongly rugose. Calice is shallow, cup-shaped, with weakly developed septal crests apparent. Earliest growth stages are lacking. Corallite diameter ranges from 50 to 55 mm in two smaller specimens to 65 mm in the doubtfully included form (GSC 44916).

Septa are variably developed, but typically rather weak and discontinuous throughout ontogeny with short, low crests developed in dissepimentarium adjacent to tabularium, locally extending to near periphery, but generally breaking down to discrete spines in broad peripheral region. Irregular development of crests makes septal count difficult but, in the doubtfully included form, major septa number approximately 45; where apparent, the minor septa are developed largely as discrete spines, fused radially to produce short crests nearly as long as major septa near tabularium. Length of major septa is variable and, as crests are low and discontinuous, it depends on position of transverse section. Maximum length observed is 0.6 of corallite radius, but septa are always strongly discontinuous in peripheral region of corallite. Trabeculae are very slender and weakly fused radially. In peripheral region, discrete spines may pierce several layers of dissepiments and very rare discrete carinae may also occur in this area.

Dissepiments are globose to weakly elongate, generally small and steeply inclined peripherally. Lateral dissepiments are rare or more commonly absent. Axial tabellae form a broad zone generally free of septa. They are considerably larger than dissepiments and form strongly sagging series.

Remarks. GSC 44916 (Pl. 22, figs. 5, 6) is included in this species doubtfully as it is somewhat larger and has more regular development of septal crests. The overall weak septal development of this form, however, suggests that it has closer affinities with *L. vescum* than the other Hume species. It should be noted that rare specimens of *L. andersonense* may show degeneration of septa in the latest ephebic stage similar to that in *L. vescum*. Such forms, however, show well-developed septa of the *andersonense* type through the greater part of their ontogeny whereas in *L. vescum* the septa remain very weakly developed throughout corallite growth. These specimens (e.g. GMUS Cr 11; Pl. 17, figs. 9, 10) could perhaps be regarded as intermediate between *L. andersonense* and *L. vescum* but are left for the present in *L. andersonense*.

Lekanophyllum aubergense (Wedekind, 1922) from the Junkerberg Beds (middle Eifelian) of the Eifel is closely comparable to *L. vescum* in its weak septal development (Wedekind, 1922, Pl. 1, fig. 3a; 1924, p. 32, Fig. 43). However, it is a generally smaller form (corallite diameter 19-43 mm, average 29 mm; Birenheide, 1964, p. 36) and there is a tendency for more regular development of septal crests.

Lekanophyllum credulum (Ulitina, 1968), from the upper Givetian of the Transcaucasus, shows similarities in its weak septal development and size. It appears, however, to have generally longer spines peripherally and a narrower axial zone free of septa (Ulitina, 1968, Pl. 5, figs. 1a-v).

Lekanophyllum cornubovis (Etheridge, 1899) from the Moore Creek Limestone (late Eifelian) of the New England area of northern New South Wales also shows weak septal development but, although not adequately known, appears to have somewhat thicker septa, which are generally more regularly developed; minor septa are mostly absent. There is also a narrower axial zone free of septa (Etheridge, 1899, Pl. 31, fig. 1; Hill, 1942b, Pl. 4, fig. 3).

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PLATES

ILLUSTRATIONS OF FOSSILS

PLATE 1

(All specimens from the upper Eifelian Hume Formation unless otherwise stated)

Cystiphylloides aggregatum (Billings, 1859)

Figure 1.	Neotype GSC 6331. ?Bois Blanc Formation, Lot 6, Conc. 13, Walpole tp., Ontario ?Late Emsian. x1. (cf. Lambe, 1901, Pl. 18, fig. 3). *See also* Pl. 2, figs. 2, 3, Pl. 3, fig. 2.
Figure 2.	ROM 895 UH. ?Bois Blanc Formation, Hagersville, Ontario ?Late Emsian. x1. *See also* Pl. 2, fig. 6.

Microplasma gotlandicum Dybowski, 1874

Figures 3-5.	?Topotypes RM Cn 59574-59576, Slite Beds, Lerberget, Stora Karlsö Island. Middle Wenlock. Collected by B.E. Neuman. x2.

Cystiphylloides macrocystis (Schlüter, 1889)

Figures 6, 7.	GSC 44806. GSC loc. C-3871. x1.

Cystiphylloides macrocystis? (Schlüter, 1889)

Figures 8, 9.	GSC 44811. GSC loc. C-3871. x1. *See also* Pl. 3, figs. 6, 7.

Cystiphylloides pumilum sp. nov.

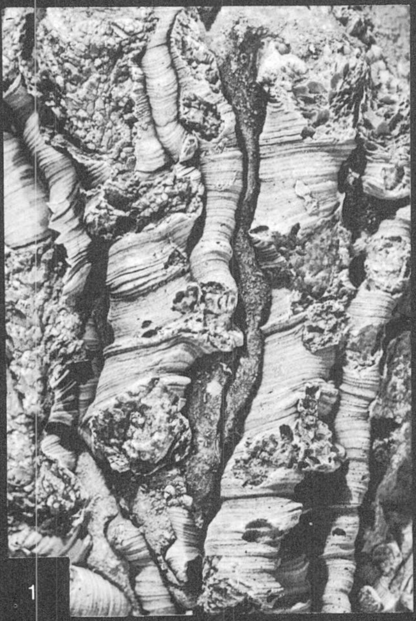
Figures 10, 11.	Holotype GSC 44814. GSC loc. C-3871. x1. *See also* Pl. 5, figs. 14, 15.

Digonophyllum rectum (Meek, 1867)

Figures 12, 13.	GSC 44878. Possible juvenile specimen. GSC loc. C-3871. x1.
Figure 14.	USNM 14546 (b). Lectotype of *Cysteophyllum americanum* var. *arcticum* Meek, 1867. "Onion River". x1. (cf. Meek, 1867, Pl. 9, fig. 6). *See also* Pl. 11, figs. 5, 6.
Figure 15.	GSC 44852. GSC loc. C-3871. x1.
Figure 17.	GSC 44866. GSC loc. C-25839. x1. *See also* Pl. 14, fig. 7.
Figures 18, 19.	Lectotype USNM 1175 (a). Anderson River. x1. (cf. Meek, 1867, Pl. 11, figs. 1, 1a). *See also* Pl. 10, figs. 14, 15.
Figures 20, 21.	GSC 44853. GSC loc. C-3871. x1. *See also* Pl. 14, figs. 2-6.

Digonophyllum powellense sp. nov.

Figure 16.	Paratype GSC 44884. GSC loc. C-3871. x1. *See also* Pl. 13, figs. 3, 4.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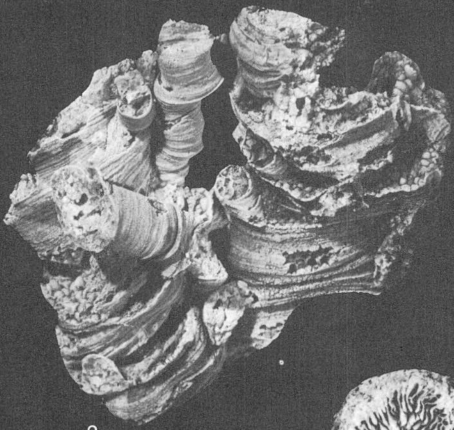
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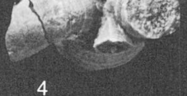
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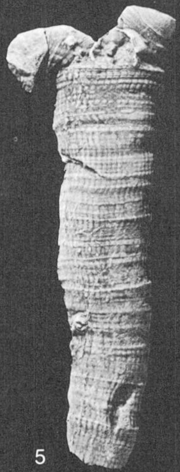
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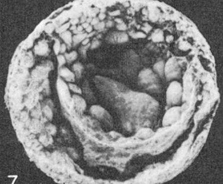
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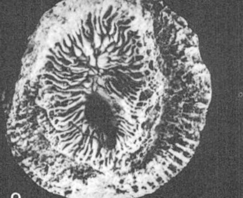
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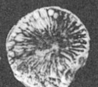
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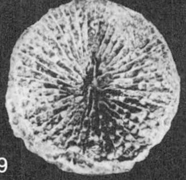
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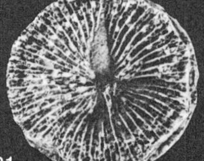
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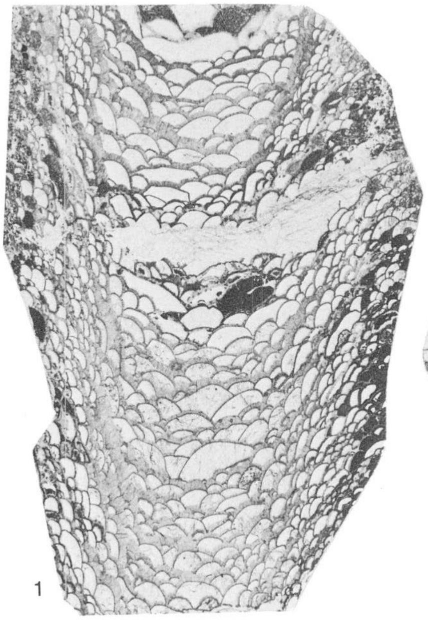
PLATE 2

Cystiphylloides aggregatum (Billings, 1859)

Figures 1, 4, 5.	GSC 44798. ?Bois Blanc Formation, Cayuga, Ontario. ?Late Emsian. Fig. 1 is x2, Fig. 4 (longitudinal section) and Fig. 5 (transverse section) are x10. *See also* Pl. 3, figs. 4, 5.
Figures 2, 3.	Neotype GSC 6331. ?Bois Blanc Formation, Lot 6, Conc. 13, Walpole tp., Ontario. ?Late Emsian. x2. *See also* Pl. 1, fig. 1, Pl. 3, fig. 2.
Figure 6.	ROM 895 UH. ?Bois Blanc Formation, Hagersville, Ontario. ?Late Emsian. x2. *See also* Pl. 1, fig. 2.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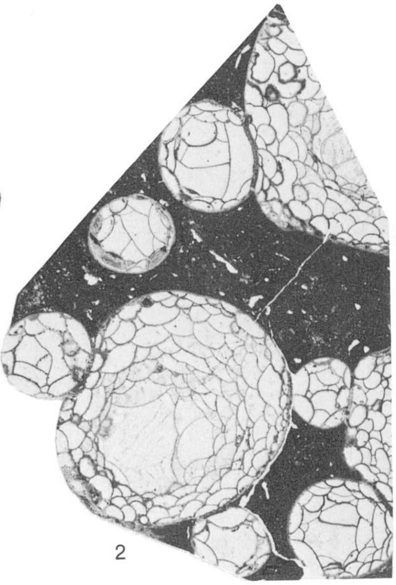
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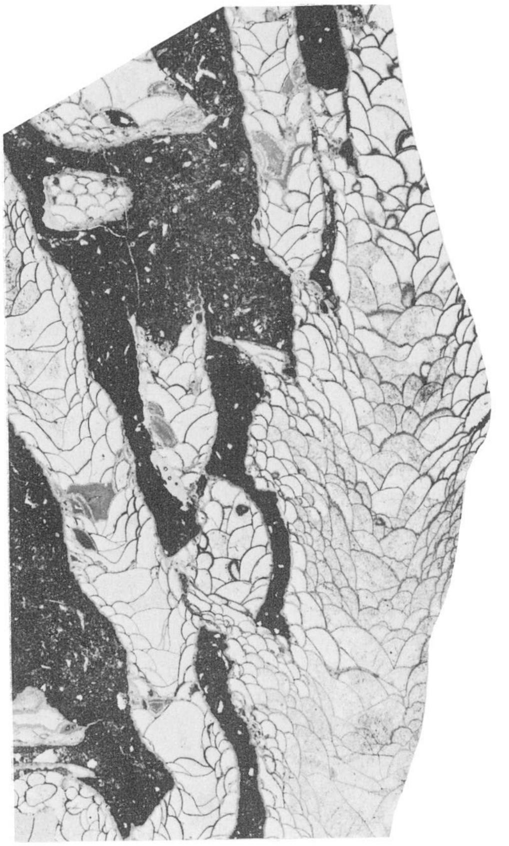
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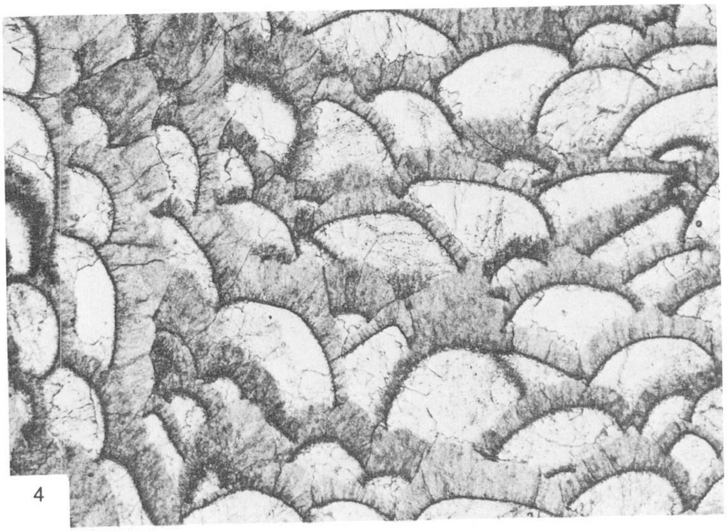
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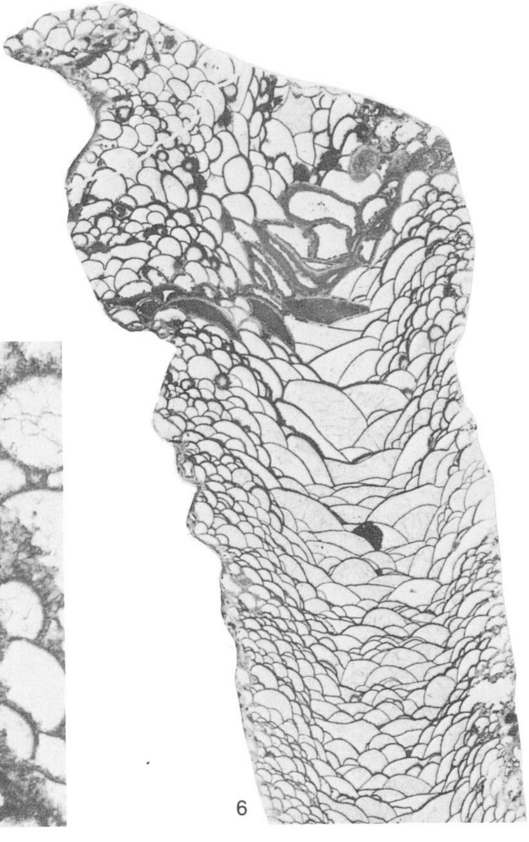
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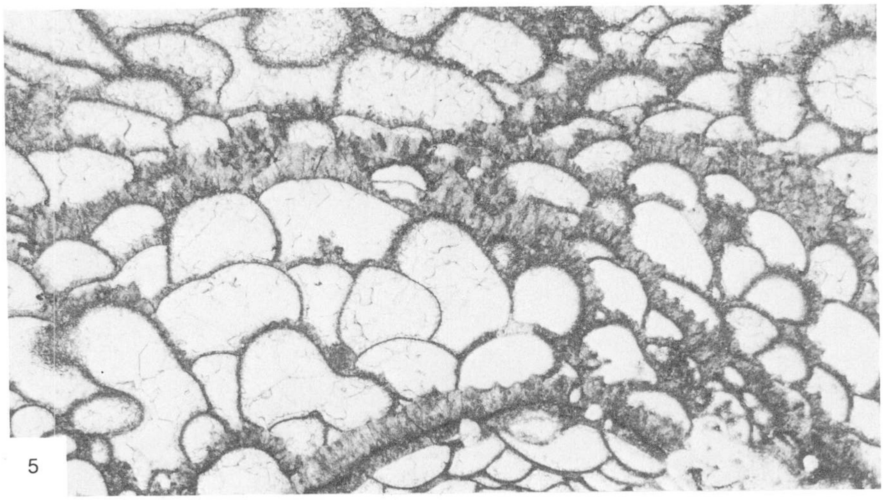
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PLATE 3

(All specimens from the upper Eifelian Hume Formation unless otherwise stated)

Cystiphylloides fruticosum (Nicholson, 1875)

Figures 1, 3. GSC 3401. ?Bois Blanc Formation, Lot 1, Conc. 1, Port Colborne, Ontario. ?Late Emsian. x2.

Cystiphylloides aggregatum (Billings, 1859)

Figure 2. Neotype GSC 6331. ?Bois Blanc Formation, Lot 6, Conc. 13, Walpole tp., Ontario. ?Late Emsian. x2. *See also* Pl. 1, fig. 1, Pl. 2, figs. 2, 3.

Figures 4, 5. GSC 44798. ?Bois Blanc Formation, Cayuga, Ontario. ?Late Emsian. x2.

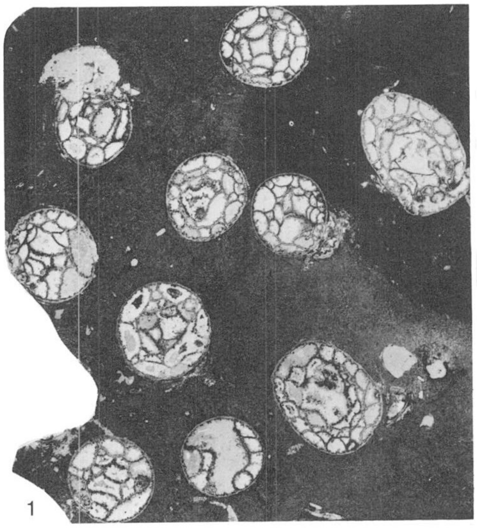
Cystiphylloides macrocystis? (Schlüter, 1889)

Figures 6, 7. GSC 44811. GSC loc. C-3871. x2. *See also* Pl. 1, figs. 8, 9.

Cystiphylloides macrocystis (Schlüter, 1889)

Figures 8, 9. GSC 44803. GSC loc. C-2522. x2.

PLATE 3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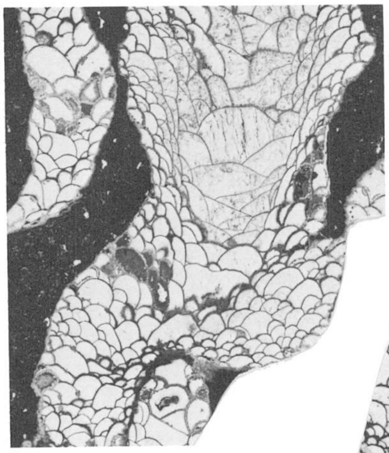
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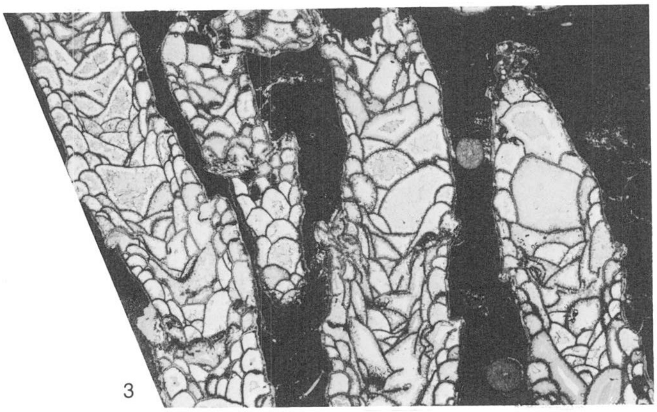
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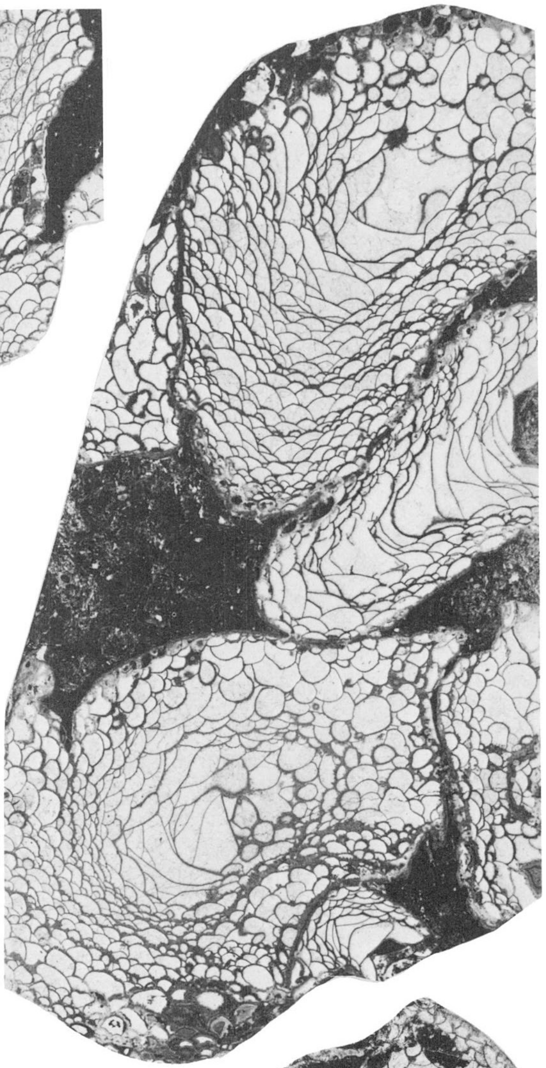
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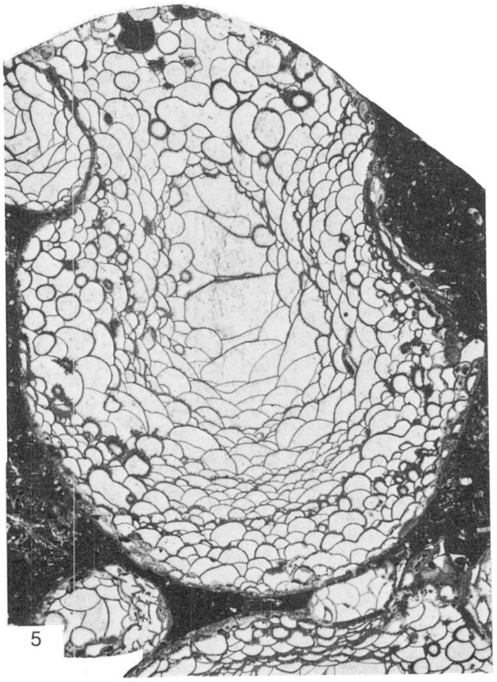
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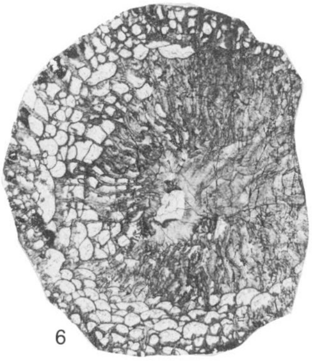
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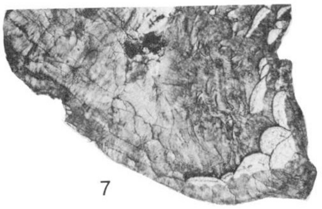
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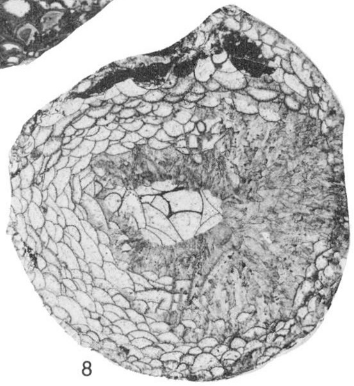
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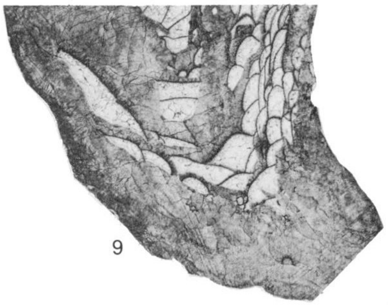
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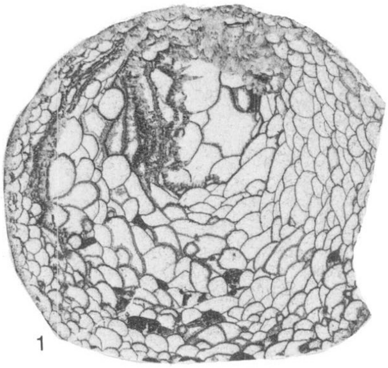
PLATE 4

(All specimens from the upper Eifelian Hume Formation)

Cystiphylloides macrocystis (Schlüter, 1889)

Figures 1, 2, 7.	GSC 44805. GSC loc. C-2522. x2.
Figures 3-6.	GSC 44809. GSC loc. C-25839. x2.
Figures 8, 10.	GSC 44804. GSC loc. C-2522. x2.
Figure 9.	GSC 44802. GSC loc. C-2522. x2. *See also* Pl. 5, figs. 1, 2.
Figures 11-13.	GSC 44800. GSC loc. C-2522. x2.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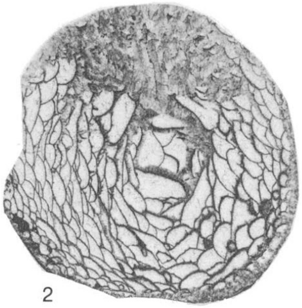
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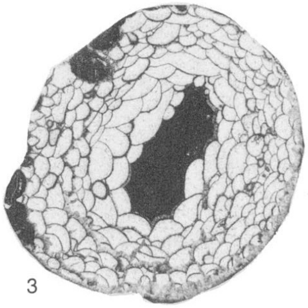
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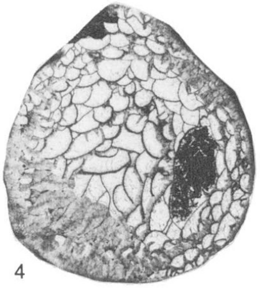
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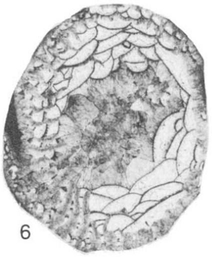
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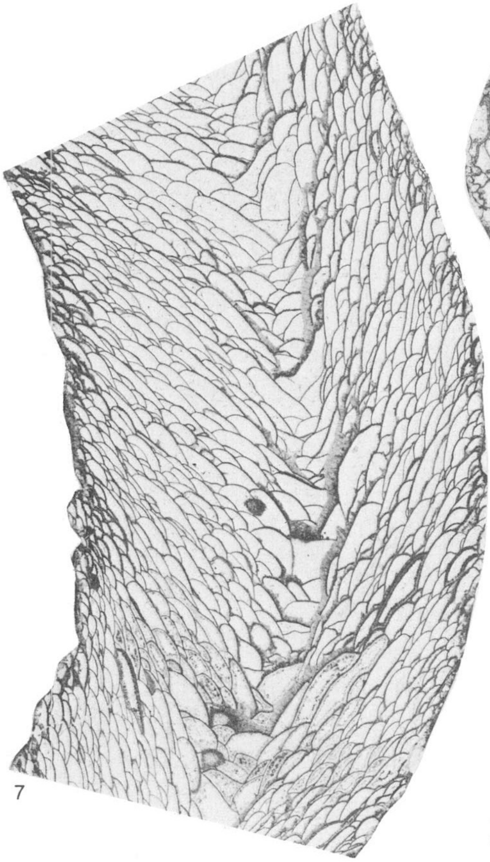
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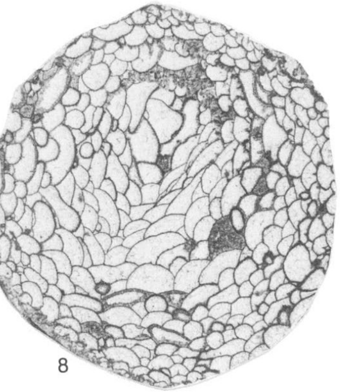
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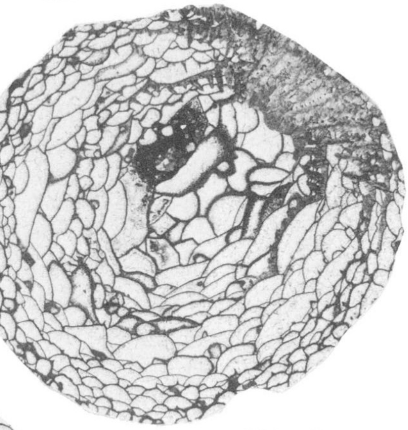
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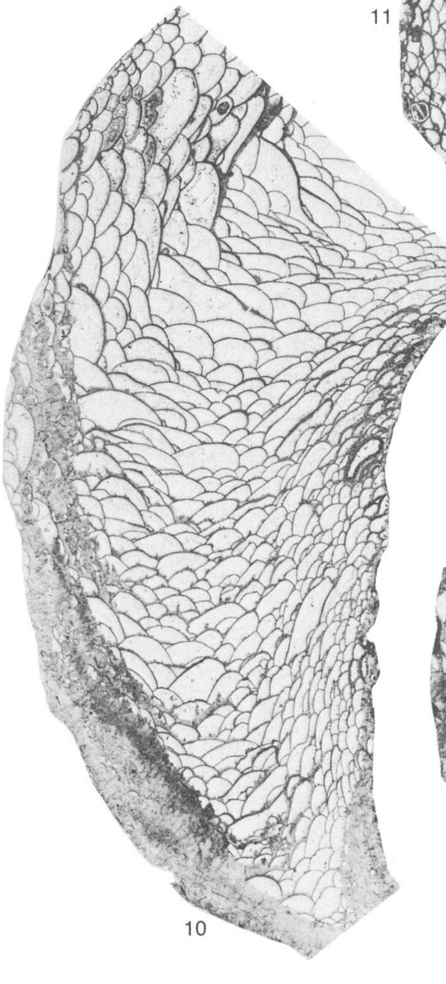
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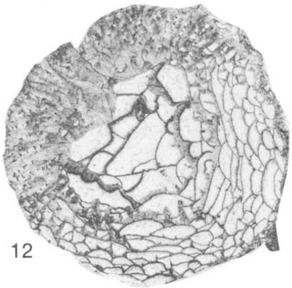
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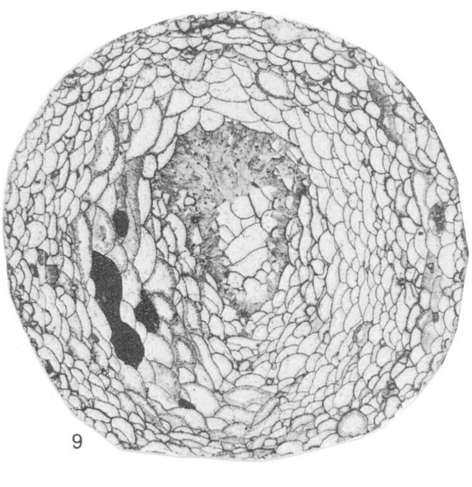
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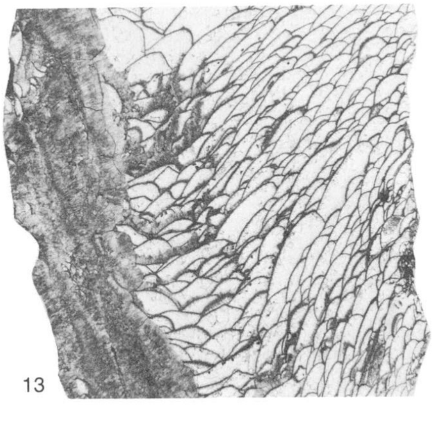
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PLATE 5

(All specimens from the upper Eifelian Hume Formation)

Cystiphylloides macrocystis (Schlüter, 1889)

Figures 1, 2.	GSC 44802. GSC loc. C-2522. x2. *See also* Pl. 4, fig. 9.

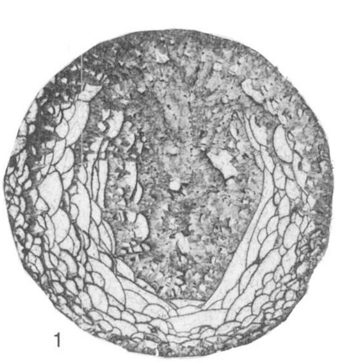
Cystiphylloides macrocystis? (Schlüter, 1889)

Figures 3, 4.	GSC 44812. GSC loc. C-3872. x2.
Figures 5-8.	GMUS Cr 1. South limb of Imperial Anticline. x2.

Cystiphylloides pumilum sp. nov.

Figures 9, 11, 12.	Paratype GSC 44817. GSC loc. C-3871. x3.
Figures 10, 13.	Paratype GSC 44816. GSC loc. C-3871. x3.
Figures 14, 15.	Holotype GSC 44814. GSC loc. C-3871. x3. *See also* Pl. 1, figs. 10, 11.

PLATE 5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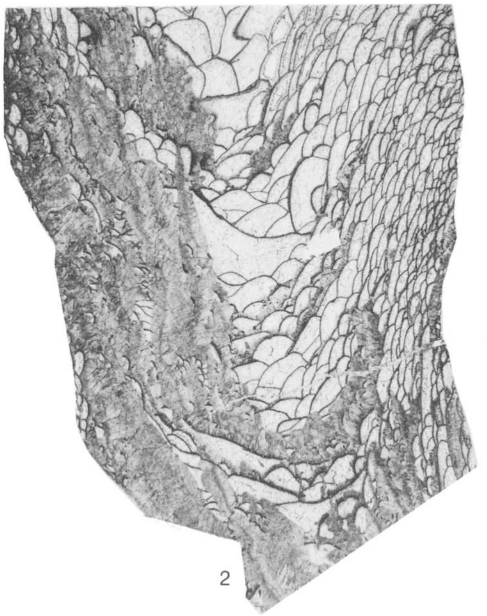
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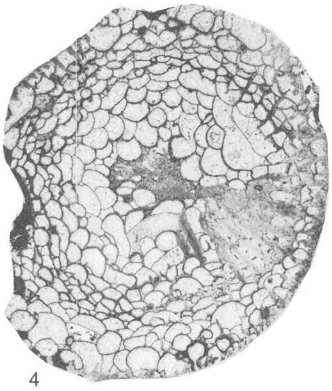
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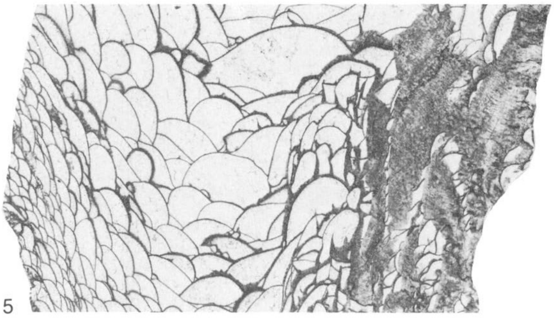
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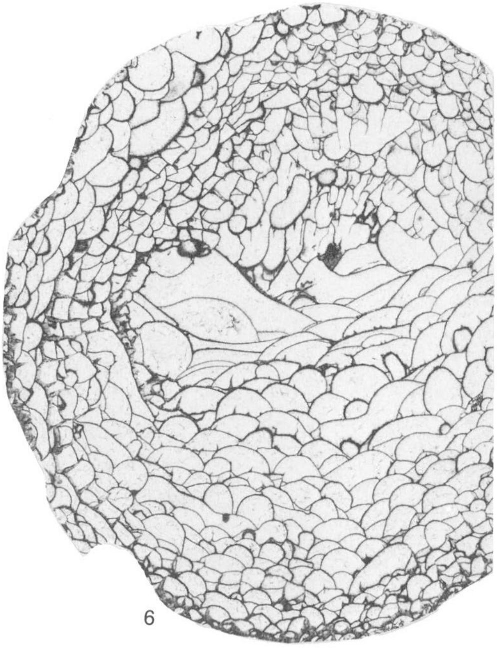
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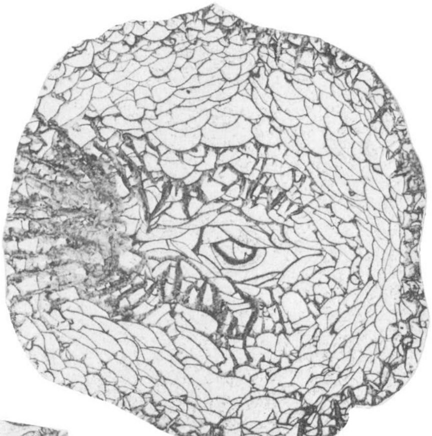
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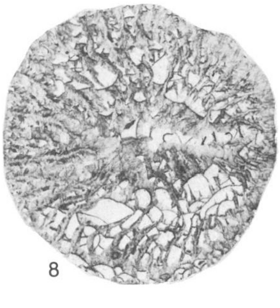
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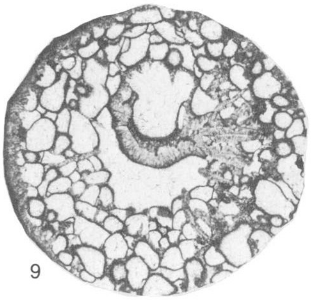
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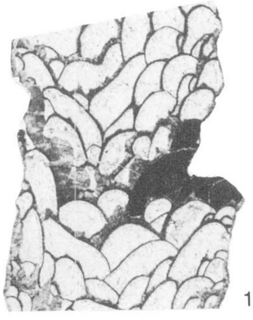
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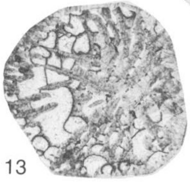
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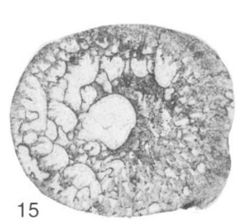
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PLATE 6

Cystiphylloides pumilum sp. nov.

Figures 1, 2. Paratype GSC 44819. GSC loc. C-2521. Hume Formation. Upper Eifelian. x3.

Microplasma gotlandicum Dybowski, 1874

Figures 3, 5. ?Topotype RM Cn 59577, Slite Beds, Lerberget, Stora Karlsö Island. Middle Wenlock. x3.

Figure 4. ?Topotype RM Cn 59578, Slite Beds, Lerberget, Stora Karlsö Island. Middle Wenlock. x3.

Figures 6, 7. ?Topotype RM Cn 59579, Slite Beds, Lerberget, Stora Karlsö Island. Middle Wenlock. x3.

Figure 9. ?Topotype RM Cn 59580, longitudinal section showing microstructure of peripheral stereozone. Slite Beds, Lerberget, Stora Karlsö Island. Middle Wenlock. x20.

Figures 10, 11. ?Topotype RM Cn 59581, Slite Beds, Lerberget, Stora Karlsö Island. Middle Wenlock. Fig. 10 is x3, Fig. 11 (longitudinal section showing microstructure of peripheral stereozone) is x20.

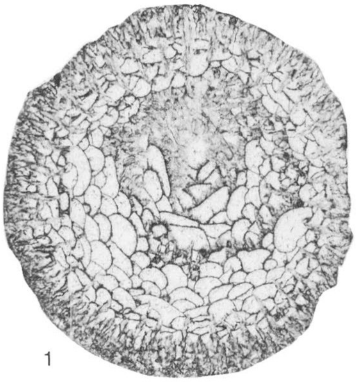
Microplasma fasciculatum (Swartz, 1913)

Figures 8, 13. USNM 239846. Keyser limesteon (Lower member under Clifton Forge Sandstone Member), USGS loc. 6834-SD, 6.4 km (4 miles) southwest of Millboro Springs, Virginia. Pridolian. x2.

Microplasma caespitosum (Schlüter, 1882)

Figure 12. Holotype GMBo Schlüter 190 b. Probably Loogh Beds, Ahrdorfer or Hillesheimer Mulde, "Ahrhütte" (=?Ahütte), Eifel, West Germany (fide Birenheide, 1964, p. 35). ?Early Givetian. x3. Copy of polaroid photograph taken by D.J. McLaren. (cf. Schlüter, 1889, Pl. 8, fig. 3; Birenheide, 1964, Pl. 10, fig. 51b).

PLATE 6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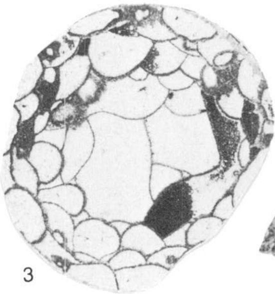
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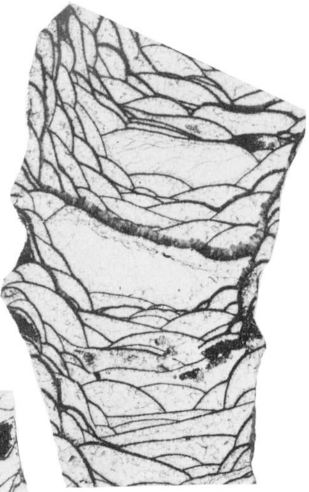
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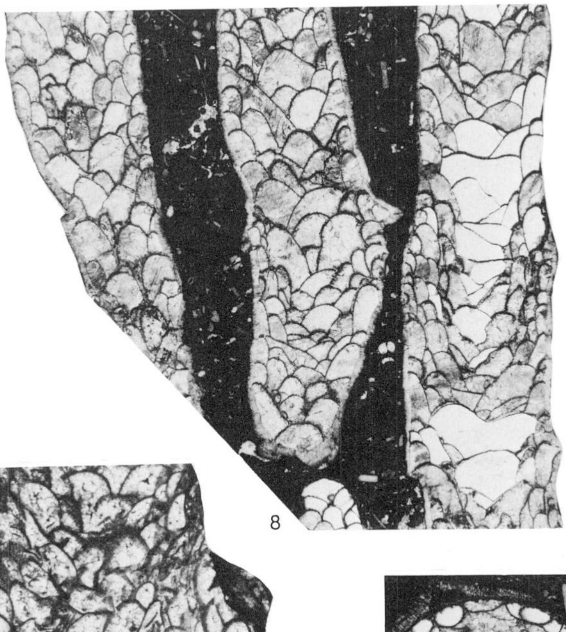
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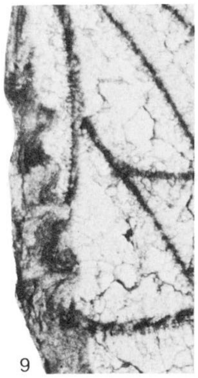
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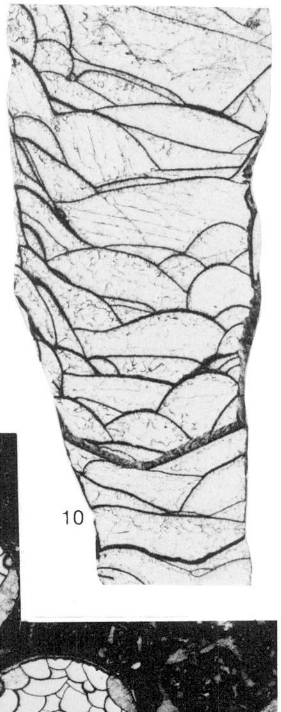
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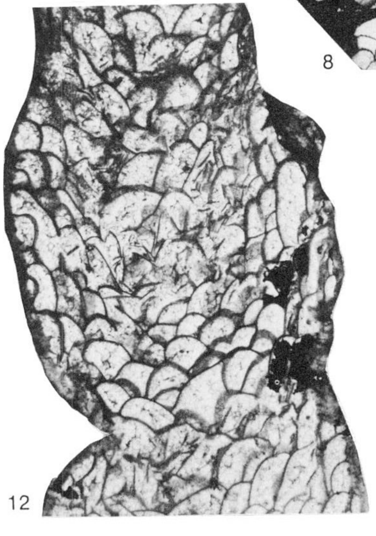
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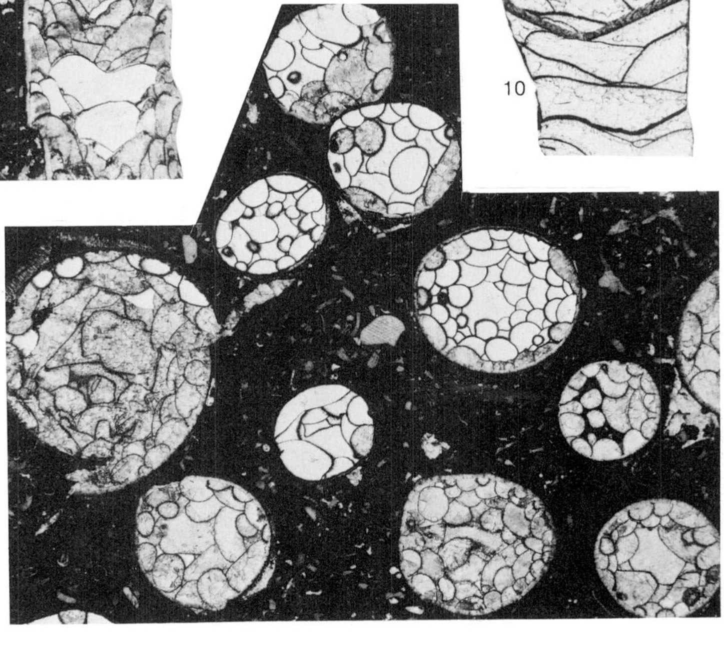
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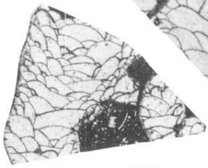
PLATE 7

(All specimens from the upper Eifelian Hume Formation)

Microplasma caespitosum (Schlüter, 1882)

Figures 1, 2.	GSC 44822. GSC loc. 49148. x2.
Figures 3, 6.	GSC 44831. GSC loc. C-24640. x2.
Figures 4, 7.	GSC 44827. GSC loc. C-3861. x2. (Note breakdown of corallite wall and contiguous dissepiments between adjoining corallites in Fig. 4).
Figure 5.	GSC 44824. Longitudinal section showing microstructure of peripheral stereozone of adjoining corallites. Lenz collection, Anderson River. x20.
Figures 8, 9.	GSC 44826. Longitudinal and oblique sections showing microstructure of peripheral stereozone. GSC loc. C-2522. x20. *See also* Pl. 9, fig. 2.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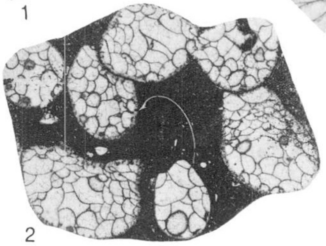
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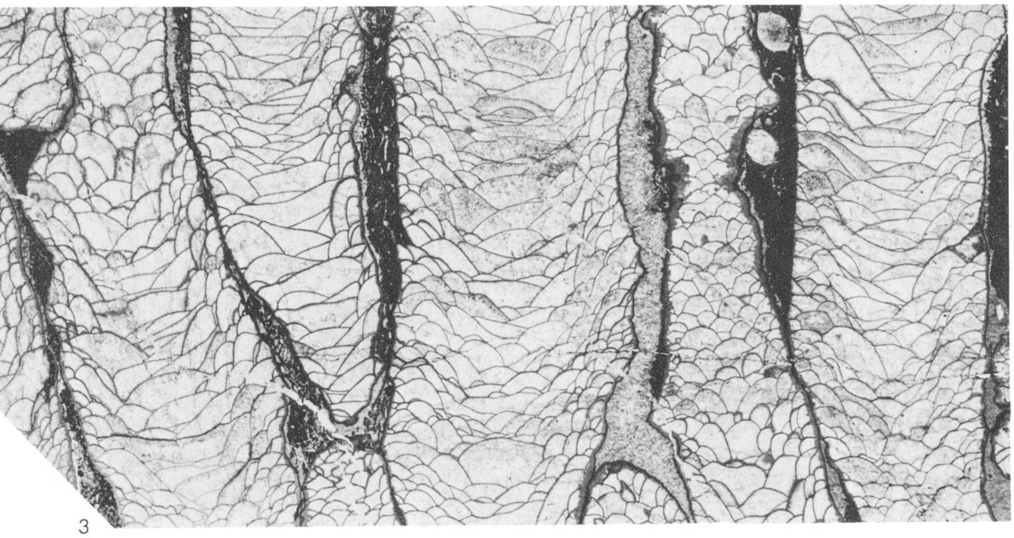
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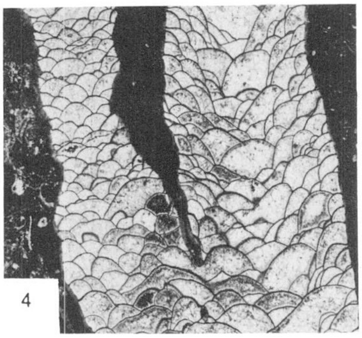
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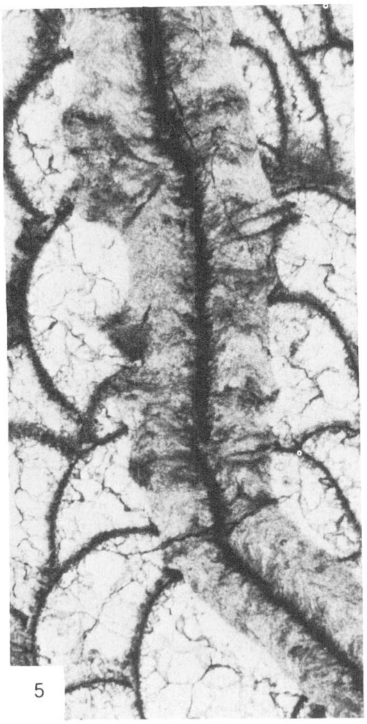
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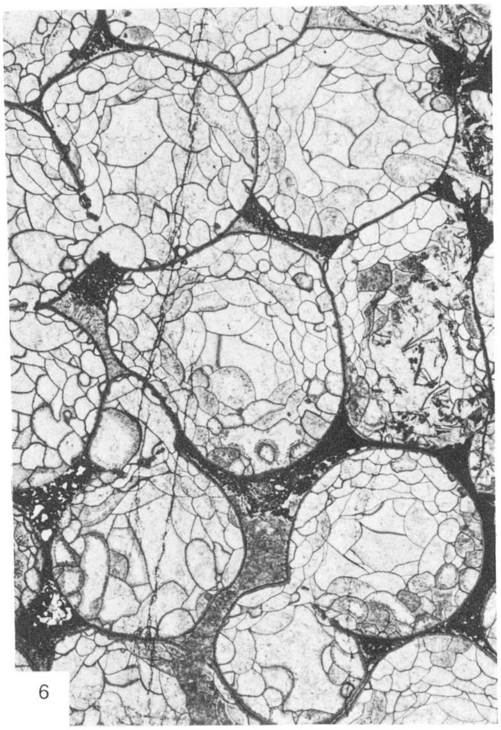
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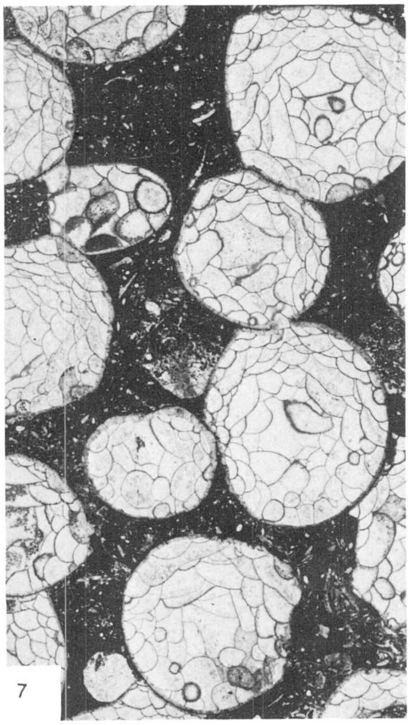
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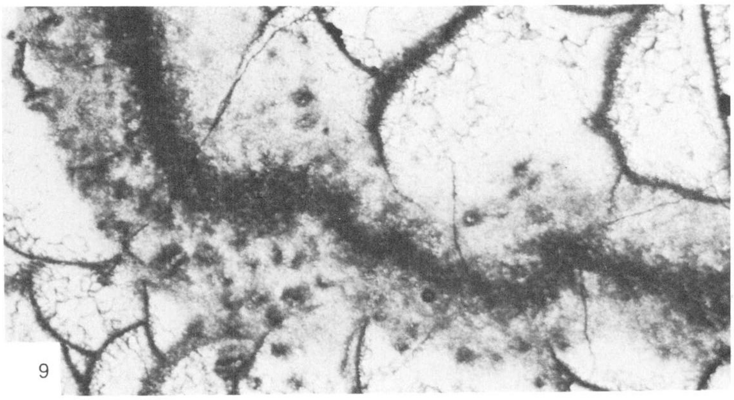
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PLATE 8

(All specimens from the upper Eifelian Hume Formation)

Microplasma caespitosum? (Schlüter, 1882)

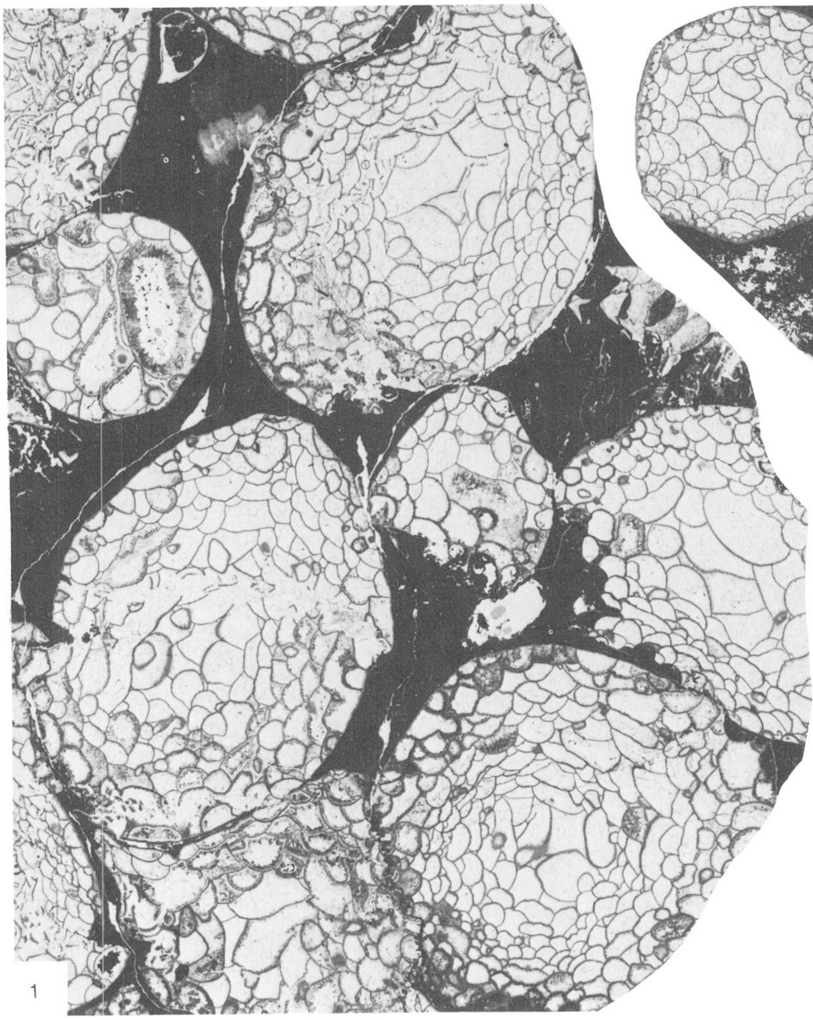
Figures 1, 5.	GSC 44834. GSC loc. C-2535. x2.

Microplasma caespitosum (Schlüter, 1882)

Figures 2, 3.	GSC 44833. GSC loc. C-1803a. x2. *See also* Pl. 9, fig. 1.

Microplasma hadron sp. nov.

Figure 4.	Holotype GSC 44835. GSC loc. C-24639. x2. (Note breakdown of corallite walls.) *See also* Pl. 9, figs. 3, 8.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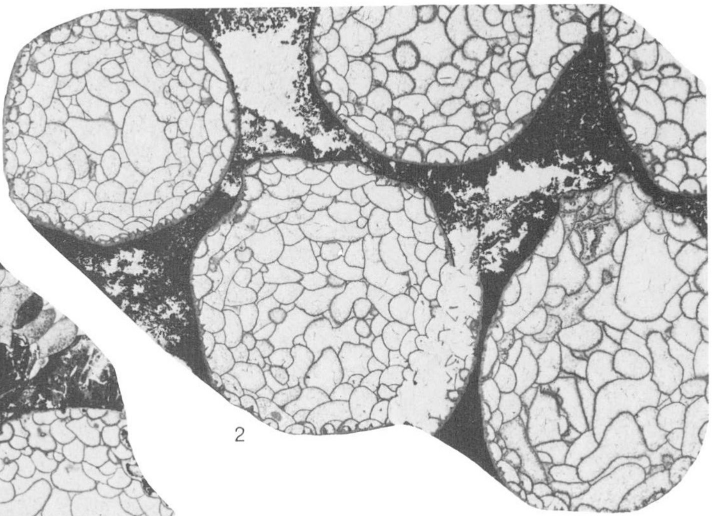
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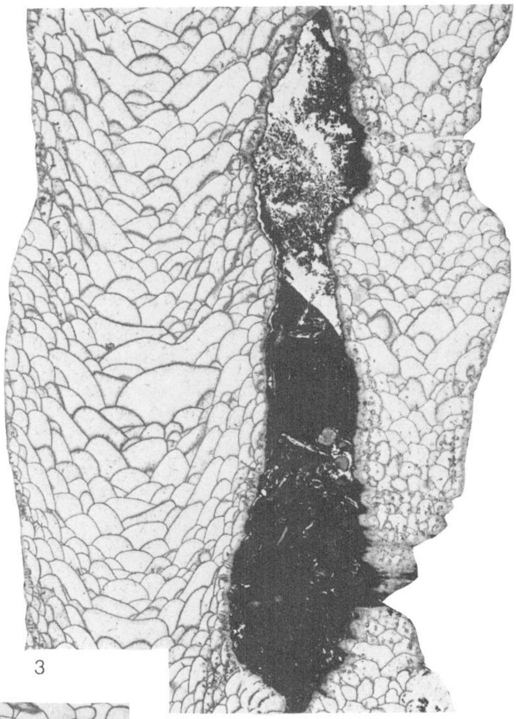
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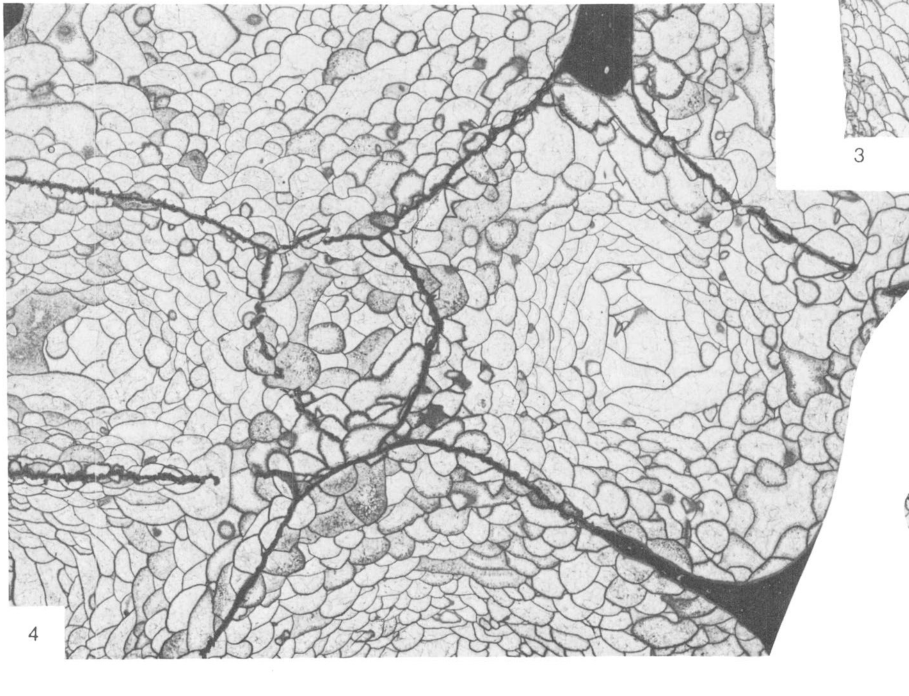
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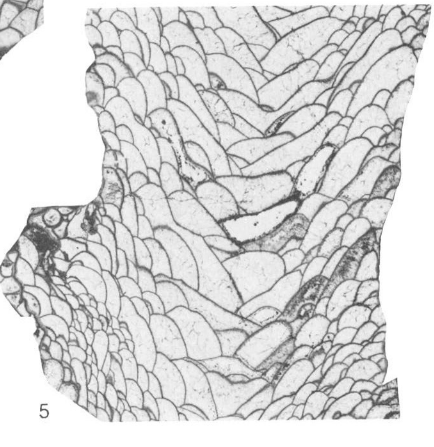
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PLATE 9

(All specimens from the upper Eifelian Hume Formation)

Microplasma caespitosum (Schlüter, 1882)

Figure 1. GSC 44833. Longitudinal section showing unusually coarse septal spines in peripheral stereozone. GSC loc. C-1803a. x20. *See also* Pl. 8, figs. 2, 3.

Figure 2. GSC 44826. Longitudinal section showing calicinal increase. GSC loc. C-2522. x2. *See also* Pl. 7, figs. 8, 9.

Microplasma hadron sp. nov.

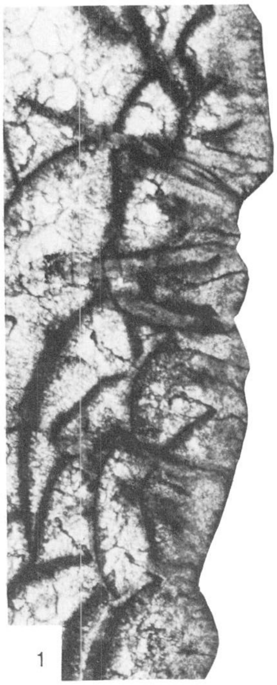
Figures 3, 8. Holotype GSC 44835. GSC loc. C-24639. x2. *See also* Pl. 8, fig. 4.

Zonophyllum petilum sp. nov.

Figures 4-6. Paratype GSC 44840. GSC loc. C-2522. x2.

Zonophyllum petilum? sp. nov.

Figure 7. GSC 44841. GSC loc. C-25839. x2. *See also* Pl. 10, fig. 3.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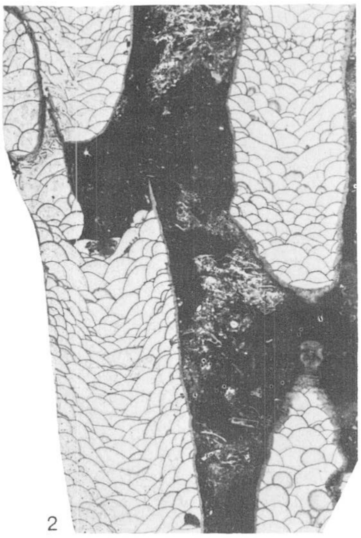
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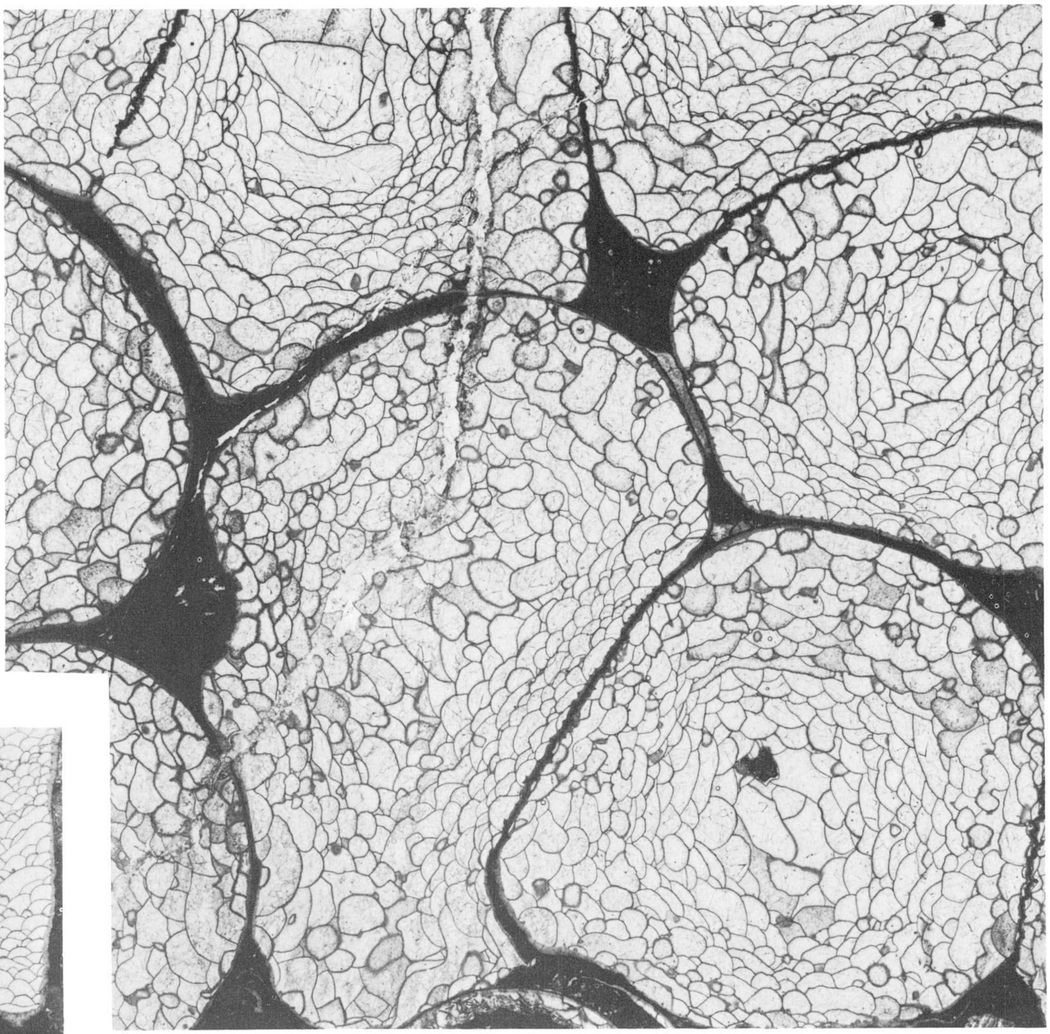
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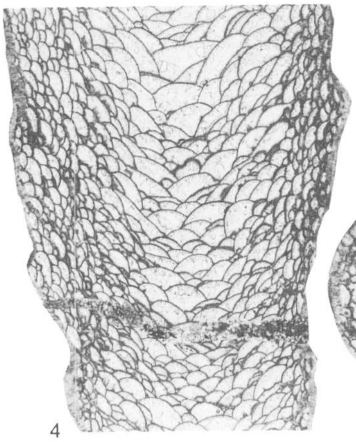
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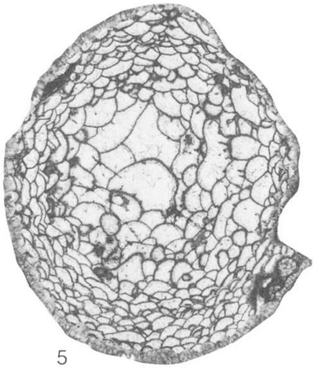
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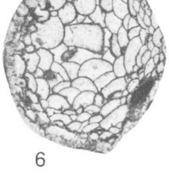
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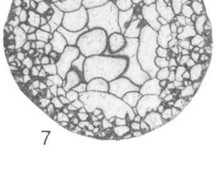
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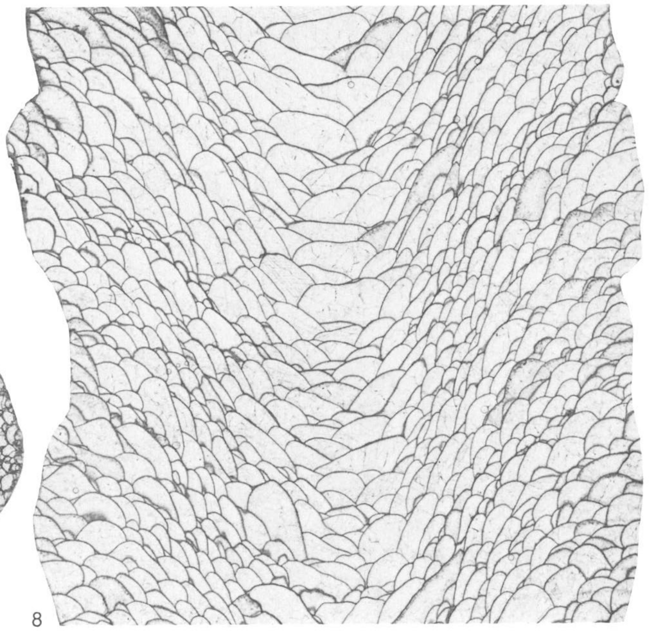
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PLATE 10

(All specimens from the upper Eifelian Hume Formation)

Zonophyllum petilum sp. nov.

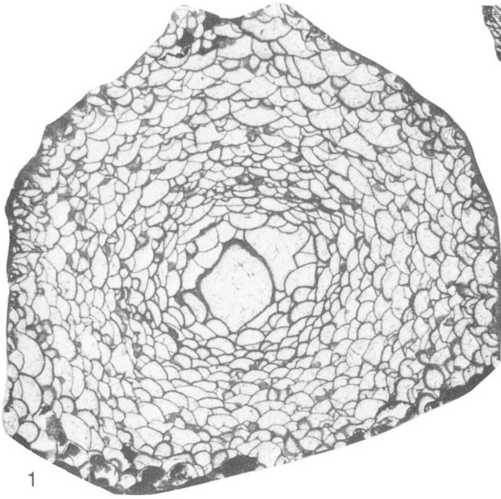
Figures 1, 2.	Holotype GSC 44836. GSC loc. 49212. x2.
Figures 4-6.	Paratype GSC 44837. GSC loc. C-24674. x2.

Zonophyllum petilum? sp. nov.

Figure 3.	GSC 44841. GSC loc. C-25839. x2. *See also* Pl. 9, fig. 7.

Digonophyllum rectum (Meek, 1867)

Figure 7.	GSC 44859. GSC loc. C-3871. x2. (Note rejuvenescence)
Figures 8-10.	GSC 44864. GSC loc. C-25838. x2.
Figures 11, 12.	GSC 44854. GSC loc. C-3871. x2.
Figure 13.	GSC 44865. GSC loc. C-25838. x2.
Figures 14, 15.	Lectotype USNM 1175(a). Anderson River. x2. *See also* Pl. 1, figs. 18, 19.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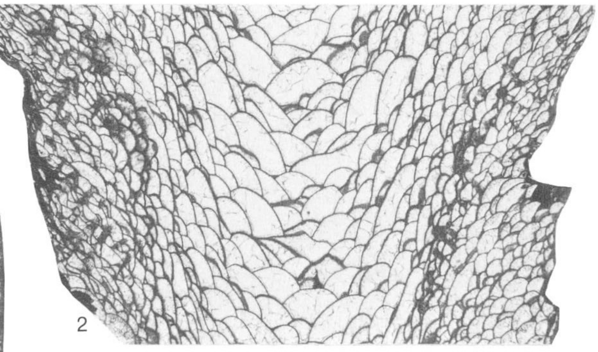
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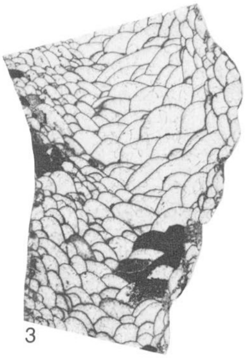
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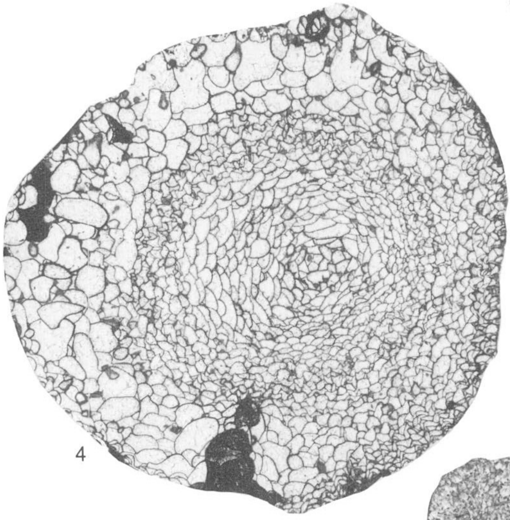
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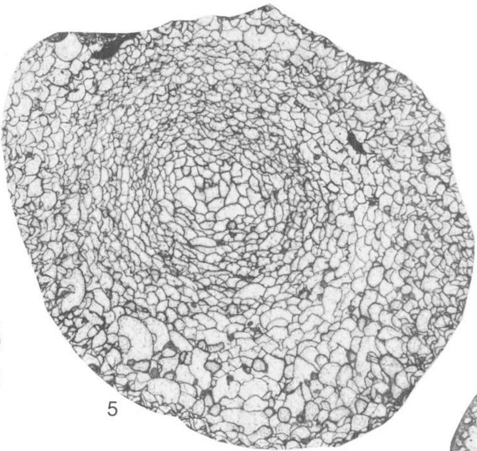
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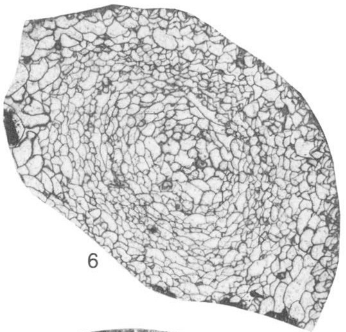
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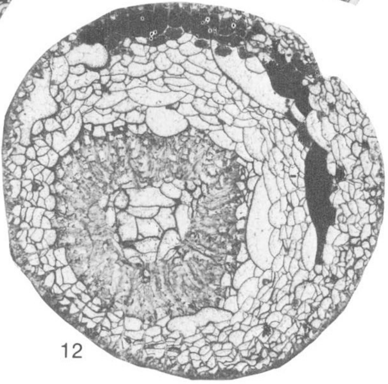
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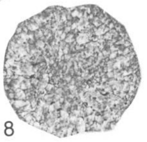
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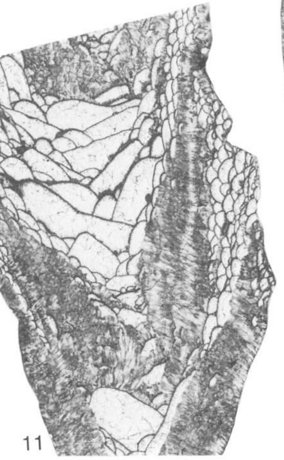
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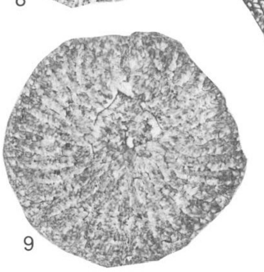
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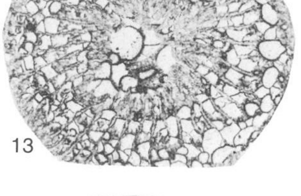
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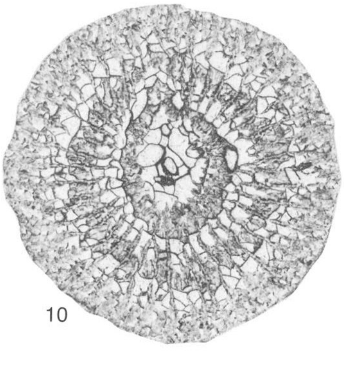
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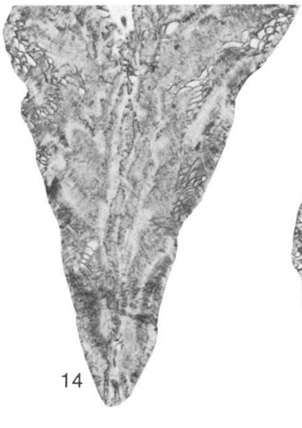
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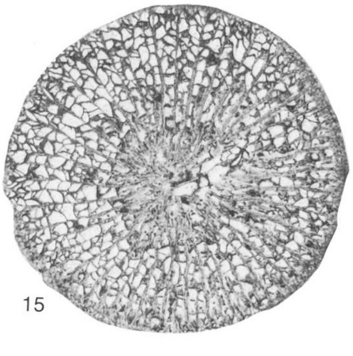
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PLATE 11

(All specimens from the upper Eifelian Hume Formation)

Digonophyllum powellense sp. nov.

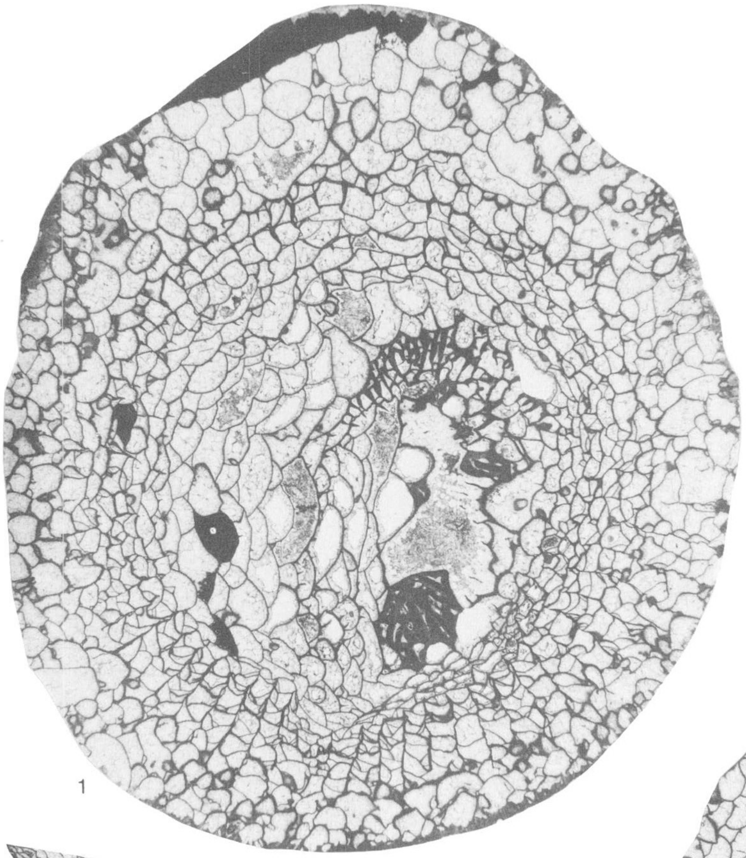
Figures 1, 4, 7. Paratype GSC 44883. GSC loc. C-3871. x2.

Digonophyllum rectum? (Meek, 1867)

Figures 2, 3. GSC 44876. GSC loc. C-2538. x2.

Digonophyllum rectum (Meek, 1867)

Figures 5, 6. USNM 14546(b). Lectotype of *Cysteophyllum americanum* var. *arcticum* Meek, 1867. "Onion River". x2. *See also* Pl. 1, fig. 14.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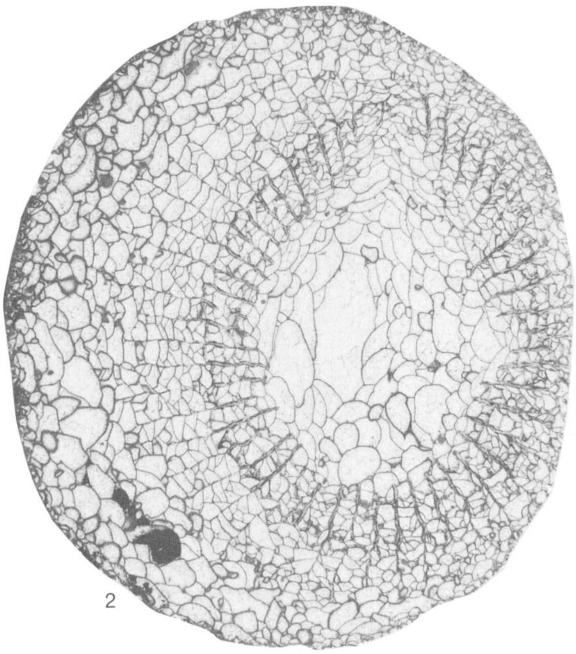
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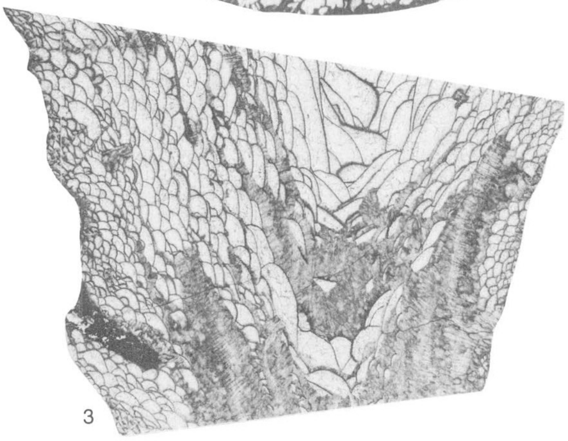
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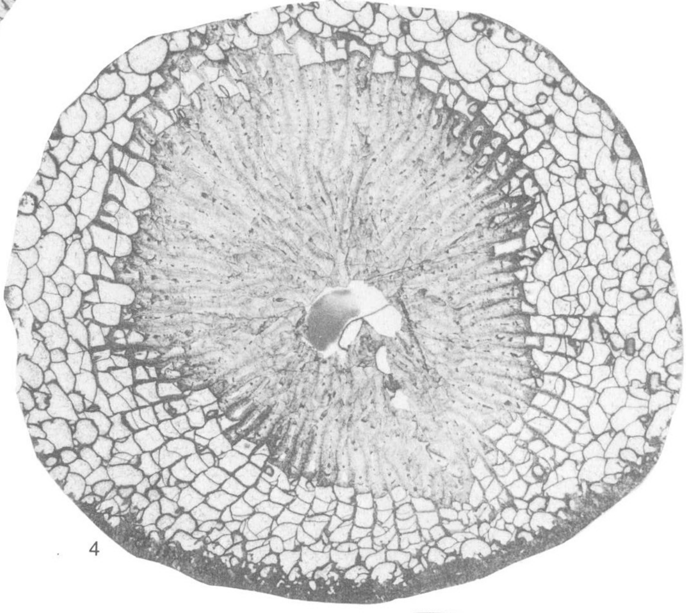
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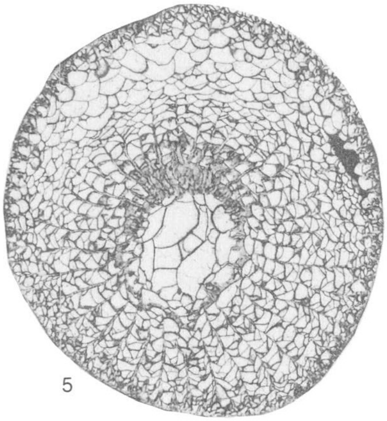
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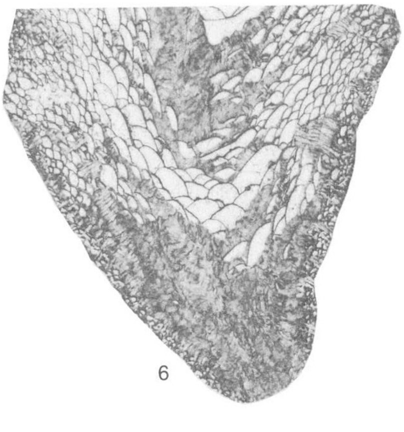
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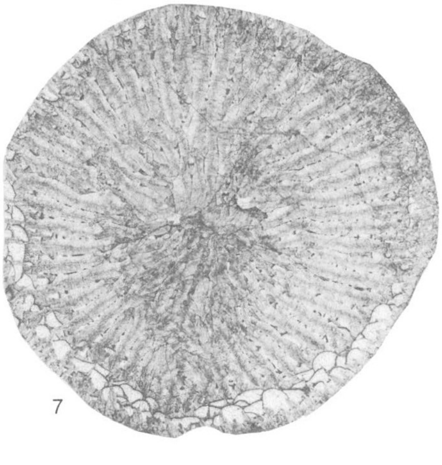
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PLATE 12

(All specimens from the upper Eifelian Hume Formation)

Digonophyllum powellense sp. nov.

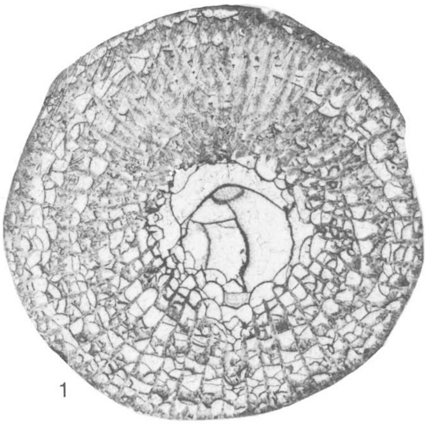
Figures 1, 2, 6. Paratype GSC 44885. GSC loc. C-3871. x2.

Figures 3-5. Paratype GMUS Cr 5. Hume River. x2.

Figures 7, 8. Paratype GSC 44886. GSC loc. C-3872. x2.

Digonophyllum rectum (Meek, 1867)

Figure 9. GSC 44844. GSC loc. C-3871. x2.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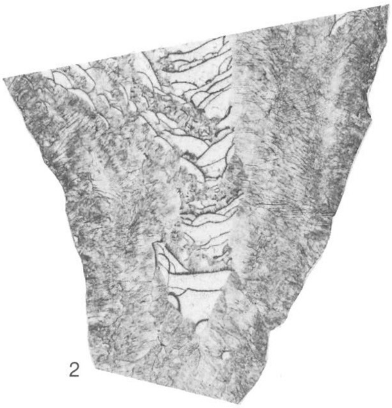
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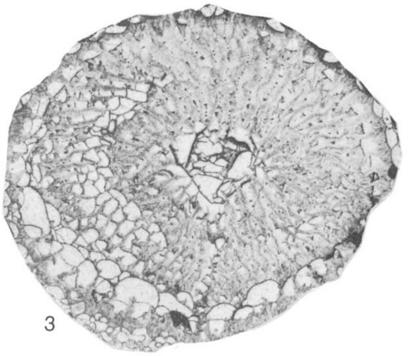
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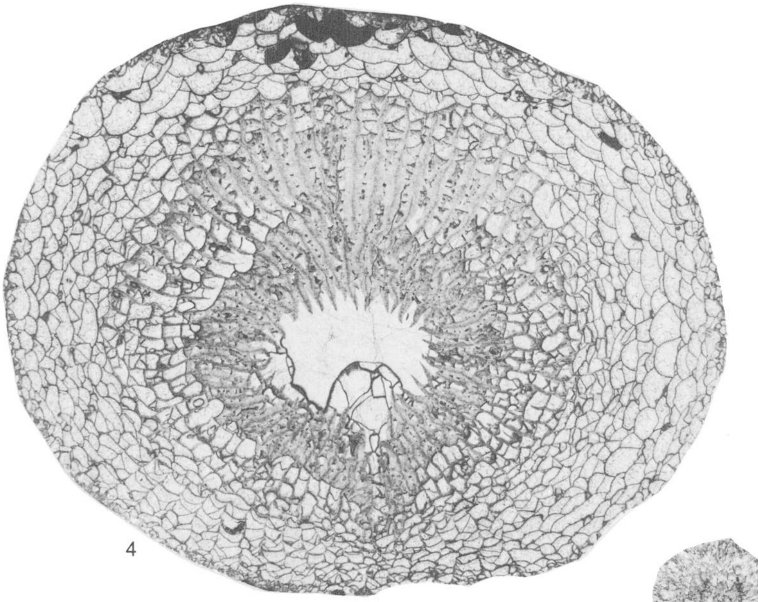
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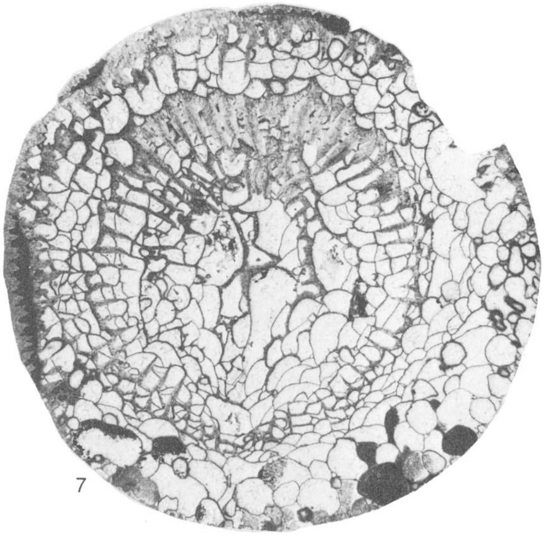
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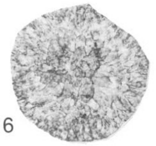
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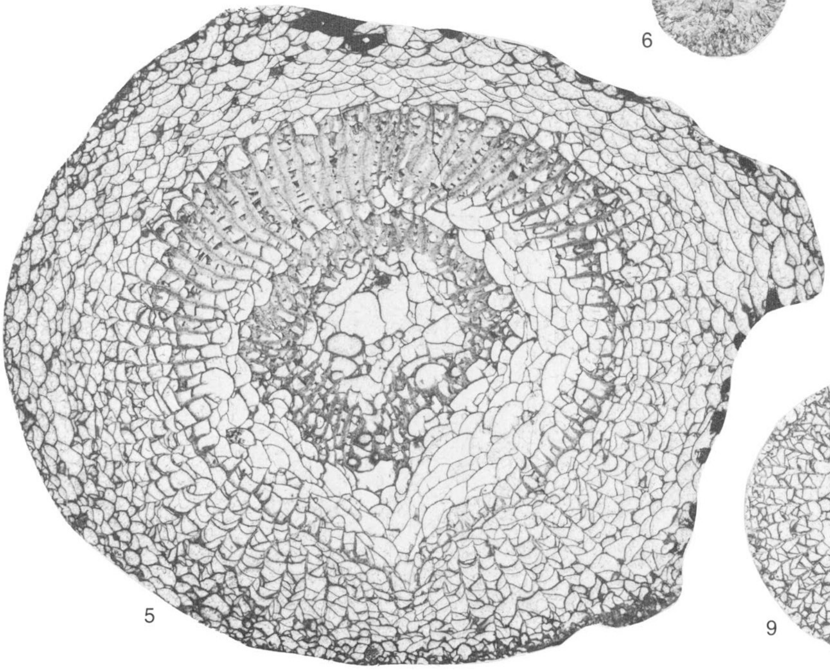
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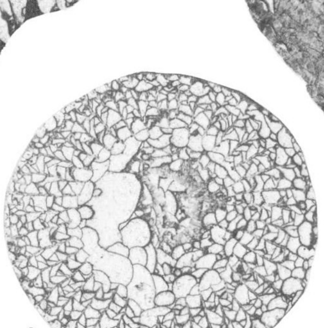
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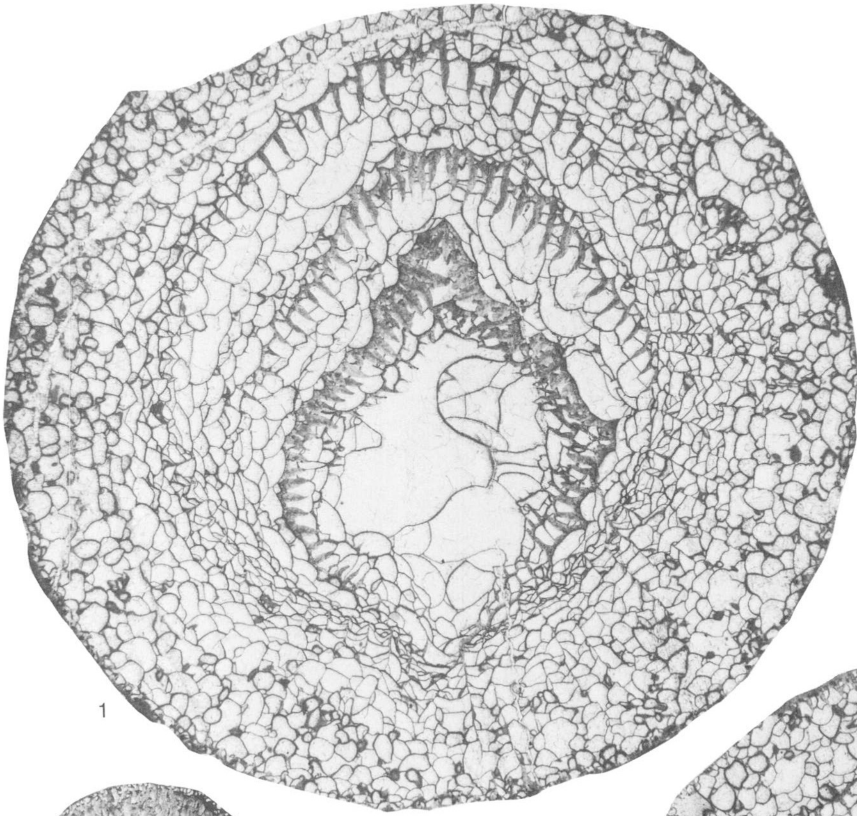
PLATE 13

(All specimens from the upper Eifelian Hume Formation)

Digonophyllum powellense sp. nov.

Figures 1, 2.	Paratype GMUS Cr 4. Hume River. x2.
Figures 3, 4.	Paratype GSC 44884. GSC loc. C-3871. x2. *See also* Pl. 1, fig. 16.
Figures 5-7.	Holotype GSC 44881. GSC loc. C-3871. x2.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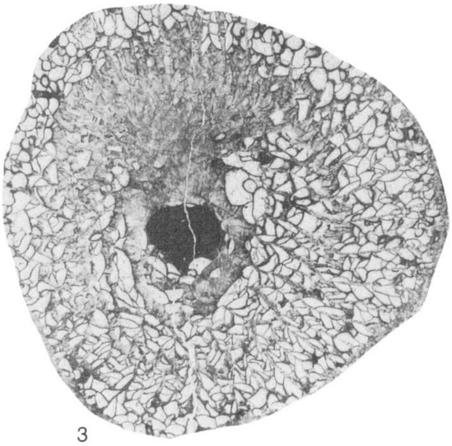
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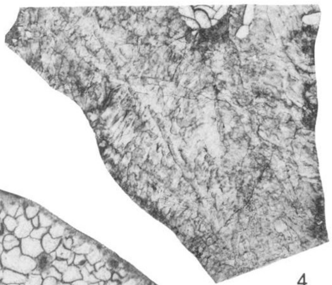
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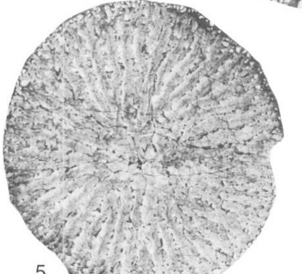
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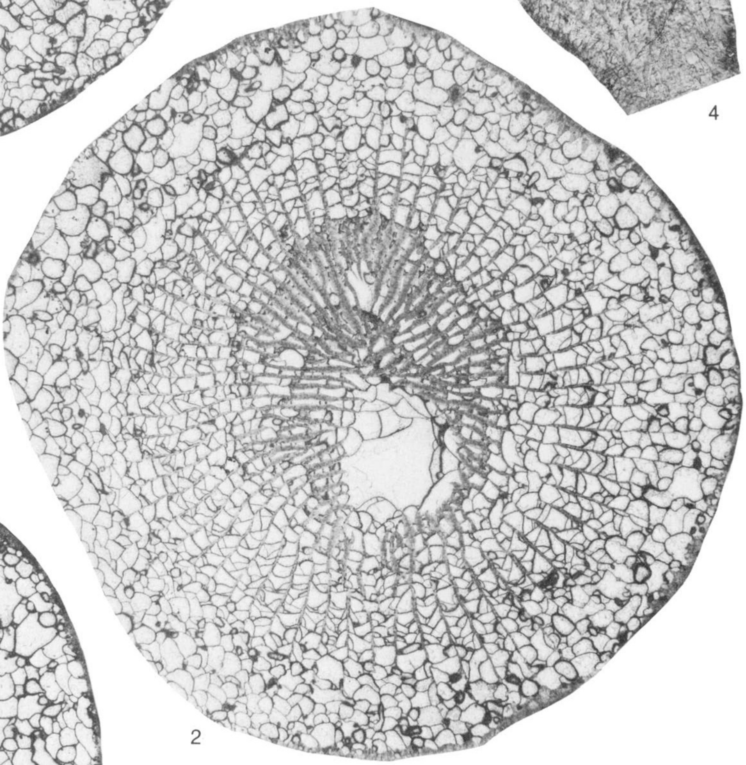
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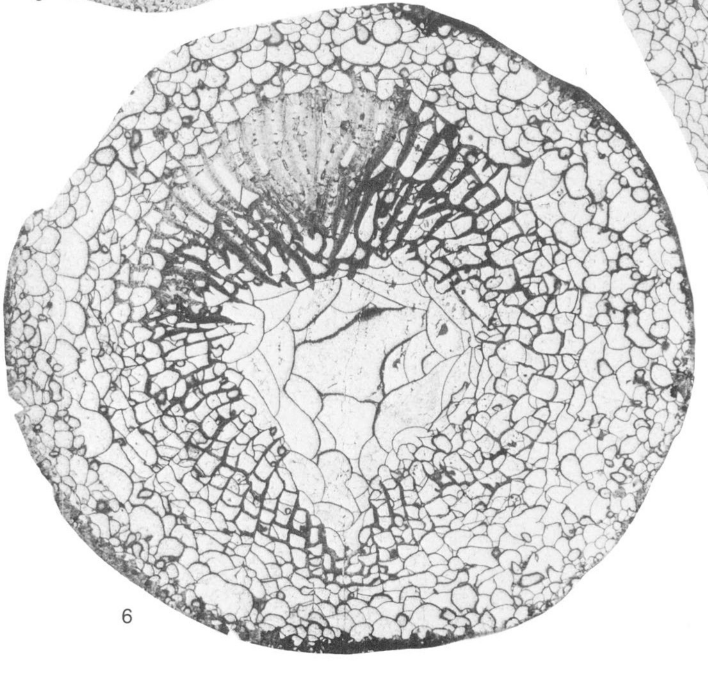
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PLATE 14

(All specimens from the upper Eifelian Hume Formation)

Digonophyllum rectum (Meek, 1867)

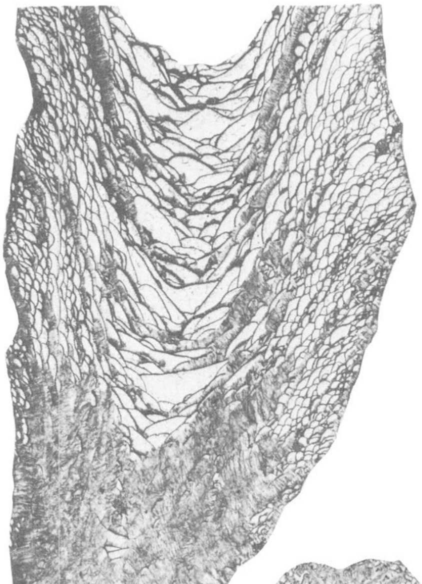
Figure 1. GSC 44847. GSC loc. C-3871. x2.

Figures 2-6. GSC 44853. GSC loc. C-3871. x2. *See also* Pl. 1, figs. 20, 21.

Figure 7. GSC 44866. GSC loc. C-25839. x2. *See also* Pl. 1, fig. 17.

Digonophyllum sp.

Figures 8, 9. GSC 44890. GSC loc. C-2537. x1.5.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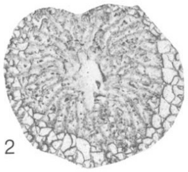
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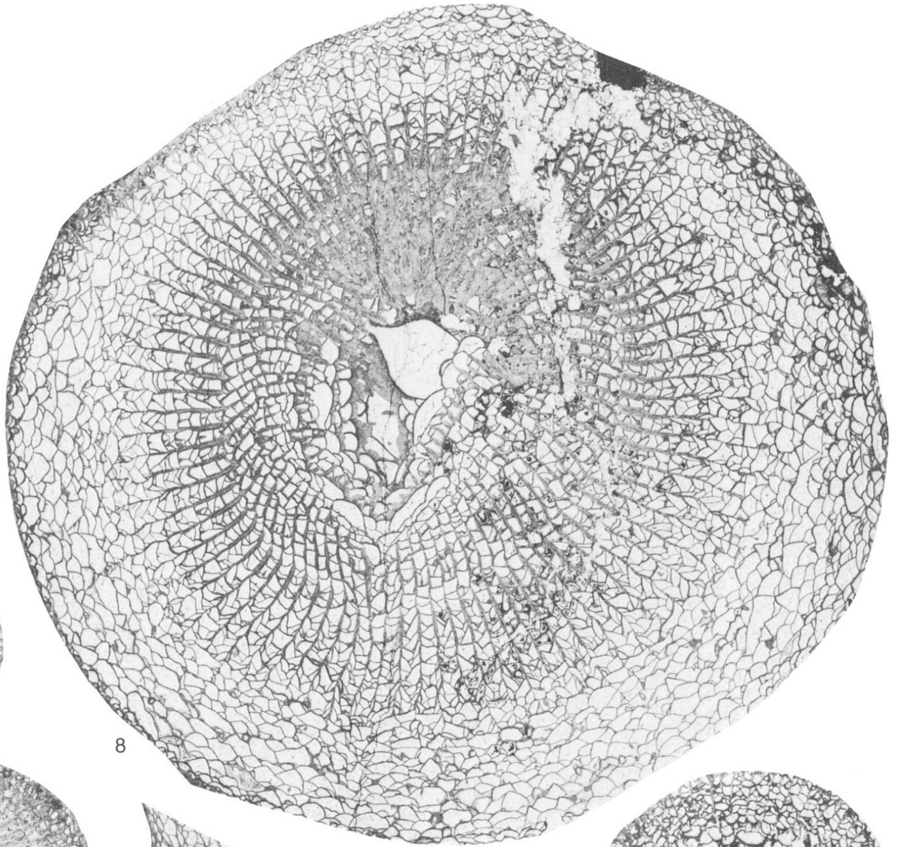
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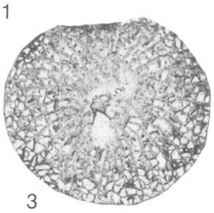
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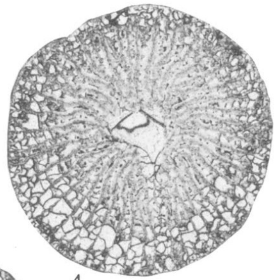
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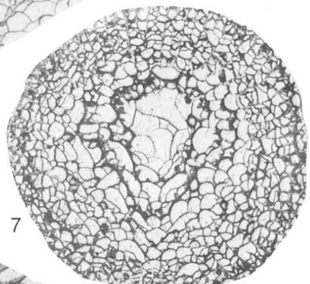
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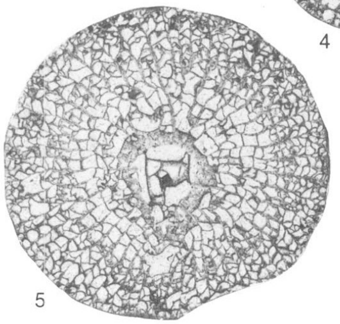
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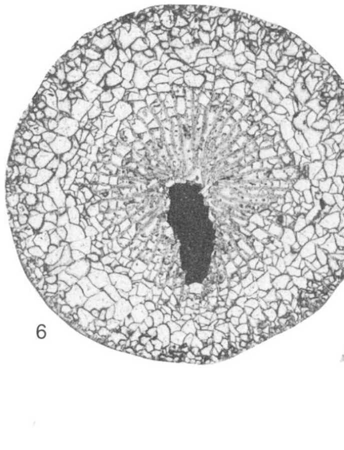
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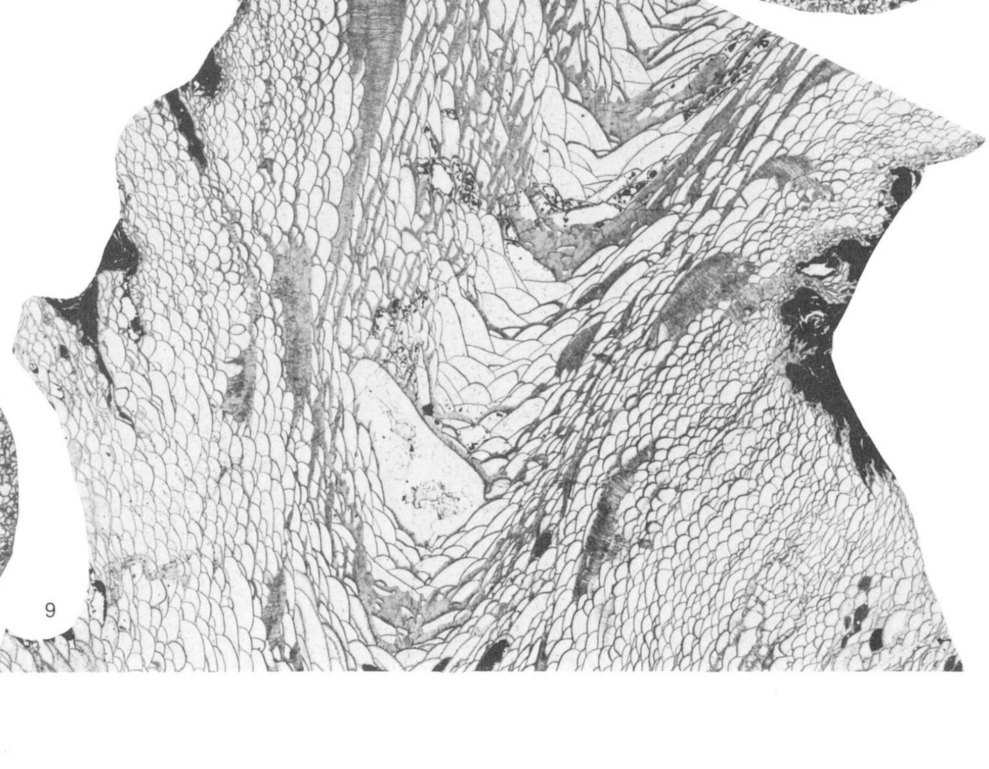
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PLATE 15

(All specimens from the upper Eifelian Hume Formation)

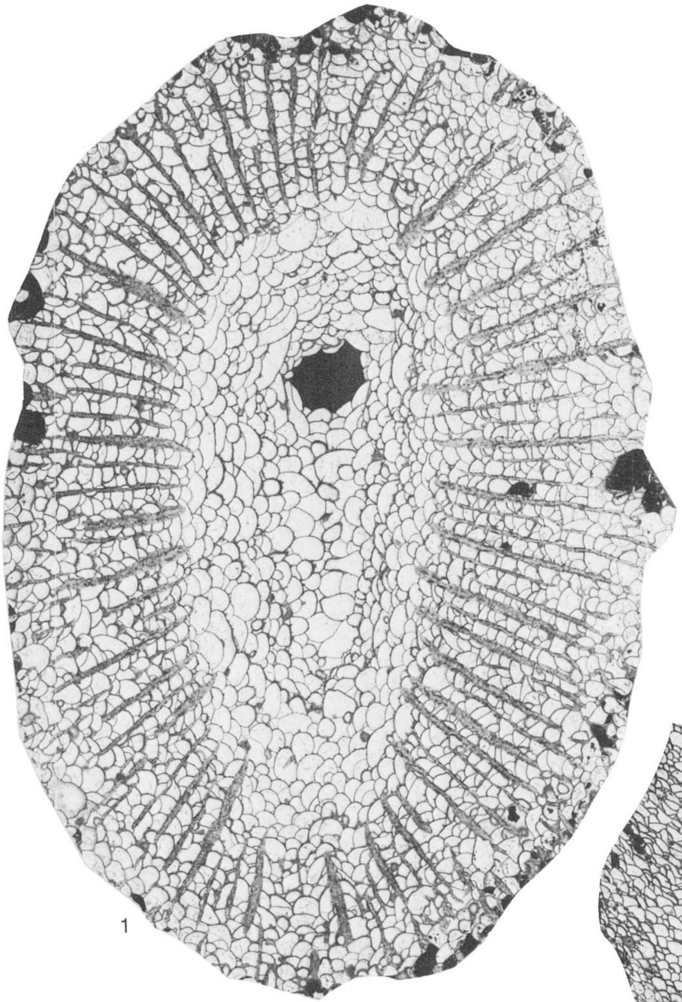
Lekanophyllum ellipticum sp. nov.

Figure 1. Holotype GSC 44891. GSC loc. C-2522. x1.5. *See also* Pl. 16, figs. 2, 4.

Figure 2. Paratype GMUS Cr 8. Transverse section showing septal microstructure. Hume River. x5. *See also* Pl. 16, fig. 1.

Digonophyllum sp.

Figures 3-5. GSC 44889. GSC loc. C-2522. x1.5.



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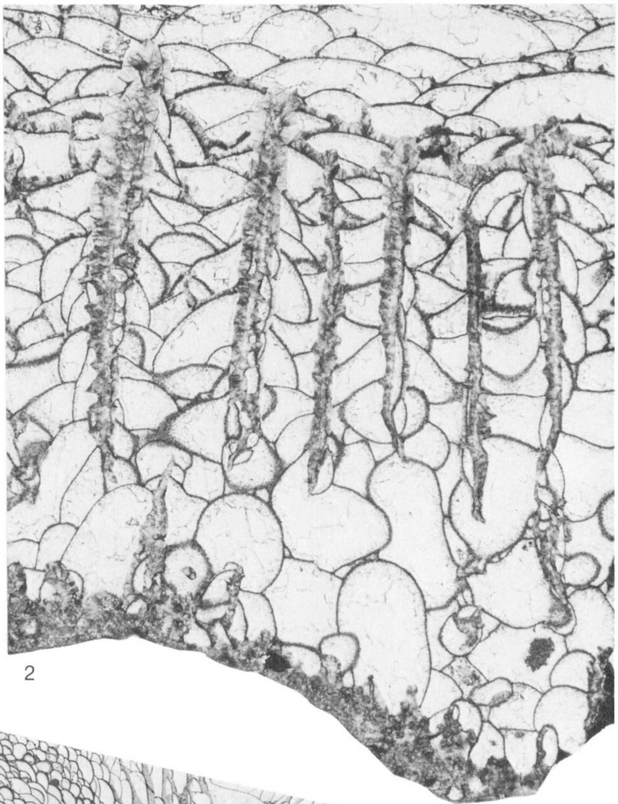

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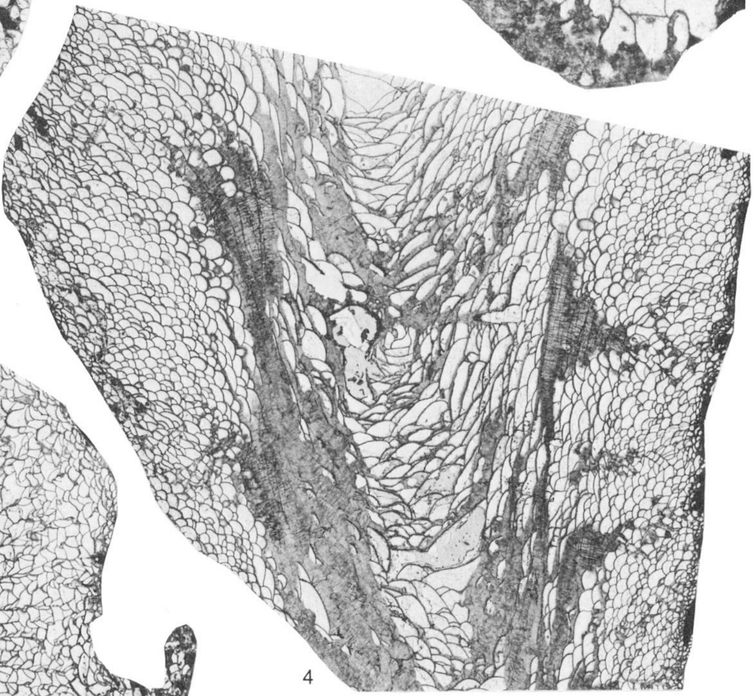

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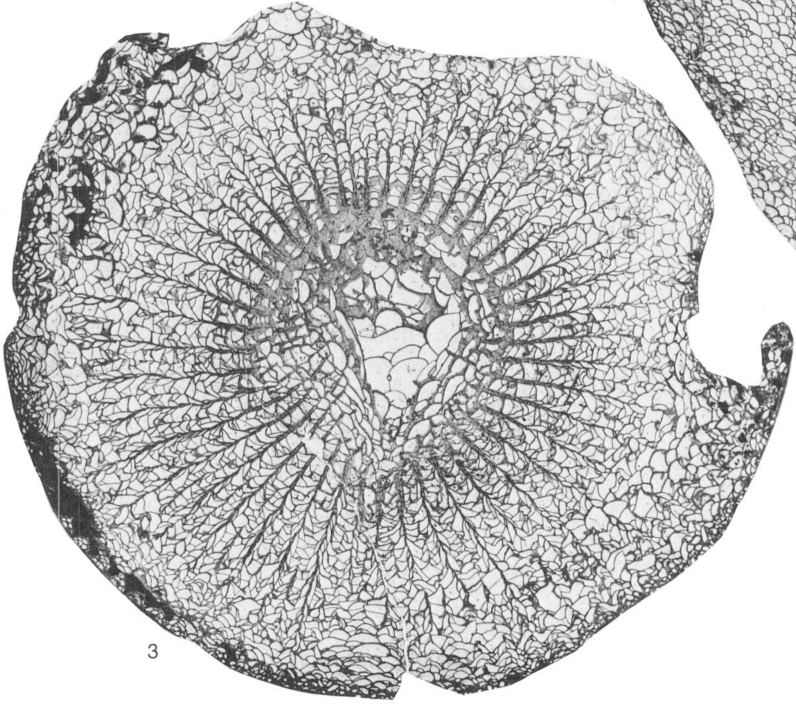

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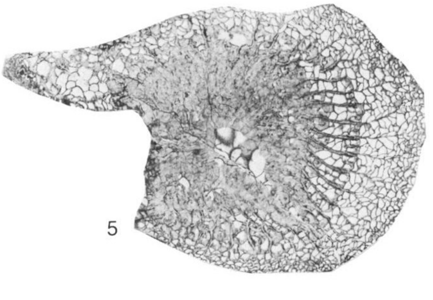

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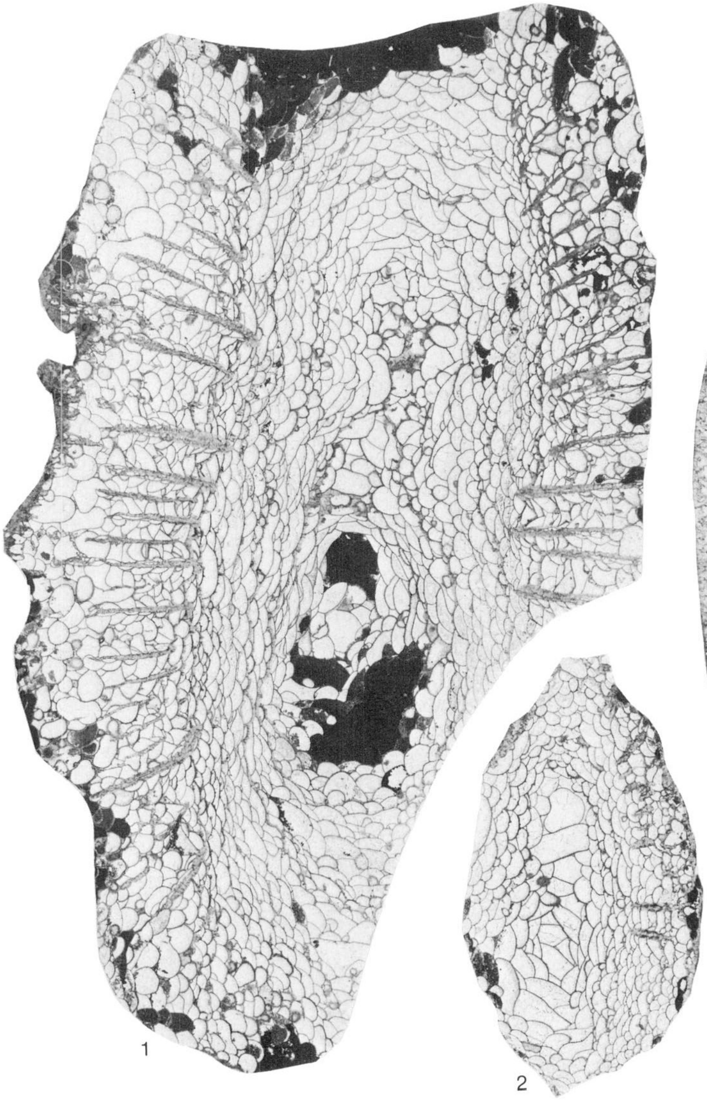
PLATE 16

(All specimens from the upper Eifelian Hume Formation)

Lekanophyllum ellipticum sp. nov.

Figure 1.	Paratype GMUS Cr 8. Hume River. x1.5. *See also* Pl. 15, fig. 2.
Figures 2, 4.	Holotype GSC 44891. GSC loc. C-2522. x1.5. *See also* Pl. 15, fig. 1.
Figure 3.	Paratype GSC 44892. GSC loc. C-2538. x1.5. *See also* Pl. 17, fig. 1.



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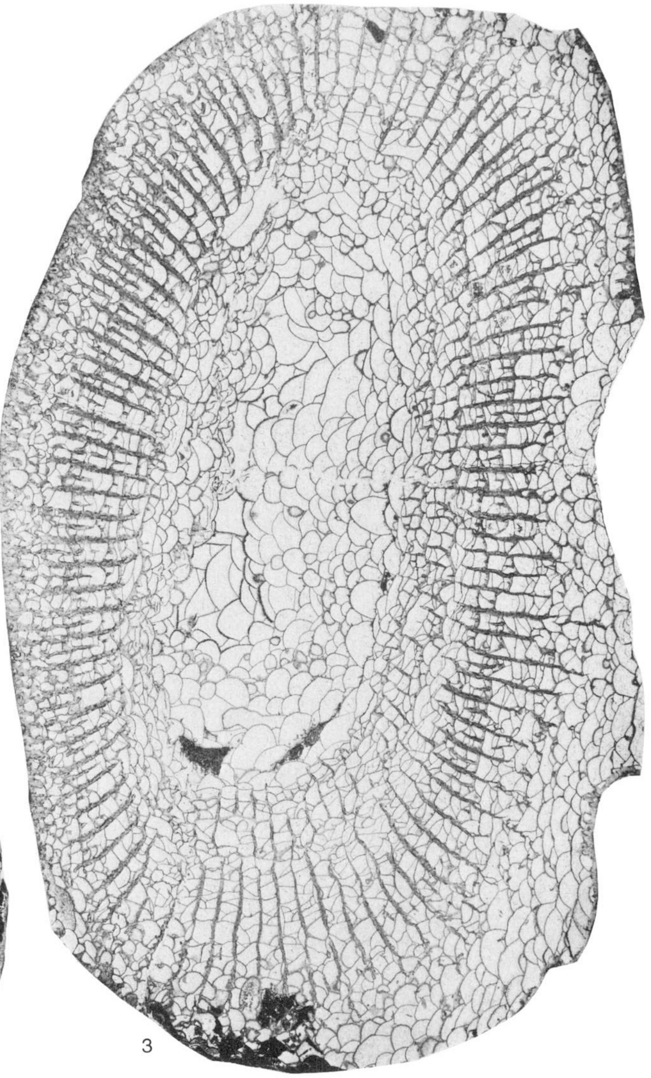

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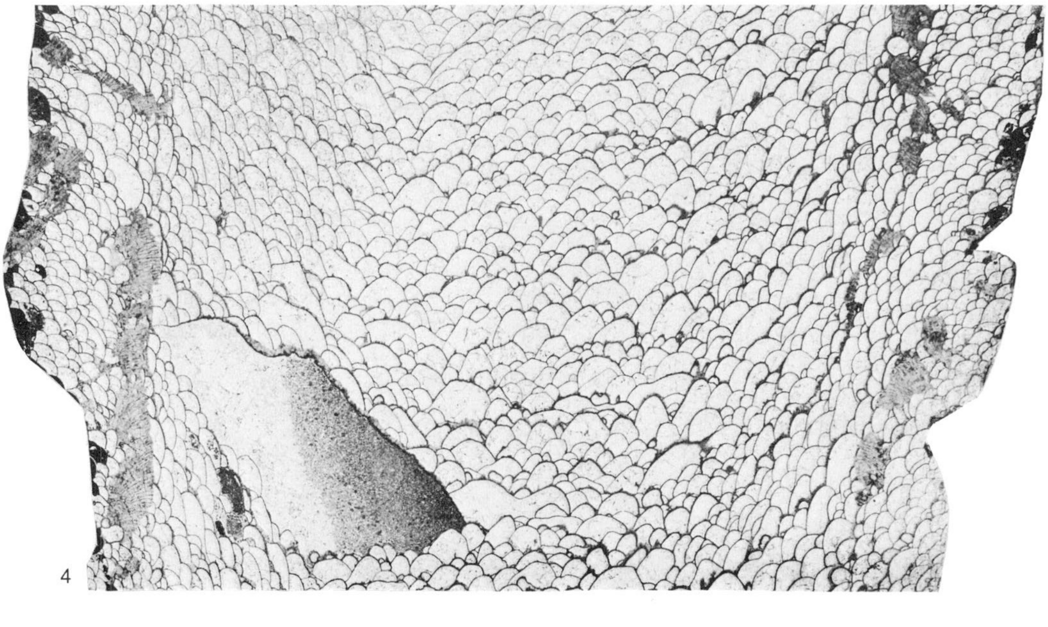

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PLATE 17

(All specimens from the upper Eifelian Hume Formation)

Lekanophyllum ellipticum sp. nov.

Figure 1. Paratype GSC 44892. GSC loc. C-2538. x1.5. *See also* Pl. 16, fig. 3.

Lekanophyllum mediale sp. nov.

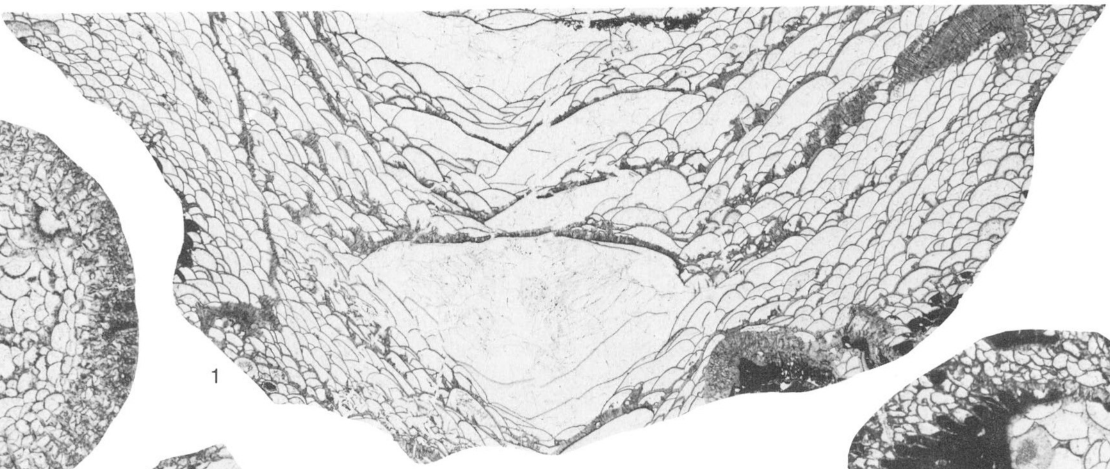
Figures 2-4. Paratype GSC 44899. GSC loc. C-3871. x3.

Figures 5-8. Paratype GSC 44894. Serial sections in sequence with Fig. 8 showing early stage attached to calice of another specimen of this species. x3.

Lekanophyllum andersonense? sp. nov.

Figures 9, 10. GMUS Cr 11. South limb of Imperial Anticline. x2.

PLATE 17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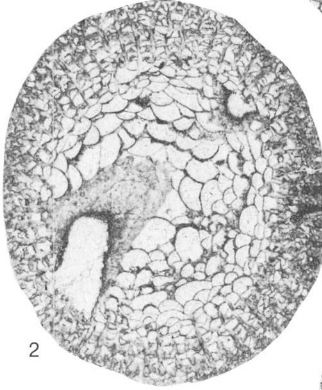
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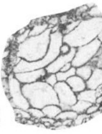
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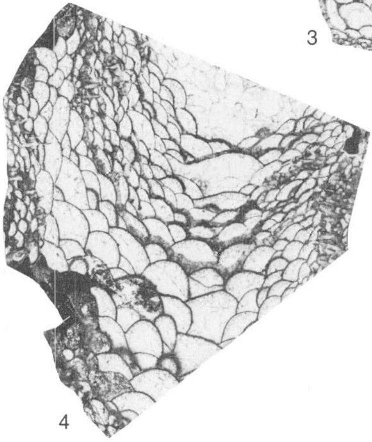
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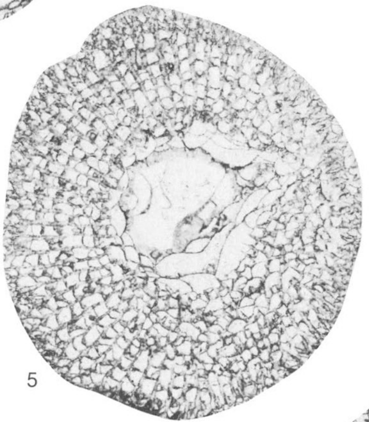
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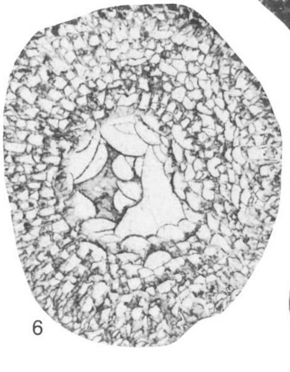
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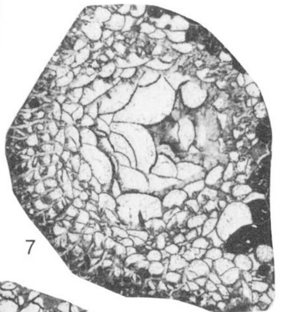
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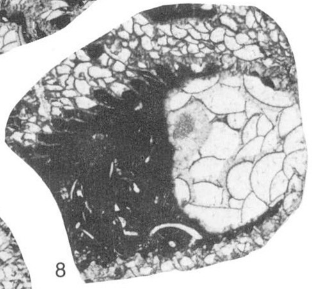
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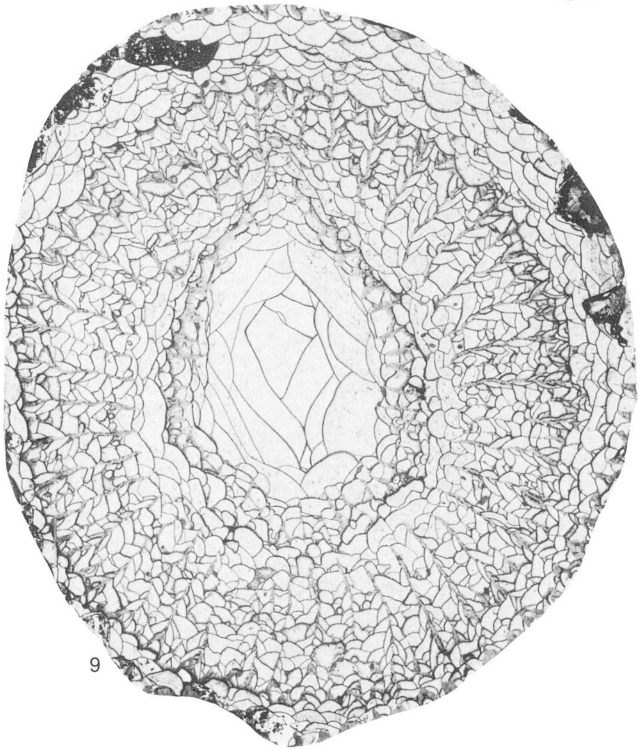
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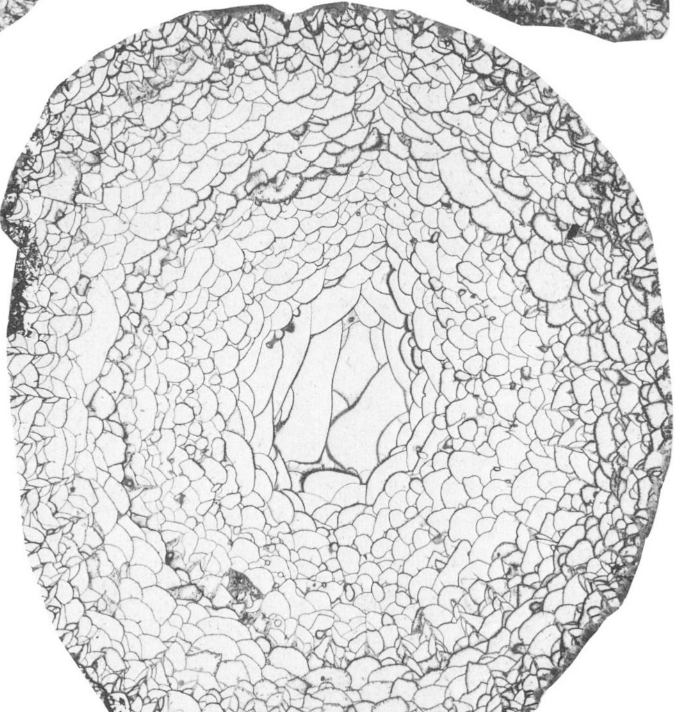
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PLATE 18

(All specimens from the upper Eifelian Hume Formation)

Lekanophyllum aff. *andersonense* sp. nov.

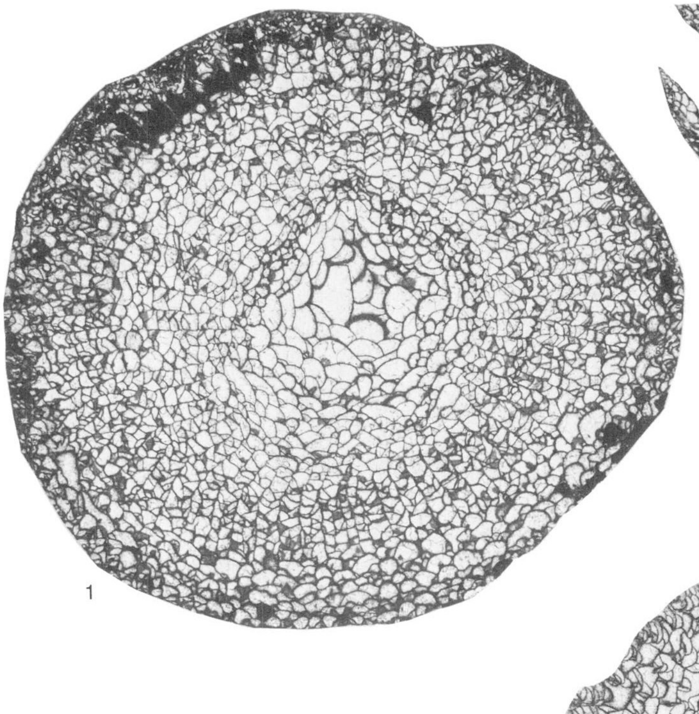
Figures 1, 2. GSC 44910. GSC loc. 49212. x2.

Lekanophyllum mediale sp. nov.

Figures 3, 4. Holotype GSC 44893. GSC loc. C-1828. x3. (Note holdfast development in lower left of Fig. 4.)

Lekanophyllum andersonense sp. nov.

Figure 5, 6. Paratype GSC 44903. Lenz collection, Canyon Creek. x2. (cf. Lenz, 1961, Pl. 2, figs. 3, 13).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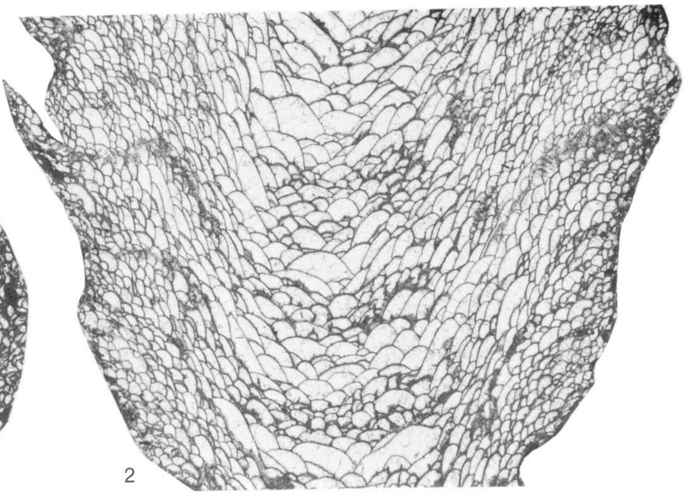
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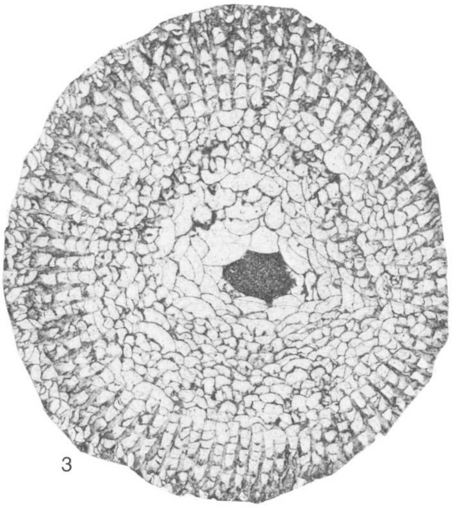
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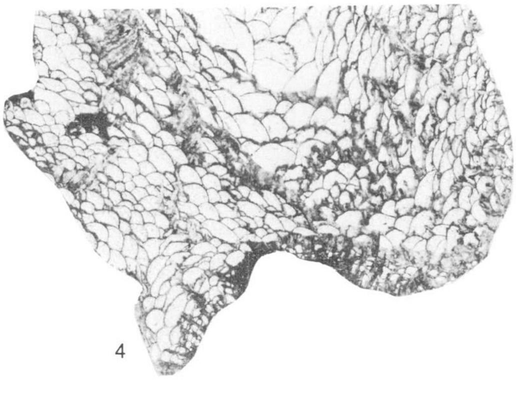
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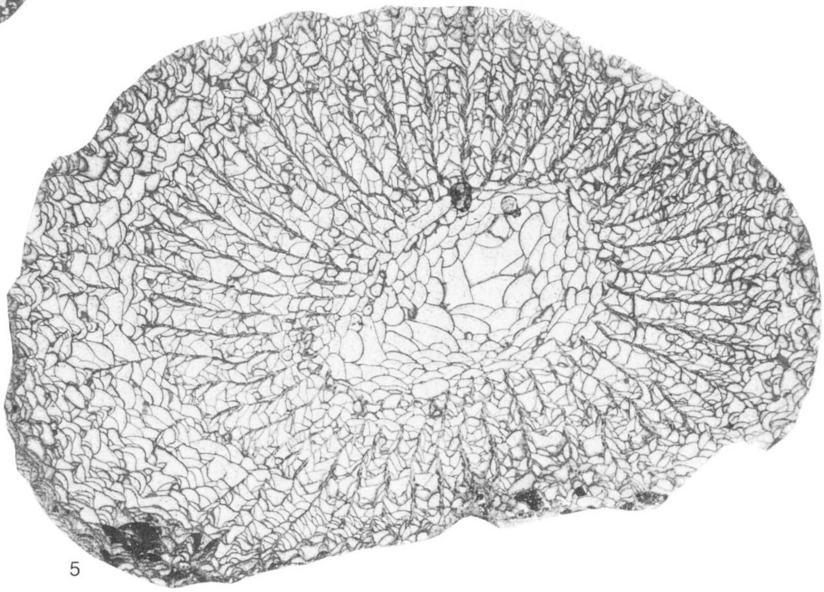
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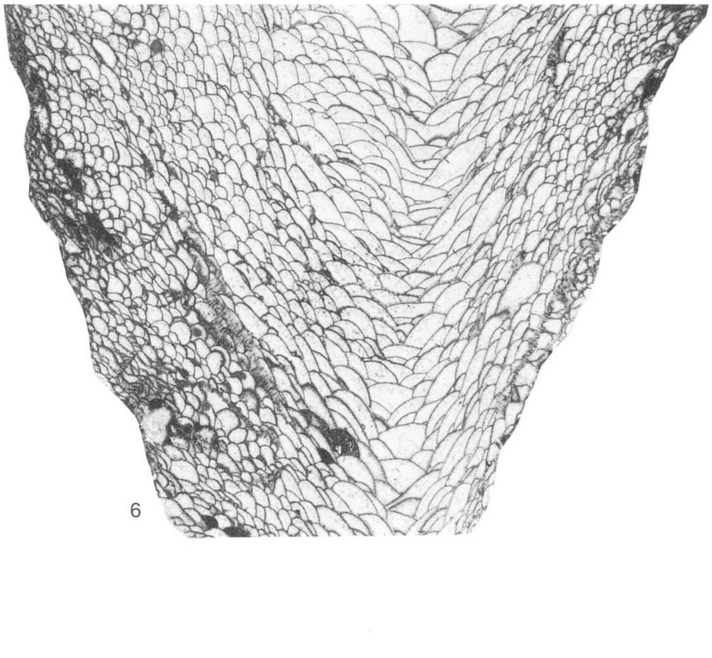
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PLATE 19

(All specimens from the upper Eifelian Hume Formation)

Lekanophyllum andersonense sp. nov.

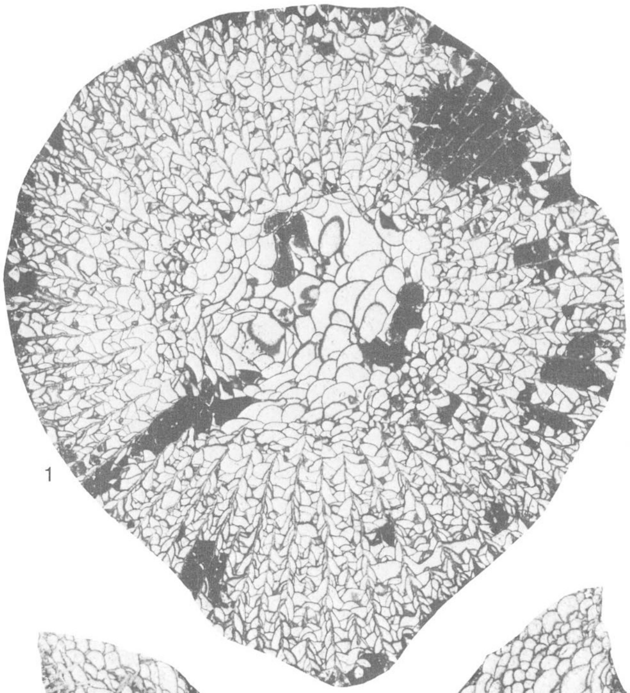
Figures 1, 2.	Paratype GSC 44905. GSC loc. C-2522. x2.
Figures 8-10.	Paratype GMUS Cr 9. Carnwath River. x2.

Lekanophyllum mediale sp. nov.

Figure 3.	Paratype GSC 44898. Turbinate form showing extensive distortion of corallite at right to form large supporting structure. GSC loc. C-3871. x3.

Lekanophyllum mediale? sp. nov.

Figures 4-7.	GSC 44901. GSC loc. C-2522. x3.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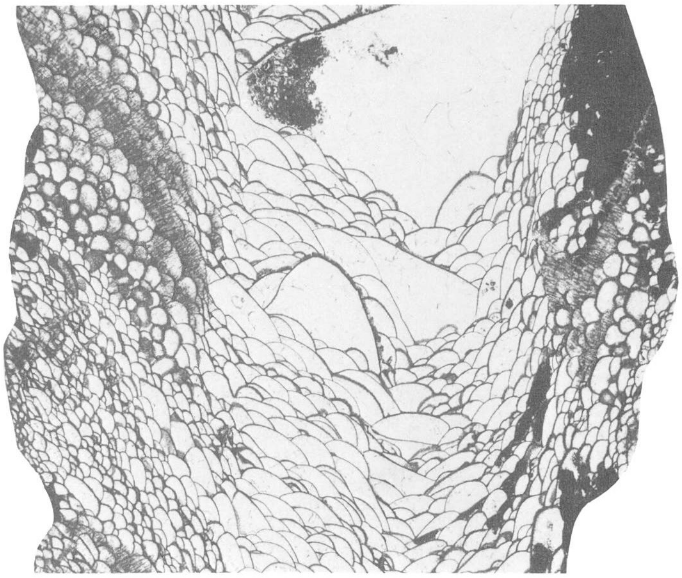
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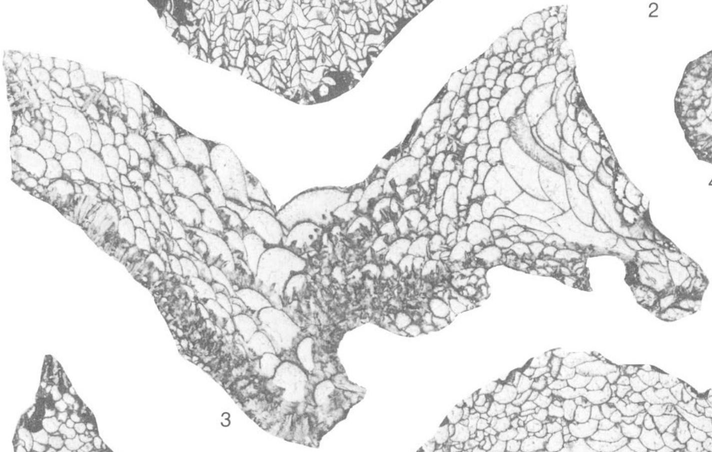
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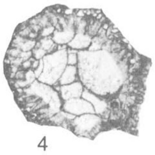
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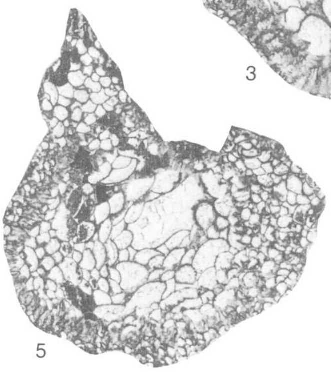
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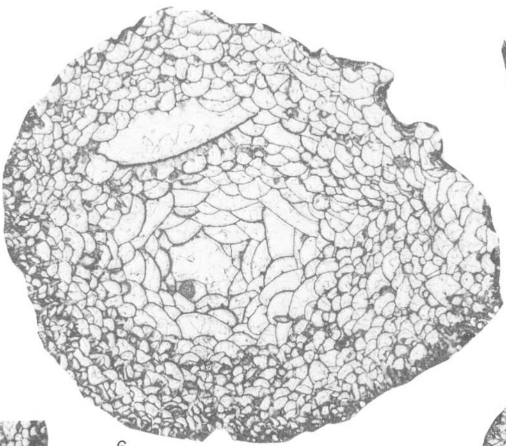
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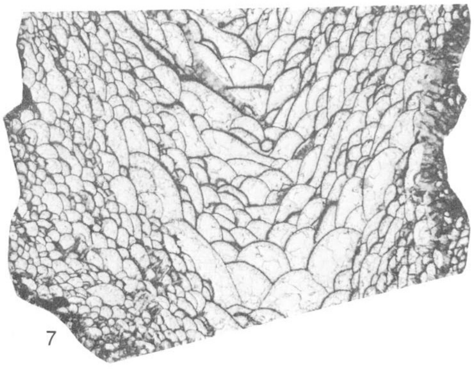
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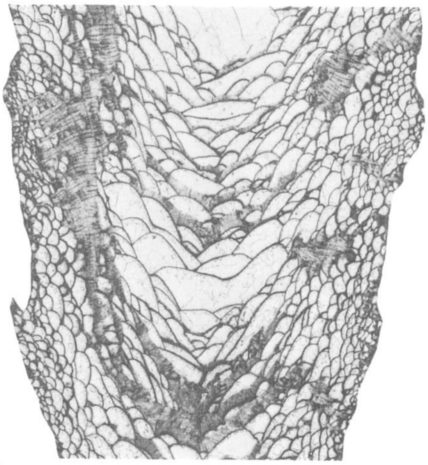
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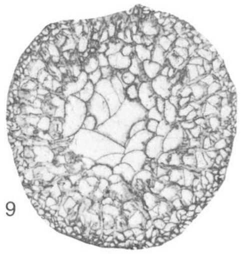
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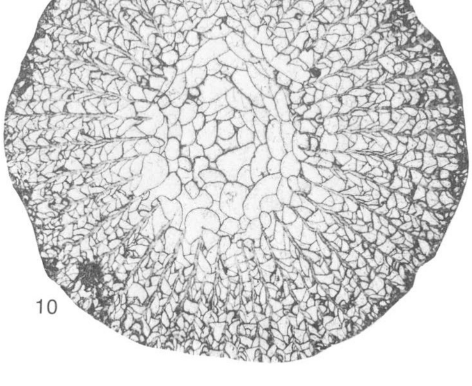
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PLATE 20

(All specimens from the upper Eifelian Hume Formation)

Lekanophyllum andersonense var. *major* var. nov.

Figures 1, 2. Holotype GSC 44911. GSC loc. C-2522. x1.5.

Lekanophyllum andersonense? sp. nov.

Figure 3. GMUS Cr 10. Hume River. x2. *See also* Pl. 21, fig. 5.

Lekanophyllum mediale? sp. nov.

Figure 4. GSC 44900. GSC loc. 49212. x3.


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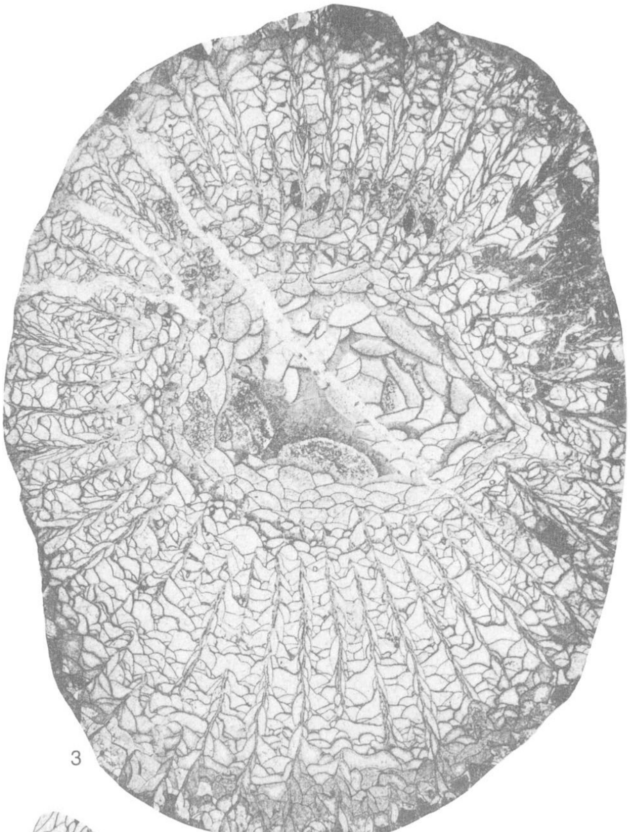
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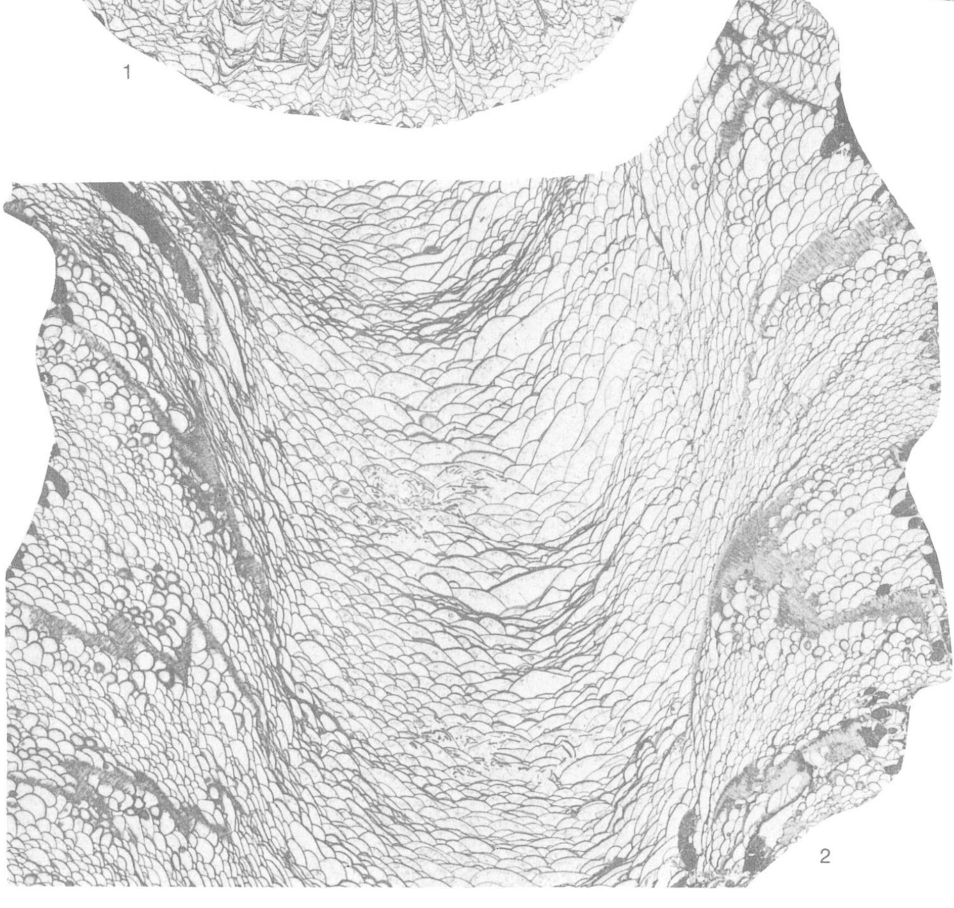
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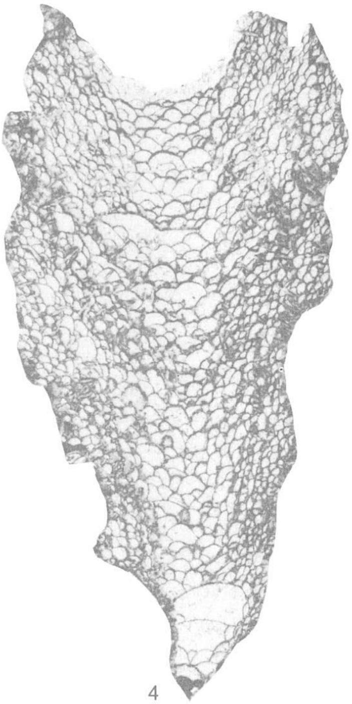
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PLATE 21

(All specimens from the upper Eifelian Hume Formation)

Lekanophyllum andersonense var. *major* var. nov.

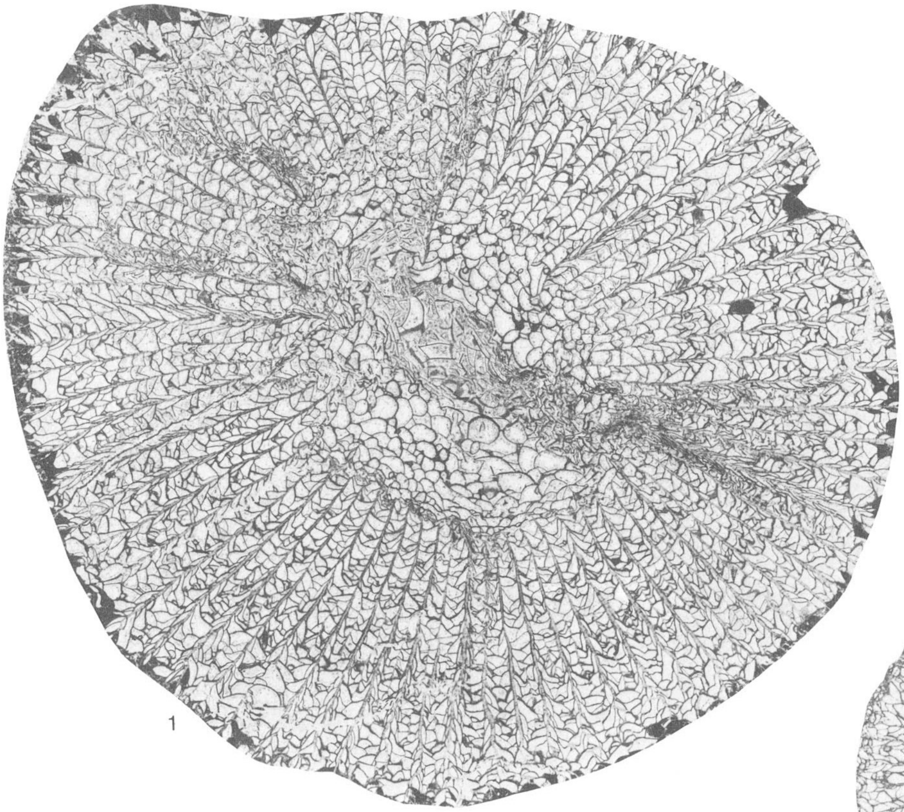
Figures 1, 2.	Paratype GSC 44912. GSC loc. C-2522. x1.5.

Lekanophyllum andersonense sp. nov.

Figures 3, 4, 6.	Holotype GSC 44902. GSC loc. 49148. x2.

Lekanophyllum andersonense? sp. nov.

Figure 5.	GMUS Cr 10. Hume River. x2. *See also* Pl. 20, fig. 3.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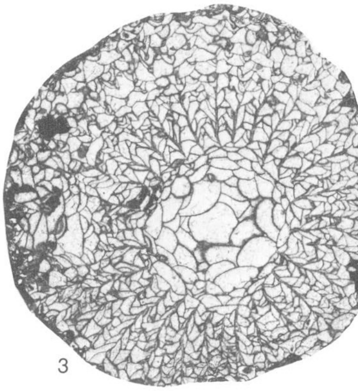
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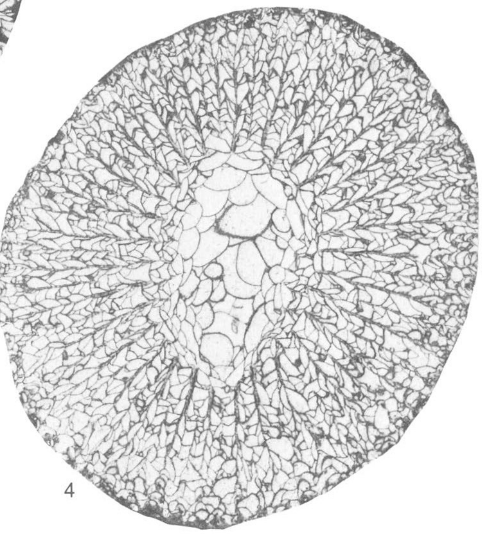
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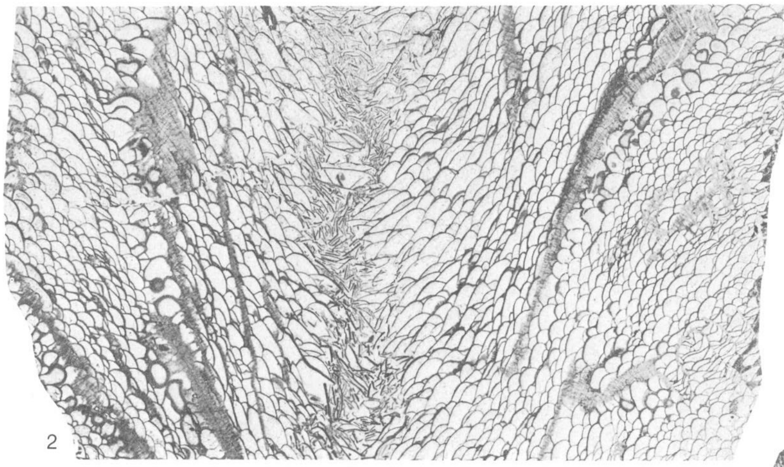
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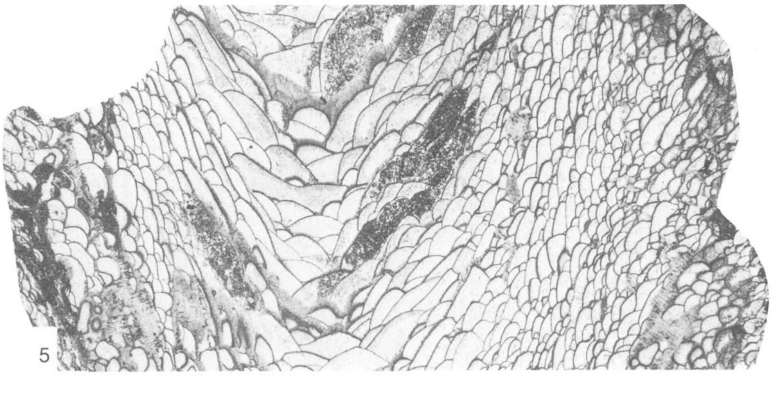
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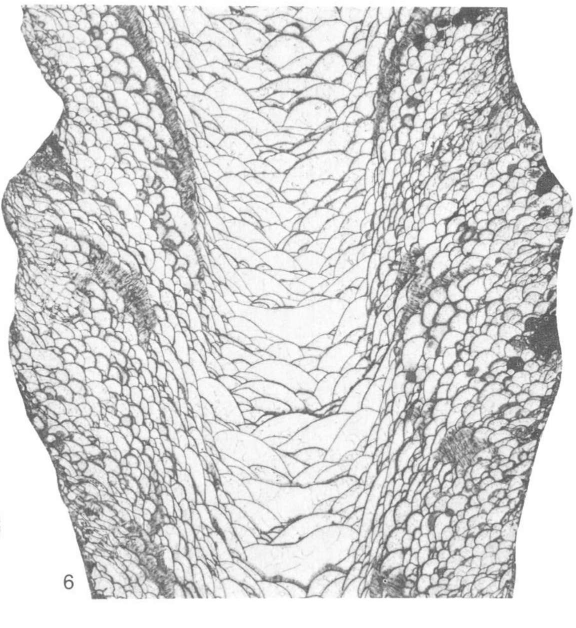
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PLATE 22

(Both specimens from the upper Eifelian Hume Formation)

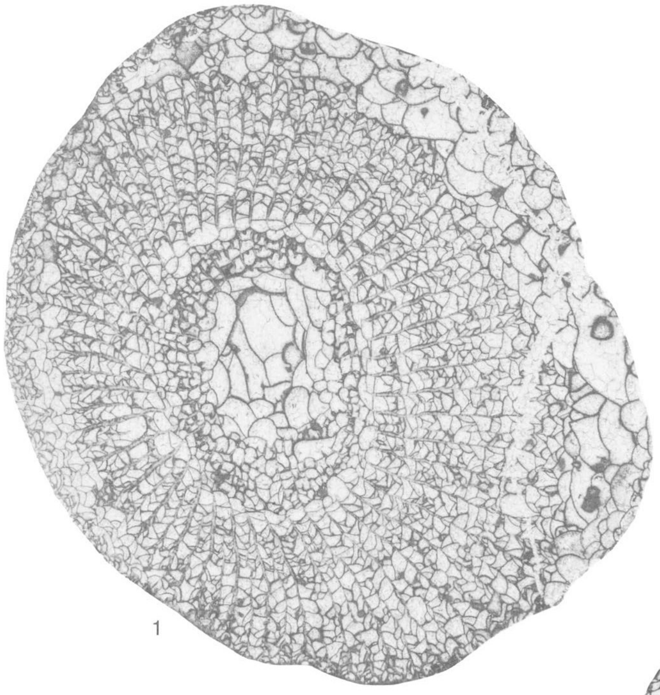
Lekanophyllum andersonense sp. nov.

Figures 1-4.	Paratype GSC 44908. GSC loc. C-2538. x2.

Lekanophyllum vescum? sp. nov.

Figures 5, 6.	GSC 44916. GSC loc. C-2522. x2. *See also* Pl. 23, fig. 6.

PLATE 22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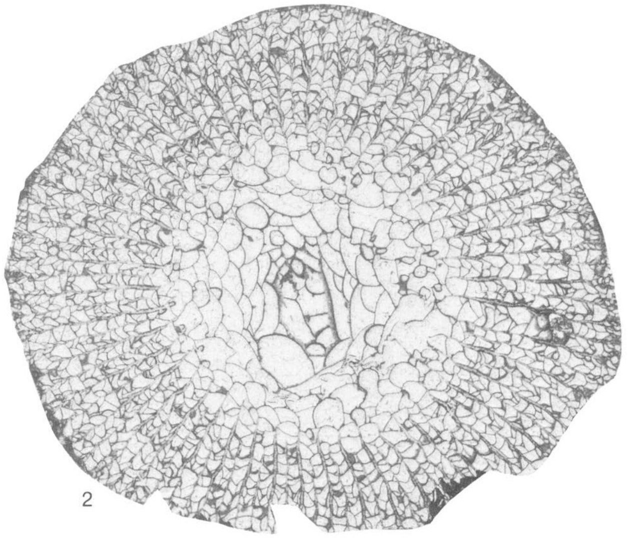
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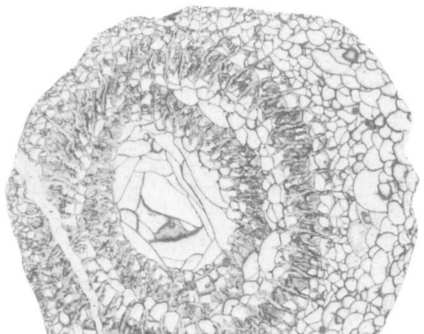
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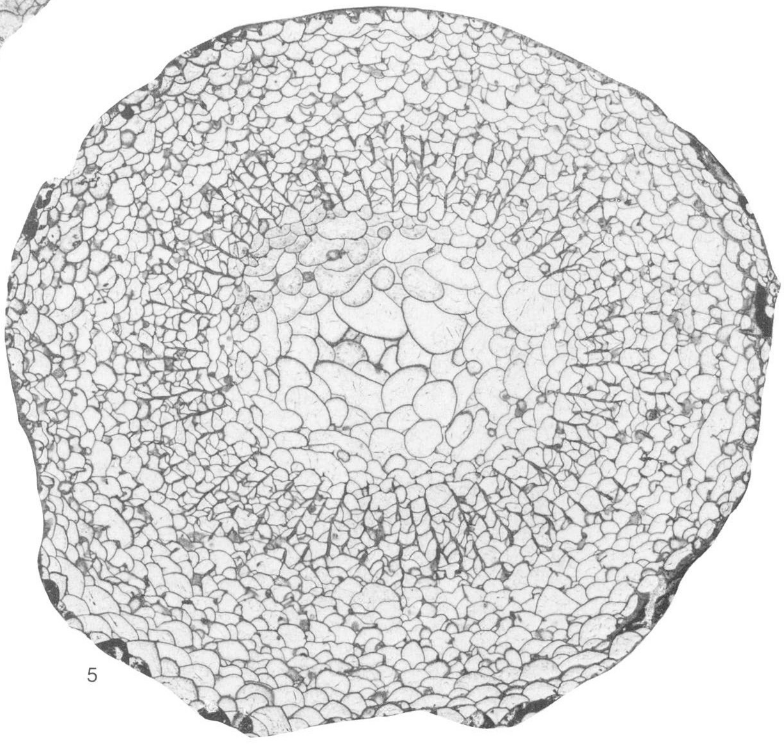
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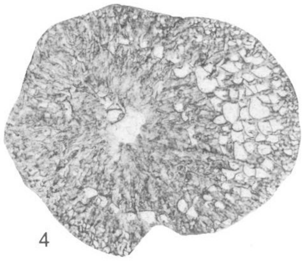
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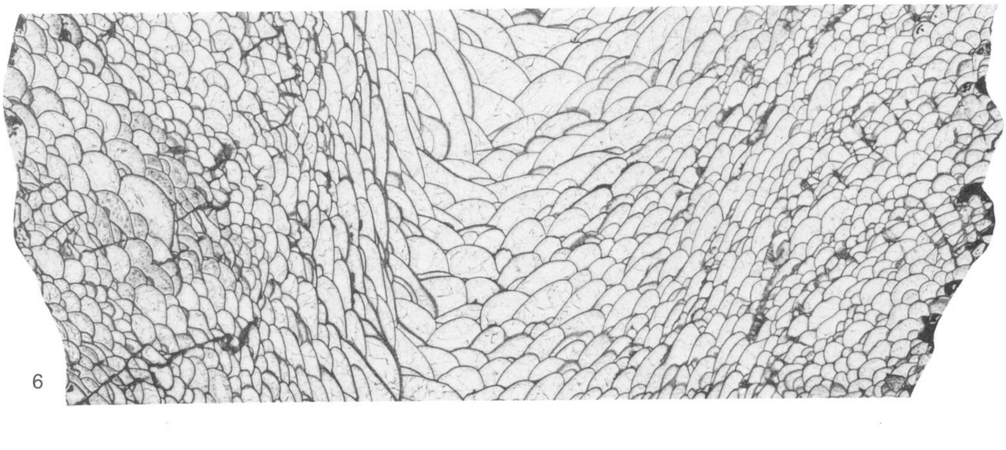
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PLATE 23

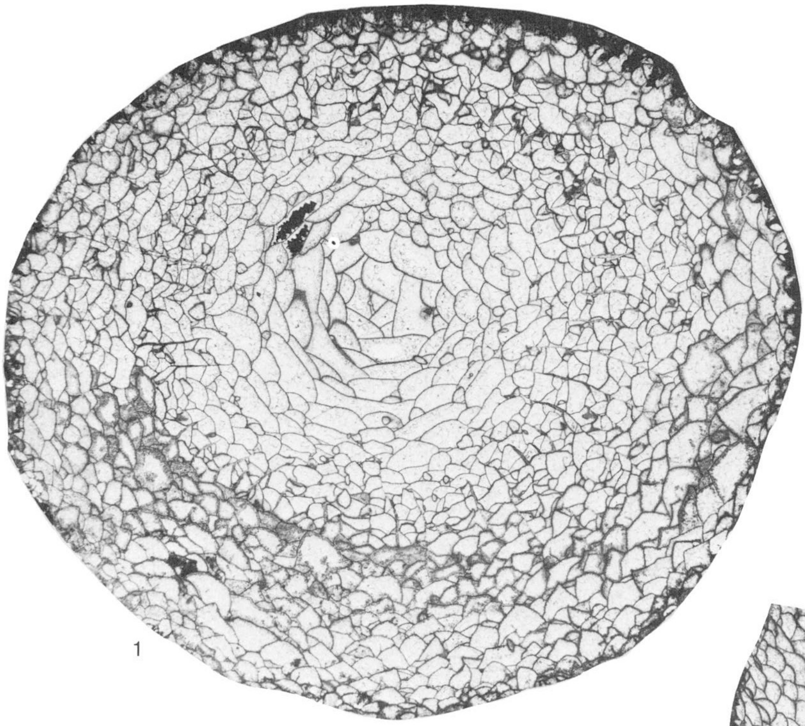
(All specimens from the upper Eifelian Hume Formation)

Lekanophyllum vescum sp. nov.

Figures 1, 2, 5.	Holotype GSC 44914. GSC loc. C-3866. x2.
Figures 3, 4.	Paratype GSC 44915. GSC loc. C-3867. x2.

Lekanophyllum vescum? sp. nov.

Figure 6.	GSC 44916. GSC loc. C-2522. x2. *See also* Pl. 22, figs. 5, 6.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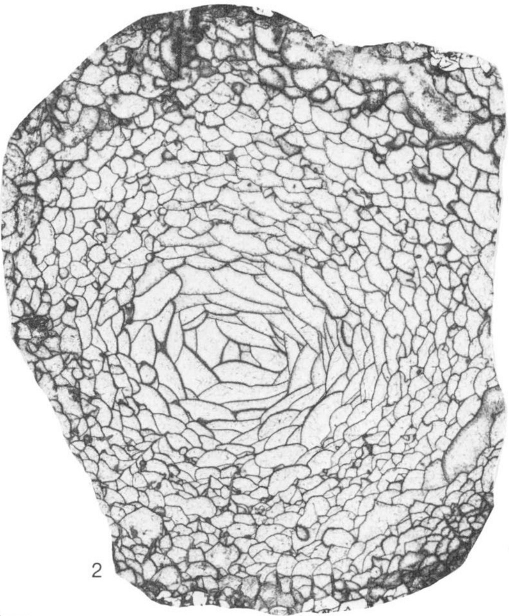
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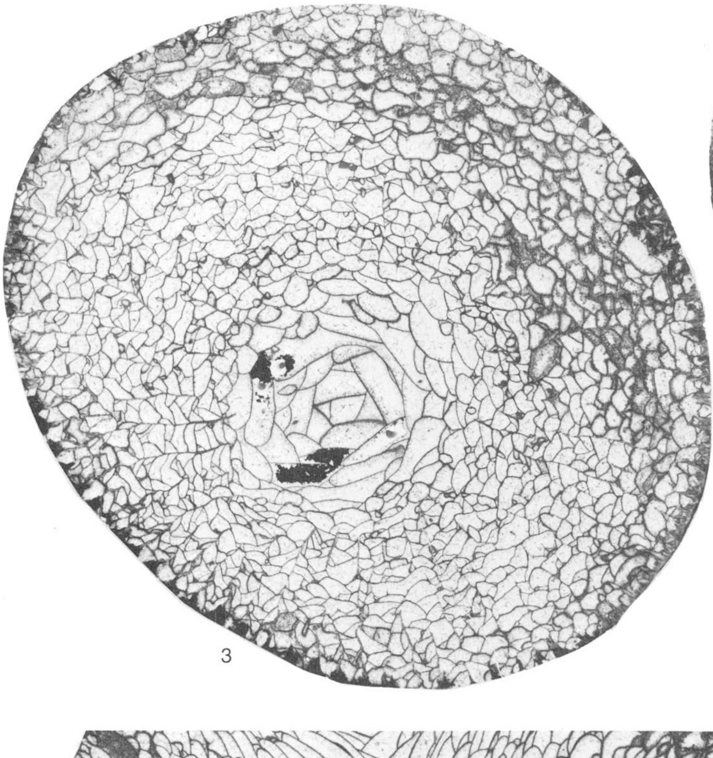
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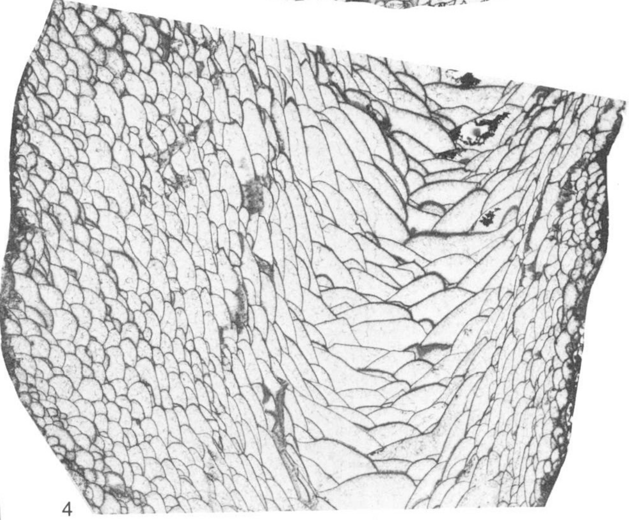
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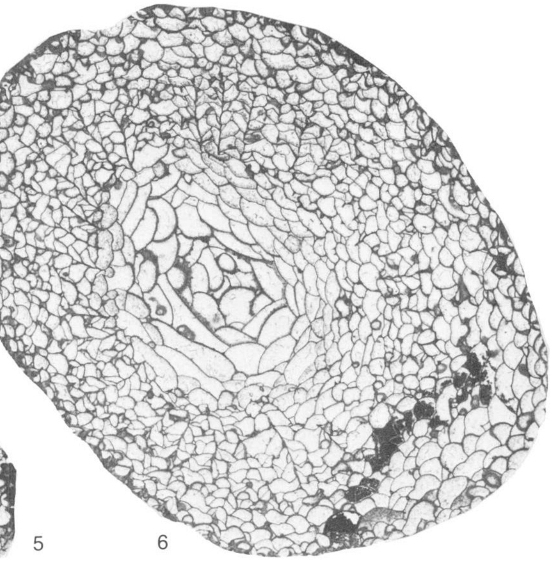
5


6

APPENDIX

LOCALITY INDEX FOR DESCRIBED CYSTIPHYLLIDS FROM THE HUME FORMATION

GSC localities

49101, Tributary of Bosworth Creek, near Norman Wells, approximately Latitude 65°18'N, Longitude 126°34'W; 35.1 to 39.6 m (115-130 ft) below top; collected by A.E.H. Pedder, 1959 (Textfig. 1, loc. 11).

49148 (=GSC loc. 37316), Anderson River, left bank, Latitude 68°31'45"N, Longitude 127°12'30"W; *adoceta* zone; collected by A.E.H. Pedder, 1959 (Textfig. 1, 1 c. 2).

49174, Anderson River, left bank, Latitude 68°31'40" N, Longitude 127°15'W; 23.8 to 60.4 m (78-198 ft) above base, 0 to 36.6 m (0-120 ft) below top; collected by A.E.H. Pedder, 1959 (Textfig. 1, loc. 3).

49212, Anderson River, right bank, Latitude 68°32' 30"N, Longitude 127°09'W; 0 to 0.6 m (0-2 ft) above base, *adoceta* zone; collected by A.E.H. Pedder, 19 9 (Textfig. 1, loc. 1).

C-149, Gayna River, Latitude 65°15'N, Longitude 129° 22'W; upper 3.0 m (10 ft); collected by W.S. MacKenzie, 1967 (Textfig. 1, loc. 19).

C-166, Flyaway Creek, Latitude 65°27'N, Longitude 132°01'W; approximately 91.4 m (300 ft) above base, 99.7 m (327 ft) below top; collected by W.S. MacKenzie, 1967 (Textfig. 1, loc. 21).

C-1803a, Prohibition Creek, Latitude 65°12'N, Longitude 126°09'W; *adoceta* zone; collected by W.S. MacKenzie, 1968 (Textfig. 1, loc. 14).

C-1826, Anderson River, Latitude 68°22'N, Longitude 127°58'W; about 12.2 m (40 ft) above base of exposed part; collected by W.S. Mackenzie, 1968 (Textfig. 1, loc. 5).

C-1828, Anderson River, Latitude 68°22'N, Longitude 127°58'W; about 21.3 m (70 ft) above base of exposed part; collected by W.S. MacKenzie, 1968 (Textfig. 1, loc. 5).

C-1830, Anderson River (east section), Latitude 68° 26'N, Longitude 127°33'W; about 20.4 m (67 ft) below top; collected by W.S. MacKenzie, 1968 (Textfig. 1, loc. 4).

C-2521, Carnwath River, right bank, Latitude 67°23' N, Longitude 127°44'W; isolated outcrop of approximately 12.2 m (40 ft) thickness, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1968 (Textfig. 1, loc. 8).

C-2522, Carnwath River, right bank, Latitude 67°32' N, Longitude 127°56'30"W; isolated outcrop of approximately 13.7 m (45 ft) thickness, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1968 (Textfig. 1, loc. 7).

C-2535, Sam MacRae Lake, southwest side, Latitude 65° 57'N, Long. 127°15'W; 64.0 to 67.1 m (210-220 ft) above base, 9.1 to 12.2 m (30-40 ft) below exposed top, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1968 (Textfig. 1, loc. 10).

C-2536, Sam MacRae Lake, southwest side, Latitude 65°57'N, Longitude 127°15'W; 16.8 to 21.3 m (55-70 ft) above base, 57.9 to 59.4 m (180-195 ft) below exposed top, *adoceta* zone; collected by A.E.H. Pedder, 1968 (Textfig. 1, loc. 10).

C-2537, Sam MacRae Lake, southwest side, Latitude 65°57'N, Longitude 127°15'W; talus from upper 16.8 m (55 ft) of 76.2 m (250 ft) section, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1968 (Textfig. 1, loc. 10).

C-2538, Scarp on north side of Echo Bend on Hare Indian River, Latitude 66°20'30"N, Longitude 127°17'30"W; 3.7 m (12 ft) cliff at or very close to the top of formation, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1968 (Textfig. 1, loc. 9).

C-3077, Anderson River, Latitude 68°26'N, Longitude 127°32'W; top of formation; collected by H.R. Balkwill, 1968 (Textfig. 1, loc. 4).

C-3861, Powell Creek, Latitude 65°16'30"N, Longitude 128°46'W; 87.5 to 90.5 m (287-297 ft) above base, 43.0 to 46.0 m (141-151 ft) below top, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1969 (Textfig. 1, loc. 16).

C-3866, Powell Creek, Latitude 65°16'30"N, Longitude 128°46'W; 103.0 to 104.5 m (338-343 ft) above base, 29.0 to 30.5 m (95-100 ft) below top, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1969 (Textfig. 1, loc. 16).

C-3869, Powell Creek, Latitude 65°16'30"N, Longitude 128°46'W; 110.6 to 114.3 m (363-375 ft) above base, 19.2 to 22.9 m (63-75 ft) below top, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1969 (Textfig. 1, loc. 16).

C-3871, Powell Creek, Latitude 65°16'30"N, Longitude 128°46'W; 117.7 to 131.1 m (386-430 ft) above base, 2.4 to 15.8 m (8-52 ft) below top, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1969 (Textfig. 1, loc. 16).

C-3872, Powell Creek, Latitude 65°16'30"N, Longitude 128°46'W; 129.5 to 131.1 m (425-430 ft) above base, 2.4 to 4.0 m (8-13 ft) below top, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1969 (Textfig. 1, loc. 16).

C-12120, Prohibition Creek, west fork, Latitude 65° 12'30"N, Longitude 126°13'W; 35.7 to 38.1 m (117-125 ft) above base, 76.2 to 78.6 m (250-258 ft) below top, *adoceta* zone; collected by A.E.H. Pedder, 1971 (Textfig. 1, loc. 13).

C-24639, Hume Formation type section, Latitude 65° 19'45"N, Longitude 129°59'W; 39.0 to 40.8 m (128-134 ft) above base, 73.8 to 75.6 m (242-248 ft) below top, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1972 (Textfig. 1, loc. 20).

C-24640, Hume Formation type section, Latitude 65° 19'45"N, Longitude 129°59'W; 40.8 to 41.1 m (134-135 ft) above base, 73.5 to 73.8 m (241-242 ft) below top, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1972 (Textfig. 1, loc. 20).

C-24674, Hume Formation type section, Latitude 65° 19'45"N, Longitude 129°59'W; talus from upper 4.3 m (14 ft) of formation, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1972 (Textfig. 1, loc. 20).

C-25838, Gayna River gorge, Latitude 65°24'45"N, Longitude 129°11'15"W; talus 100.3 to 102.7 m (329-337 ft) above base, 0 to 2.4 m (0-8 ft) below top, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1972 (Textfig. 1, loc. 18).

C-25839, Bell Creek, Latitude 65°17'N, Longitude 128°53'30"W; 7.3 to 9.1 m (24-30 ft) below top, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1972 (Textfig. 1, loc. 17).

C-25841, Bell Creek, Latitude 65°17'N, Longitude 128°53'30"W; 4.3 to 6.1 m (14-20 ft) below top, *dysmorphostrota* zone; collected by A.E.H. Pedder, 1972 (Textfig. 1, loc. 17).

GMUS specimens

Cystiphylloides macrocystis? (Schlüter)

GMUS Cr 1, South limb of Imperial Anticline, Latitude 65°25'N, Longitude 128°10'W; upper 15.2 m (50 ft); collected by W.G.E. Caldwell, 1959 (Textfig. 1, loc. 15).

GMUS Cr 2, Powell Creek, Latitude 65°15'N, Longitude 128°46'W; approximately upper 24.4 m (80 ft); collected by W.G.E. Caldwell, 1960 (Textfig. 1, loc. 16).

Digonophyllum rectum? (Meek)

GMUS Cr 3, Powell Creek, Latitude 65°15'N, Longitude 128°46'W; upper 15.2 m (50 ft); collected by W.G.E. Caldwell, 1959 (Textfig. 1, loc. 16).

Digonophyllum powellense sp. nov.

GMUS Cr 4-7, Hume River, Latitude 65°21'N, Longitude 129°58'W; upper 36.6 m (120 ft); collected by W.G.E. Caldwell, 1959 (Textfig. 1, loc. 20).

Lekanophyllum ellipticum sp. nov.

GMUS Cr 8, Hume River, Latitude 65°21'N, Longitude 129°58'W; upper 36.6 m (120 ft); collected by W.G.E. Caldwell, 1959 (Textfig. 1, loc. 20).

Lekanophyllum andersonense sp. nov.

GMUS Cr 9, Carnwath River, Latitude 67°57'N, Longitude 128°55'W (Textfig. 1, loc. 6).

Lekanophyllum andersonense? sp. nov.

GMUS Cr 10, Hume River, Latitude 65°21'N, Longitude 129°58'W; approximately 79.2 to 61.0 m (260-200 ft) below top; collected by W.G.E. Caldwell, 1959 (Textfig. 1, loc. 20).

GMUS Cr 11, South limb of Imperial Anticline, Latitude 65°25'N, Longitude 128°10'W; approximately 18.3 to 15.2 m (60-50 ft) below top; collected by W.G.E. Caldwell, 1959 (Textfig. 1, loc. 15).

Lenz collection (*see* Lenz, 1961). Locality data as provided by Lenz (1961, pers. com. to D.J. McLaren).

"*Microplasma* cf. *fongi* Yoh"; GSC 44824, Anderson River, Latitude 68°31'N, Longitude 127°12'30"W; upper Hume Formation (Textfig. 1, loc. 2).

Digonophyllum rectum (Meek), specimen lost, Anderson River, Latitude 68°32'N, Longitude 127° 15'W; upper Hume Formation (Textfig. 1, loc. 3).

"*Zonodigonophyllum* cf. *simplex* Wedekind", specimen lost, Dal Lake area, Latitude 63°07'N, Longitude 126°30'W, middle Hume Formation.

"*Cystiphylloides? americanum arcticum* (Meek)", GSC 44877, Gayna River, Latitude 65°18'N, Longitude 129°13'W; uppermost Hume Formation. (Outcrop unconfirmed, possibly Textfig. 1, loc. 19).

"*Cystiphylloides kwangsiense?* Yoh", GSC 44842, tributary of Bosworth Creek, north of Norman Wells, Latitude 65°20'N, Longitude 126°40'W; middle Hume Formation (Textfig. 1, ?loc. 11).

"*Atelophyllum fultum* (Hill)", GSC 44903, Canyon Creek, east of Norman Wells; Latitude 65°16' N, Longitude 126°25'W; upper Hume Formation (Textfig. 1, loc. 12).