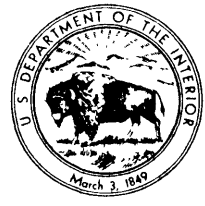
Devonian Rugose Corals From Northern Maine

GEOLOGICAL SURVEY BULLETIN 1111-A



Devonian Rugose Corals From Northern Maine

By WILLIAM A. OLIVER, JR.

CONTRIBUTIONS TO GENERAL GEOLOGY

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A description of two new faunules from rocks of Helderberg and Schoharie age

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CONTRIBUTIONS TO GENERAL GEOLOGY

DEVONIAN RUGOSE CORALS FROM NORTHERN MAINE

By WILLIAM A. OLIVER, JR.

ABSTRACT

Corals which were collected by A. J. Boucot from rocks of Devonian age in the Moose River synclinorium, northern Maine, are from the Beck Pond limestone of Helderberg age and the upper part of the Moose River sandstone of Schoharie age.

Four new rugose coral species from two Beck Pond limestone faunules are assigned to the genera *Amplexiphyllum*, *Briantelasma*, *Lyriclasma* and *Tryplasma*. Some fragmentary *Favosites* are also described. Specimens are fairly abundant and well preserved. Species that are morphologically similar are known from the Helderberg group in New York and the Keyser limestone in Maryland and adjacent States. One of the Beck Pond faunules represents a biostrome environment. The other may have been collected from an off-biostrome facies or may be from rocks of slightly different age.

Corals were an important part of the upper Moose River fauna; but preservation is poor, and the material is inadequate for formal taxonomic treatment.

INTRODUCTION

The corals described here were collected between 1951 and 1955 by A. J. Boucot during his study of the stratigraphy of the Moose River synclinorium in Somerset and adjacent counties, northern Maine. The corals are one of several groups of fossils being studied by various workers. Papers by Boucot (1960) and Boucot, Harper, and Rhea (1959) established the stratigraphic framework within which the fauna is described.

Corals from 2 formations at 9 localities have been studied. Corals from the Beck Pond limestone, Helderberg age (Boucot, 1960; Boucot, Harper, and Rhea, 1959, p. 9) are well preserved and fairly common. They are interesting because very few corals of Helderberg age (early Lower Devonian) are known from North America. Oliver (1960) described a new fauna from a reef facies in the Helderberg group in New York. The corals from Maine show a relationship to this fauna, but also to corals from the Keyser limestone in Maryland and adjacent states. Table 1 lists the corals described from Boucot's two Beck Pond limestone collections.

TABLE 1.—*Number of specimens and distribution of corals from Beck Pond limestone*

	USGS localities [1]	
	3499-SD	3601-SD
Amplexiphyllum nanum n. sp.	5	
Briantelasma mainense n. sp.	25	
Lyrielasma annulatum n. sp.	2	50+
Tryplasma rhopalium n. sp.	4	1
Favosites sp.	12	

[1] From U.S. Geological Survey Silurian-Devonian catalog.

Corals from the upper part of the Moose River sandstone, Schoharie age (Boucot, 1960), are poorly preserved, usually as calice or exterior molds, and can be described only in general terms. Some molds can be compared with previously described corals from other areas, but none can be certainly identified. The corals are an interesting addition to the Moose River fauna and add to the picture of Schoharie time. Table 2 lists the corals in Boucot's seven Moose River collections.

All the fossils herein described or illustrated were collected by A. J. Boucot, except for the West Virginia specimen of *Tryplasma*, which was borrowed from the U.S. National Museum, collector unknown. Thin sections were prepared by William C. Pinckney; photographs are by N. W. Shupe and R. H. Raymond.

TABLE 2.—*Number of specimens and distribution of corals from upper Moose River sandstone*

	USGS localities						
	2723-SD	2730-SD	2750-SD	2814-SD	2820-SD	2840-SD	2873-SD
Small horn corals:							
Zaphrentis cf. *Z. phrygia*	----	----	----	1	11	----	1
Zaphrentis? sp.	----	----	----	----	2	2	1
"*Heliophylloides*" sp.	----	----	----	----	2	----	----
Cyathophylloid	----	----	1	----	4	----	----
Indeterminate calice molds	----	2	4	----	11	----	----
Indeterminate exterior molds	----	----	2	1	8	1	----
Indeterminate miscellaneous fragments	----	----	----	----	----	2	----
Total	----	2	7	2	38	5	2
Pleurodictyum cf. *P. problematicum*	4	----	----	----	----	----	----

LOCALITIES

The following information was taken from the U.S. Geological Survey Silurian-Devonian catalog and additional notes by Boucot.

Upper Moose River sandstone:

2723–SD. Southeast shore of Farm Island in Moosehead Lake, Brassua Lake quadrangle, Piscataquis County, Maine.

2730–SD. Point on Brassua Lake, 0.4 mile northwest of the southeast corner of Brassua Township, Brassua Lake quandrangle, Somerset County, Maine.

2750–SD. Baker Brook Point on Moosehead Lake, Brassua Lake quadrangle, Somerset County, Maine.

2814–SD. Same as locality 2730–SD; a separate boulder.

2820–SD. On Blaine-Tenmile Swing road, about 3.5 miles northwest of the bridge over Moose River, Brassua Lake quadrangle, Somerset County, Maine.

2840–SD. Cliff, 0.95 mile S. 18° E. of Poplar Ripps, Brassua Lake quadrangle, Somerset County, Maine.

2873–SD. North bank of Moose River, 0.02 mile west of confluence of Stony Brook and Moose River, Brassua Lake quandrangle, Somerset County, Maine.

Beck Pond limestone:

3499–SD. On trail that crosses outlet stream of Beck Pond 0.1 mile south of the pond, just west of the stream at an altitude of 1,740 feet; central ninth of Spencer quadrangle, Somerset County, Maine. Outcrop 10 of Boucot, Harper, and Rhea (1959, p. 11).

3601–SD. On trail that runs from Spencer Lake south of Beck Pond to east shore of King and Bartlett Lake; 0.25 mile west of locality 3499, at an altitude of 1,860 feet; central ninth of Spencer quadrangle, Somerset County, Maine. Outcrop 22 of Boucot, Harper, and Rhea (1959, p. 17).

CORALS FROM BECK POND LIMESTONE

NATURE AND PRESERVATION

Corals from the Beck Pond limestone were collected from two localities. The localities represent very different environments, but fossil preservation is similar. Gross structures which are conventionally used for identification and description are well shown. Thin sections are useful for precise measurement and more accurate viewing of the internal details, but some recrystallization has occurred and microstructure is largely obscured. The corals are preserved as calcite in limestone, and their exteriors are generally not seen.

AGE

The Helderberg (Early Devonian) age assignment of the Beck Pond limestone is based primarily on the more numerous brachiopods (Boucot, written communication; Boucot, Harper and Rhea, 1959,

p. 10), but the corals offer additional data. Corals comparable to the Beck Pond species are found in the Coeymans limestone, Helderberg age, in New York, and in the Keyser limestone, Late Silurian and Early Devonian(?) age, in Maryland and West Virginia.

Briantelasma mainense n. sp. is closely related to the type species of the genus, *B. americanum* Oliver, from New York. Similarly *Tryplasma rhopalium* n. sp. is morphologically close to *T. fascicularia* Oliver, from New York. Both species suggest that the Beck Pond limestone is of Helderberg age. In addition the Beck Pond *Favosites* seem closest to New York Helderberg types although knowledge of the species of this genus in both areas is inadequate for detailed comparison.

Corals morphologically similar to two of the Maine species are known from the Keyser limestone in Maryland and West Virginia. *Lyrielasma annulatum* n. sp. is close to "*Cyathophyllum*" *schucherti* Swartz, from Maryland and adjacent states. In addition, *Tryplasma rhopalium* n. sp. is close to or conspecific with a probably undescribed *Tryplasma* from West Virginia.

The Keyser limestone has been assigned at different times to either the Lower Devonian (Helderberg) or Upper Silurian (Swartz, and others 1942, p. 534) but is classed as Silurian in the recent National Research Council correlation charts (Swartz and others, 1942; Cooper and others, 1942).

Halysites indicates a Late Silurian age for at least part of the formation. The corals discussed here suggest that the upper part may be of Early Devonian age.

PALEOECOLOGY

The coelenterate faunas at the two localities are significantly different. Locality USGS 3601–SD represents a stromatoporoid bioherm or biostrome (Boucot, Harper, and Rhea, 1959, p. 17, member 2) in which abundant specimens of *Lyrielasma annulatum* lived in close association with the stromatoporoids. Most specimens of the coral are covered with an encrusting stromatoporoid several layers thick; others are buried in a massive stromatoporoid; and only a few specimens are free. The corals are oriented perpendicular to the growth layers in the massive stromatoporoid and are completely surrounded by continuous layers in the encrusting form indicating a probable life association. This stromatoporoid-coral bed or reef probably represents shallow, well-agitated water as suggested for some Belgian Devonian reefs by Lecompte (1954, p. 176).

The collection from locality USGS 3499–SD (Boucot, Harper, and Rhea, 1959, p. 10–11, member 5) is almost entirely different from that of locality USGS 3601–SD (table 1). The coral collection is small,

and the paleoecology is not known. It may represent an off-reef deposit contemporaneous with the stromatoporoid-coral unit, or may be of slightly different age.

SYSTEMATIC PALEONTOLOGY

The specimens described are in the collections of the U.S. National Museum (USNM). Locality numbers are those of the U.S. Geological Survey Silurian-Devonian catalog (USGS–SD), and are listed on page 3.

Order RUGOSA

Family METRIOPHYLLIDAE

Genus AMPLEXIPHYLLUM Stumm

1949. *Amplexiphyllum* Stumm, p. 9.
1956. *Amplexiphyllum* Stumm. Hill, p. 257.

Type species.—By original designation, *Amplexus hamiltoniae* Hall, (1877, pl. 19, figs. 20–23). Hamilton group, Middle Devonian, New York.

Diagnosis.—Simple, ceratoid to cylindrical corals with rugose exterior. In ephebic stage major septa are attenuate and short, usually extending less than half-way to the axis; minor septa very short. In early growth stages, major septa extend to the axis and unite; somewhat shorter in late neanic stage. Tabulae gently arched. Epitheca a narrow septal stereozone.

Remarks.—Previously described species of *Amplexiphyllum* are of Middle Devonian age. The Maine species here described is the oldest yet known and possesses some characters which suggest that it might be ancestral to the later Onondaga and Hamilton forms.

Amplexiphyllum nanum, n. sp.

Plate 3, figures 6–11

Diagnosis.—Small *Amplexiphyllum* in which major septa extend one-half to two-thirds of the distance to the axis; tabulae arched with broad, depressed, flat area in center.

External features.—Simple, small, ceratoid or cylindrical corals commonly with irregular bends in growth axis. Dimensions of 5 available specimens: diameter, 5 to 10 mm; length (incomplete), up to 15 mm. Exterior marked by sharp, broadly V-shaped septal grooves and rounded interseptal ridges; marking gives scalloped appearance in transverse section. Fine encircling striae and occasional coarse rugae owing to bending also present. Calice not known.

Internal features.—In the mature part of the corallum, major septa attenuate and widely spaced, extend from ½ to ⅔ the distance to

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the axis, number 22 or 23 in sections of 5.5 to 6.5 mm. diameter. Minor septa very short. No modification of the protosepta has been observed. Corallite wall 0.3 thick is formed by peripheral dilation of septa. Sections through the lower part of the coralla show major septa extending to or almost to the axis. Septa and epitheca irregularly thickened with stereoplasm.

Tabulae flat over a broad axial area, periaxially arched and peripherially down-bent to give an inverted bowl shape.

Remarks.—The above description is based on five incomplete specimens which are uniform in appearance and structure. *A. nanum* is smaller than other known species of Amplexiphyllum and is characterized by longer major septa, which may be a primitive feature in the group.

Occurrence: Beck Pond limestone, Helderberg age, Somerset County, Maine. All five specimens are from locality USGS 3499–SD.

Material: Holotype, USNM 137806; illustrated paratypes USNM 137807, 137808; unifigured paratypes, USNM 137809.

Family STREPTELASMATIDAE

Subfamily STREPTELASMATINAE

Genus BRIANTELASMA Oliver

1960. *Briantelasma* Oliver, p. 89.

Type species.—*Briantelasma americanum* Oliver (1960, p. 89, pl. 14, figs. 1–14). Reef facies of Coeymans limestone, Helderberg age, Early Devonian, Madison and Oneida Counties, New York.

Diagnosis.—Simple trochoid to cylindrical corals with subpinnately arranged major septa extending nearly to the axis; minor septa one-third to two-thirds as long. Marginarium formed by stereoplasmic infilling between irregularly dilated septa. Tabularium may be partly or entirely filled with stereome, especially in early growth stages. Tabulae strongly domed with axial depression, complete and closely spaced. Cardinal fossula present.

Remarks.—The above diagnosis differs somewhat from the original diagnosis of Oliver (1960, p. 89). Greater emphasis is placed on the distinct but slight pinnate arrangement of the septa and on the irregular dilation, and less emphasis is placed on amount of stereoplasmic infilling. With the additional information provided by the Maine species described below, *Briantelasma* can be recognized as a fairly simple zaphrentoid coral, with excess stereoplasmic deposits. The New York type species shows structures in the marginarium which suggests incipient dissepiments. A second New York species (*B. knoxboroense* Oliver, 1960, p. 91) and the Maine species have the same structure but more weakly developed. *Briantelasma* could be

the stem group for some of the Middle Devonian and later cyathophylloids with well-developed dissepimentaria, but more likely represents a specialized streptelasmatid sideline.

Briantelasma mainense n. sp.

Plate 1, figures 1–9

Diagnosis.—*Briantelasma* with narrow marginarium and free minor septa.

External features.—Small trochoid to subcylindrical horn corals with the following maximum observed dimensions: Diameter 20 mm, length 40 mm. Exterior smooth; weak septal grooves on some specimens seem to be due to erosion; a few rugae may be present. Calice moderately deep with gently arched floor, periaxial depression, and steep sides which flatten toward the rim. Fossula in calice not known.

Internal features.—Transverse sections just below the calice show the following structures: Septa pinnately arranged; major extend to the axis, minor one-third to two-thirds as long. Major septa number 22 to 38 in 18 sections with diameters of 8 to 18 mm (average 12.7 mm). Septal ratio (number of major septa to diameter in millimeters) varies inversely with diameter from 1.78 to 3.00, average 2.32. Cardinal septum short; adjacent major septa are of increased length as alar positions are approached. Counter septum long, flanked by extra-long minor septa in most specimens. All septa moderately dilated; irregularly added stereoplasm gives appearance of zigzag carinae. Peripheral sterozone ranges in thickness from one fourth to one-half the radius of the section, formed by septal dilation and infilling.

Longitudinal sections show a wide tabularium occupied by rather widely spaced, gently to strongly domed tabulae, usually with an axial depression. Tabulae thickened by stereoplasm on the upper surfaces. Outer wall corresponds in thickness to same feature in transverse sections. No dissepiments.

Microstructure too poorly preserved for description.

Remarks.—The above description is based on 25 specimens from a single collection. Measurements and counts are from 18 transverse thin sections. Variation within the collection is mainly in terms of amount and nature of stereoplasmic deposits and shape. Also the larger specimens tend to have a more radial septal arrangement than the smaller ones.

Variation in amount of stereoplasmic filling is extreme. Most specimens show moderate septal dilation, a narrow, stereozone, and some thickening of tabulae, leaving an open interior. In a few speci-

mens, however, the peripheral stereozone fills one-third to one-half of the radius, and in one individual the tabularium is nearly closed by stereome. The peripheral stereozone is commonly formed by infilling between distinctly deliniated septa, but in some specimens the septa are more dilated and in lateral contact around part of the stereozone.

Size and shape variation is less extreme. Most of the specimens are small conical corals, but three are cylindrical and markedly longer than conical specimens of similar diameter. Figure 1 shows the variation in diameter of sections taken at the base of the calice, and corresponding variation in number of major septa. Variation in shape and other characters is comparable to that described by Oliver (1960, p. 89–91) for two New York species of *Briantelasma*.

B. mainense is clearly congeneric with the only two previously described species of *Briantelasma*, *B. americanum* and *B. knoxboroense*, both from the Helderberg group in New York. The three species are strikingly similar in general shape and appearance, septal plan, tabulae and structure of the marginarium. Both New York species have wide, sharply defined marginaria formed by stereoplasmic infilling between dilated septa; minor septa are limited to the marginarium. In addition, *B. americanum* shows considerable stereoplasmic filling of the tabularium, so that structures are obscured in most specimens. *B. mainense* differs by having a narrow, decidedly irregular marginarium, so that both major and minor septa are free for part of their lengths. Irregular septal dilation occurs in all the species but is most prominent in *B. mainense* because of the narrow marginarium.

Occurrence: Beck Pond limestone, Helderberg age, Somerset County, Maine. Twenty-five specimens from locality USGS 3499–SD.

Material: Holotype, USNM 137810; figured paratypes, USNM 137811–137817; unfigured paratypes, USNM 137818.

Family PTENOPHYLLIDAE

Genus LYRIELASMA

1939. *Lyrielasma* Hill, p. 243–244.
1942. *Lyrielasma* Hill. Hill, p. 238.
1949. *Lyrielasma* Hill. Stumm, p. 34.
1956. *Lyrielasma* Hill. Hill, p. 306.

Type species.—By original designation, *Cyathophyllum subcaespitosum* Chapman (Hill, 1939, p. 244–246, pl. 14, figs. 1–6; pl. 15, figs. 6–7).

Diagnosis.—Phaceloid or simple cylindrical corals with deep, steep-sided calices. Major septa extend nearly to the axis in slightly biradial arrangement; zigzag carinae may be characteristic. Peri-

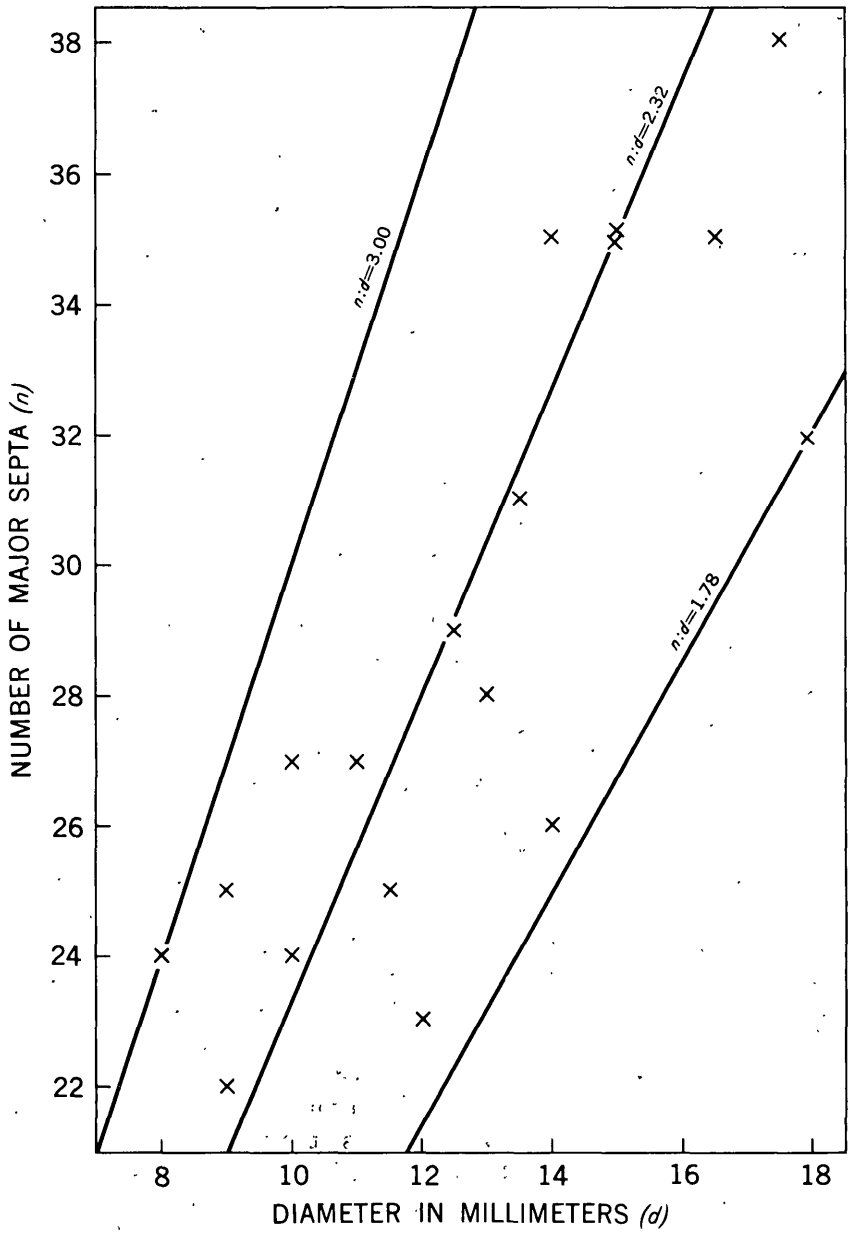

FIGURE 1.—*Briantelasma maineuse* n. sp. Scatter diagram of number of major septa × diameter in 18 specimens from locality USGS 3499-SD. Straight lines represent plots of mean, minimum, and maximum values of septal ratio for the specimens. All measurements were made in transverse thin sections near the base of the calice.

pheral stereozone of variable width is formed by irregular dilation of septa in partly lonsdaloid dissepimentarium.

Remarks.—*Lyrielasma* Hill and *Stringophyllum* Wedekind differ from *Grypophyllum* Wedekind and *Leptoinophyllum* Wedekind by peripheral septal dilation which is most marked in *Lyrielasma*. *Grypophyllum* and *Stringophyllum* have well developed lonsdaloid dissepimentaria and distinct biradial septal arrangements; both features are only weakly shown in *Lyrielasma* and *Leptoinophyllum*.

Lyrielasma annulatum n. sp.

Plate 2, figures 1–6; plate 3, figures 1–5

Diagnosis.—Small *Lyrielasma* with gently convex or concave tabulae and wide dissepimentarium partly obscured by septal dilation.

External features.—Medium- to small-sized, cylindrical to ceratoid corals; loosely phaceloid (or solitary?). Dimensions: diameter 5 to 11 mm, average 8 mm; length (incomplete) up to 30 mm. Exterior covered by encrusting stromatoporoid in most specimens; sections suggest prominent longitudinal septal grooves and broad, rounded interseptal ridges; transverse markings consist of broad, smooth, irregularly spaced rugae; finer longitudinal and transverse markings not observed. Calice deep, and steep sided with slightly flaring margins, floor flat or gently arched; septa appear on wall of calice as low, broad, V-shaped ridges. No fossula.

Internal features—Transverse sections of cylindrical parts of coralla show major septa extending nearly to the axis where they may touch other major septa or be free; moderately dilated throughout this length. Major septa number 17 to 24, average 21 in corallites of average diameter (8 mm). Minor septa alternate with major, are two-thirds to three-fourths as long, and somewhat thinner. Septal ratio (number of major septa to diameter in millimeters) varies inversely with size from 1.73 to 4.00, average 2.66. Septa in slight bilateral arrangement; primary septa can be recognized in some sections by partly developed septa in insertion positions. Peripheral septal stereozone, 0.5 to 1.5 mm wide, formed by septal dilation; in some parts of some specimens this zone is open and septa (major and (or) minor) are more attenuate or lacking (lonsdaloid). Inside peripheral zone, many dissepiments and tabulae are intercepted giving a concentric-ring appearance.

Longitudinal sections show wide dissepimentarium composed of small globose dissepiments in steeply inclined rows. Tabulae obscure in most forms; gently arched, complete or incomplete where observed.

Microstructure obscured by recrystallization in all specimens studied.

Remarks.—The above description is based on longitudinal and transverse, thin and polished sections of more than 50 individuals. Measurements and counts (fig. 2) are based on transverse and longi-

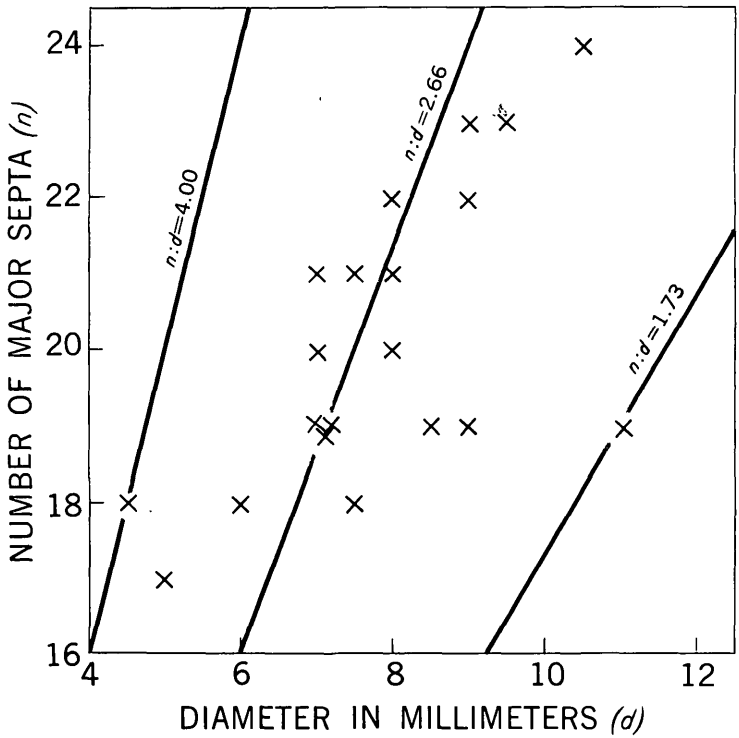

FIGURE 2.—*Lyrielasma annulatum* n. sp. Scatter diagram of number of major septa × diameter in 20 specimens from locality USGS 3601–SD. Straight lines represent plots of mean, maximum, and minimum values of septal ratio for the specimens. All measurements were made in transverse thin sections.

tudinal thin sections of 20 specimens from locality USGS 3601–SD.

The cylindrical corallites of *L. annulatum* are commonly encrusted by an unidentified stromatoporoid. In several hand specimens individuals are rather closely spaced and oriented parallel to each other; this orientation suggests a phaceloid colony with peripheral increase. However, no examples of any linkage between individuals has been found, and the coralla may be simple.

Lyrielasma annulatum is very close to the type species of the genus, *L. subcaespitosum* (Chapman), from the Lower Devonian of Victoria, Australia. The Maine species is smaller in diameter, has fewer septa, and is characterized by gently arched to sagging tabulae.

Both species have slightly wavy septa with zigzag carinae, and partly lonsdaloid dissepimentaria.

Lyrielasma curvatum and *L.* (?) *lophophylloides*, both Hill 1942, were assigned to the genus with some question. *L. curvatum* differs in its vortical septal arrangement, and *L.* (?) *lophophylloides* differs in the presence of a long, thick (presumably counter) septum.

Species previously assigned to the genus are of Lower and Middle Devonian age in Australia and Western Europe. *L. annulatum* is the only species of the genus yet recognized in North America.

"*Cyathophyllum*" *schucherti* Swartz, 1913, from the Upper Silurian or Lower Devonian of Maryland, seems to belong to the ptenophyllid group of corals and Hill (1940b. p. 268) suggested that the species might be assignable to *Grypophyllum*. "*C.*" *schucherti* is similar to *L. annulatum* in the biradial arrangement of the septa (Swartz, 1913, pl. 20, fig. 8) (which may be due to poor orientation of the illustrated section), but differs by the lack of septal dilation, and by the dendroid growth habit. The differences may be of no more than specific importance, but the type specimens of "*C.*" *schucherti* are not available for study and final decision must wait redescription of the Maryland species.

"*Cyathophyllum*" *marylandicum* Swartz, 1913, was inadequately described and illustrated and may be conspecific with or close to "*C.*" *schucherti*. The type specimens of this species are likewise unavailable for study at the present time.

Occurrence: Beck Pond limestone, Helderberg age, Somerset County, Maine. Apparently common at locality USGS 3601-SD (50+ specimens); rare at locality USGS 3499-SD (2 specimens).

Material Holotype, USNM 137819; figure paratypes, USNM 137820-28; unfigured paratypes USNM 137829-30.

Family TRYPLASMATIDAE

Genus TRYPLASMA Lonsdale

1845. *Tryplasma* Lonsdale, p. 613.
1871. *Pholidophyllum* Lindström, p. 925.
1894. *Spiniferina* Penecke, p. 592.
1907. *Tryplasma* Lonsdale. Etheridge, p. 76–77.
1927. *Stortophyllum* Wedekind, p. 30, 31.
1936. *Tryplasma* Lonsdale. Hill, p. 204–206.
1940a. *Tryplasma* Lonsdale. Hill, p. 405.
1950. *Tryplasma* Lonsdale. Schouppé, p. 80–84.
1950. *Tryplasma* Lonsdale. Wang, p. 226.
1952. *Tryplasma* Lonsdale. Stumm, p. 842.
1956. *Tryplasma* Lonsdale. Hill, p. 312.
1960. *Tryplasma* Lonsdale. Oliver, p. 96.

Type species.—By subsequent designation of Etheridge (1907, p. 42) *Tryplasma aequabile* Lonsdale, 1845, p. 613–614, 633, pl. A, figs. 7, 7a). Silurian, northern Urals, U.S.S.R.

Diagnosis.—Solitary, dendroid, or phaceloid, corals with acanthine septa and narrow septal stereozone. Tabulae usually complete; no dissepiments.

Tryplasma rhopalium n. sp.

Plate 4, figures 1–7

Diagnosis.—Cylindrical *Tryplasma* with large, dilated septal spines, and thin, sagging tabulae.

External features.—Simple (or compound?) cylindrical corallites. Dimensions of 5 individuals: diameter, 3.5 to 7.5 mm; length (incomplete), up to 2 cm. Exterior appears reticulated by fine, closely spaced rugae, and very fine longitudinal striae. Calice moderately deep and steep sided, with rather flat axial area. Discrete septal spines project into the calice from the stereome-thickened walls.

Internal features.—Septa acanthine, with blunt, thickened spines directed inward and upward; major septa extend two-thirds the distance to the axis, number 20 to 27 in 5 specimens studied. Septal stereozone of variable width, formed by dilation of septa. Minor septa lacking except in largest specimen where they are thinner and one-third as long as the major septa. Septal spines rhopaloid and nearly in contact with adjacent spines along the inner half of their length; just inside of the peripheral stereozone the spines are more attenuate with open spaces between septa.

Tabulae complete, thin, gently to strongly concave; apparently limited to inner zone between axial ends of septa because of septal dilation.

Microstructure partly obscured by recrystallization but appears similar to the monacanthine type of Hill (1936, p. 213–214).

Remarks.—The above description is based on 5 incomplete cylindrical individuals of uniform appearances and structure. They may represent fragments of phaceloid colonies or solitary forms. Variation within the 5 specimens is mainly in terms of degrees of stereoplasmic thickening of septal units but this may be a function of the position of a section near to or well below the calice.

T. rhopalium can be separated from previously described species of *Tryplasma* by its strongly concave tabulae and stereome thickened, rhopaloid septal spines. It is similar to *T. fasciculatia* Oliver (1960, p. 96) from rocks of the same approximate age in New York, but the New York species has very attenuate septal spines. *T. fasciculatia* is a phaceloid form with calicinal increase suggesting that *T. rhopalium* may also be a colonial species.

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Tryplasma rhopalium may be close to or identical with "*Cyathophyllum*" *marylandicum* Swartz (1913, p. 204) from the Keyser limestone in Maryland. Swartz did not illustrate the internal structure of "*C*". *marylandicum* but the description is as follows: "Cross sections show that the septa are very thick, uniting by their outer edges to form a thick wall. Dissepiments present, not numerous, poorly preserved." (Swartz, 1913, p. 204). The type specimens of "*C*". *marylandicum* are not available for study but a pair of thin sections in the USNM collection may represent this species. The sections are unnumbered and labeled as follows: "*Cyathophyllum schucherti* Swartz, Helderbergian (Keyser), Keyser, W. Va." They are cut from one or two specimens of a *Tryplasma* and are almost identical with corresponding sections of *T. rhopalium* (pl. 4, figs. 8–9). The specimen(s) is obviously not "*C.*" *schucherti* which has attenuate septa and a wide dissepimentarium, but may be "*C.*" *marylandicum*. There are no dissepiments in *T. rhopalium* or in the similar USNM specimen(s). It is possible that Swartz misinterpreted the structure through failure to study a longitudinal section but this cannot be ascertained until the type specimens are found. Restudy of type and additional material of "*C.*" *marylandicum* Swartz, may show it to be conspecific with *T. rhopalium*, in which case the latter will become a junior synonym of the former. It is in any case significant that a specimen from the Keyser limestone (apparently the type locality) is so similar to the Maine species.

Occurrence: Beck Pond limestone, Helderberg age, Somerset County, Maine. Specimens in the collection are from locality USGS 3499–SD (4 specimens), and 3601–SD (1 specimen).

Material: Holotype, USNM 137831; figured paratypes, USNM 137832–34; unfigured paratype, USNM 137835.

Order TABULATA

Family FAVOSITIDAE

Genus FAVOSITES Lamarck

Remarks.—See Jones (1936, 1937), Hill (1950, p. 147–148), Ross (1953), and included references for synonomies and recent discussions of *Favosites.*

Several fragmentary specimens of *Favosites* are included in one of the Beck Pond collections (3499–SD). These represent small and large, massive and ramose coralla, but the material is inadequate for formal taxonomic study. Four morphologic groups of specimens can be recognized. These are briefly described and illustrated below, but do not necessarily represent species. The previously described species

to which three of the morphologic groups are compared are badly in need of modern study and may themselves be artificial.

The described specimens are not well enough preserved to see the wall microstructure; other details also may have been destroyed during preservation.

Favosites type 1

Plate 5, figures 1, 2

Description.—Small, subspherical or hemispherical coralla averaging 4 cm in diameter. Corallites variable in size, commonly 1 to 1.5 mm in diameter (wall center to wall center). Wall thickened by stereome to one-third the radius of the corallite; no septal spines observed. Spacing of tabulae varies in 7 specimens from 8–9 to 18–20 per 5 mm. Mural pores scarce in sections.

Remarks.—The above description is based on 7 fragments, 3 of which are complete enough to show corallum form. In general shape the specimens are comparable to *F. conicus* Hall, 1883, from the Helderberg group in New York, but the Maine specimens have corallites of much smaller diameter. *Favosites* type 1 may belong to *F. helderbergiae* Hall, 1874 and (or) be conspecific with *Favosites* type 3 of the present report. Both of these differ from *Favosites* type 1 primarily by their larger, more massive coralla.

Favosites type 2

Plate 5, Figures 3, 4

Description.—A single fragment of a small- to medium-sized corallum is similar to the above but differs by the presence of very thin walls and widely spaced tabulae. Corallite diameter 1 to 1.75 mm; tabulae spaced 4 to 5 per 5 mm. Wall and other structures very thin; no septal spines. Mural pores large and concentrated in growth zones.

Favosites type 3

Plate 5, Figures 5, 6

Description.—A 2- by 2-inch fragment in the collection appears to be part of a large, massive corallum. Corallite diameter, 1 to 2 mm; tabulae spaced 9 to 12 per 5 mm. Walls thickened by stereome but less so than in *Favosites* type 1. Mural pores seen in sections, diameter approximately 0.5 mm; apparently concentrated in growth zones. No septal spines.

Remarks.—The described specimen is similar to *F. helderbergiae* Hall, 1874, from the Helderberg group in New York. The inadequacy of present material and published information on *F. helderbergiae*

prevents a detailed comparison. Undescribed specimens of *Favosites* from the reef facies of the Coeymans limestone (Helderberg group) in New York are close to if not conspecific with *Favosites* type 3.

Favosites type 4

Plate 5, Figure 7

Description.—Two small blocks of limestone contain fragments of a ramose *Favosites*. Size of corallum unknown, but branch diameter ranges from 10 to 20 mm. Corallite diameter 1 to 1.5 mm; tabulae spacing 6 to 9 per 5 mm. Walls thickened by stereome as in *Favosites* type 3. No septal spines. Mural pores scarce in sections.

Remarks.—*Favosites conradi* Girty, 1895, from the Coeymans limestone (nonreef facies) in New York, is similar in size and growth form to *Favosites* type 4, but is characterized by the possession of strong septal spines (Girty, 1895, p. 304), which are lacking in the Maine specimens. Undescribed ramose favositids of the same size and shape are common in the Coeymans limestone (reef facies) in New York. The New York reef specimens are similar in internal structure to *Favosites* type 4, and may be conspecific. Detailed restudy of *F. conradi* may show that both the Maine and the New York reef specimens are assignable to that species.

CORALS FROM THE MOOSE RIVER SANDSTONE

The upper part of the Moose River sandstone contains brachiopods that indicate a Schoharie age for this part of the formation (Boucot, 1960). Seven collections from this unit include corals. All are preserved as molds or fragments in siltstone or fine-grained sandstone, and none can be described in detail. Comparison with the abundant described corals of Schoharie and Onondaga age permits tentative assignment of some specimens to two species, but most of the material is of interest only because it provides additional information on the ecology of the upper part of the Moose River sandstone.

SYSTEMATIC PALEONTOLOGY

The specimens described are in the collections of the U.S. National Museum (USNM). Locality numbers are from the U.S. Geological Survey Silurian-Devonian catalog (USGS–SD), and are given in the section on localities.

Order RUGOSA

Family ZAPHRENTIDAE

Genus ZAPHRENTIS Rafinesque and Clifford

1820. *Zaphrenthis* Rafinesque and Clifford, p. 234.
1851. *Zaphrentis* Rafinesque and Clifford. Milne-Edwards and Haime, p. 326–327.
1914. *Zaphrentis* Rafinesque and Clifford. O'Connell, p. 177.
1938. *Zaphrentis* Rafinesque and Clifford. Schindewolf, p. 440–441.
1949. *Zaphrentis* Rafinesque and Clifford. Stumm, p. 12.
1949. [?] *Heliophylloides* Stumm, p. 18.
1956. *Zaphrentis* Rafinesque and Clifford. Hill, p. 278.

Type species.—*Z. phrygia* Rafinesque and Clifford (1820, p. 235), by subsequent designation of Hall and Simpson, 1887, p. xi. Jeffersonville limestone, Falls of the Ohio River, Indiana-Kentucky.

Diagnosis.—Simple turbinate to ceratoid corals with deep, erect calices. Septa pinnately arranged; prominent cardinal fossula formed by retarded cardinal septum. Major septa extend to the axis; minor septa vary in length; all septa carinate in outer part of corallum. Tabulae comparatively few, generally arched. A narrow dissepimentarium may be present in the calicinal wall; development in earlier stages uncertain.

Remarks.—There is much confusion in the literature regarding the structure of *Zaphrentis*. Conventionally, the genus has been considered to lack dissepiments, but several early workers as well as the most recent ones have noted dissepiments, at least in the calice wall. The above diagnosis and much of the following discussion is based on a reexamination of a large topotype collection of *Z. phrygia* in the U.S. National Museum, from which several specimens were sectioned. Definitive redescription of the species involved is in progress by Prof. E. C. Stumm (written communication, 1957).

It is now generally accepted that the type species of *Zaphrentis* is *Z. phrygia* (=*Z. corniculum* (Lesueur), 1821), but all recognizable descriptions of the species are based on secondary material. Neither Rafinesque and Clifford nor Lesueur illustrated the species, and both gave only brief descriptions. Milne-Edwards and Haime (1851, p. 327–328, pl. 6, fig. 1a–e) described and illustrated topotype material and may have had access to the Rafinesque and Clifford types (O'Connell, 1914, p. 182). O'Connell (1914) and Lang, Smith and Thomas (1940) reviewed the *Zaphrentis* problem and clarified several important points.

Schindewolf (1938, p. 440–445, pl. 44, figs. 1, 2) discussed the genus and type species at some length, but his description of the species was based on material from the type locality that is probably not conspecific with *Z. phrygia*. He indicated that the species has a wide dissepimentarium and suggested that *Zaphrentis* is very close to *Heliophyllum* Hall.

Part of the confusion is caused by two species or species groups found at the Falls of the Ohio which answer the original description of Rafinesque and Clifford. Both are small, trochoid corals with prominent cardinal fossulae on the convex side of the corallum. Both have carinate septa, pinnately arranged, and both have similarly shaped calices. One, however, has only a very narrow dissepimentarium which may be limited to the ephebic stage while the other has a moderately wide dissepimentarium composed of several rows of dissepiments which is formed in earlier stages as well (*Heliophylloides* of Stumm, 1949, p. 18). The two species (or species groups) are probably congeneric and Schindewolf's conclusions regarding the relationship of *Zaphrentis* to *Heliophyllum* are probably valid. Either of the two species could be the type on which Rafinesque and Clifford based their genus *Zaphrentis*, but in the absence of the original specimens the question of which is the type cannot be answered. The conventional concept is closest to that of the form with the narrow dissepimentarium, and it seems best to base the genus this way until a detailed restudy is available.

Zaphrentis sp. cf. Z. phrygia Rafinesque and Clifford

Plate 5, figures 9–14

1820. *Turbinolia (Zaphrenthis) phrygia* Rafinesque and Clifford, p. 235.
1821. *Caryophyllia cornicula* Lesueur, p. 297–298.
1851. *Zaphrentis cornicula* (Lesueur). Milne-Edwards and Haime [part]; p. 327–328, pl. 6, fig. 1c (possibly figs. 1, 1a, 1b, 1d; not 1e).
1938. [not] *Zaphrentis cornicula* (Lesueur). Schindewolf, p. 441–445, pl. 44, figs. 1–2.
1949. *Zaphrentis phrygia* Rafinesque and Clifford. Stumm, p. 12, pl. 5, figs. 14–16.

Description.—Small curved-trochoid horn corals with deep, wide calice. Dimensions: diameter of calice margin, 10 to 12 mm; depth of calice, 6 to 10 mm; length of corallum, estimated 10 to 15 mm. Major septa number 30 to 36, extend to axis where they may meet; many crossbar carinae are on peripheral half of septa. Minor septa short, carinate. Septa pinnately arranged with deep cardinal fossula owing to retardation in development of cardinal septum. Wall of calice very thin; dissepiments few or absent. No axial structure.

Remarks.—The above description is based on 13 external molds of calices, 2 of which also show parts of the corallum exterior. Such material cannot be definitely identified, but the specimens have been compared with topotype material of *Z. phrygia* in U.S. National Museum collections and are certainly close if not identical.

Occurrence: Upper part of Moose River sandstone, Somerset County, Maine. Detailed locality data on table 2.

Zaphrentis? spp.

Several specimens in the collections are apparently referrable to *Zaphrentis* but differ significantly from the specimens described as *Z.* cf. *Z. phrygia.*

Two specimens clearly show dissepiments on the inner face of a thick calice wall; the septa are carinate. These specimens are comparable to species which have been referred to *Heliophylloides* Stumm. (See generic discussion.)

Five specimens are of zaphrentoid, carinate corals and may be conspecific with one of the above or represent a third species.

The locality distribution of this material is shown on table 2.

MISCELLANEOUS RUGOSE CORALS

Five corals show evidence of distinct dissepimentaria but have noncarinate septa. These are loosely classified as cyathophylloid corals in table 2, but cannot be further identified.

Occurrences of additional indeterminate molds and fragments are given in table 2. These are all small trochoid to ceratoid horn corals ranging in length from 1.5 to 6 cm. Some of the calice molds are of forms with noncarinate septa and zaphrentoid septal plan and may represent the genus *Heterophrentis.* Other calice molds and all the molds of exteriors do not preserve any features which might permit even a guess as to their relationships.

Order TABULATA

Family FAVOSITIDAE

Genus PLEURODICTYUM Goldfuss

1829. *Pleurodictyum* Goldfuss, p. 113.
1879. *Pleurodictyum* Goldfuss. Nicholson, p. 142.
1952. *Pleurodictyum* Goldfuss. Smith, p. 302.
1953. *Pleurodictyum* Goldfuss. Ross, p. 74–75.
1956. *Pleurodictyum* Goldfuss. Hill and Stumm, p. 466.

Type species.—By monotypy, *P. problematicum* Goldfuss (1829, p. 113, pl. 38, figs. 18a–g). Lower Devonian, Germany.

Remarks.—See the above references for detailed synonomies and discussions of this genus.

Pleurodictyum sp. cf. P. problematicum Goldfuss

Plate 5, figure 8

1829. *Pleurodictyum problematicum* Goldfuss, p. 113.
1851. *Pleurodictyum problematicum* Goldfuss. Milne-Edwards and Haime, p. 210–211, pl. 18, figs. 3–6.
1879. *Pleurodictyum problematicum* Goldfuss. Nicholson, p. 144–148 (discussion).

Description.—Five molds of small discoidal colonies are compared to *P. problematicum* because of the presence of the vermiform tube which is often associated with that species. The coralla themselves are poorly preserved, and most features cannot be accurately determined. Dimensions as follows: Corallum diameter, 25 mm; height, 8 mm; corallite diameter at distal end, 5 mm. Tabulae poorly preserved, appear to be gently arched and incomplete. An S-shaped vermiform tube is embedded in the base of each specimen; in one specimen the end of the tube turns upward into the body of the coral. The significance of the tube has been frequently discussed; present opinion considers it a worm tube. (See Sokolov, 1948, and Schindewolf, 1959, for discussions.)

Occurrence: Upper part of the Moose River sandstone, Piscataquis County, Maine. All five specimens are from locality USGS 2732–SD.

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INDEX

[Italic numbers indicate descriptions]

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PLATES 1–5

PLATE 1

[All figures × 3]

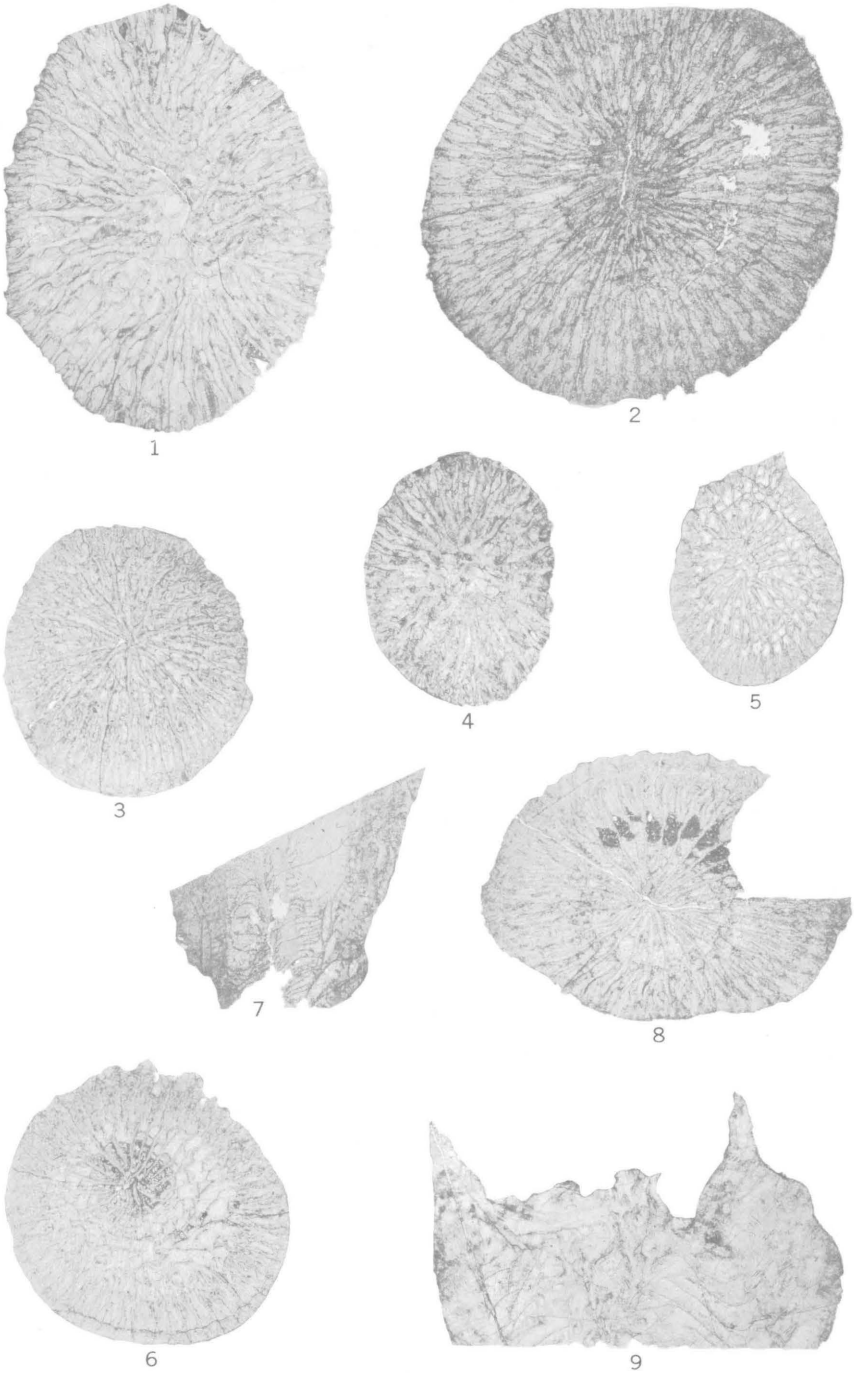
FIGURES 1–9. *Briantelasma mainense* n. sp., Beck Pond limestone (p. 7).

1, 2. Paratypes, USNM 137811 and 137812; transverse thin sections of stereome-filled specimens.

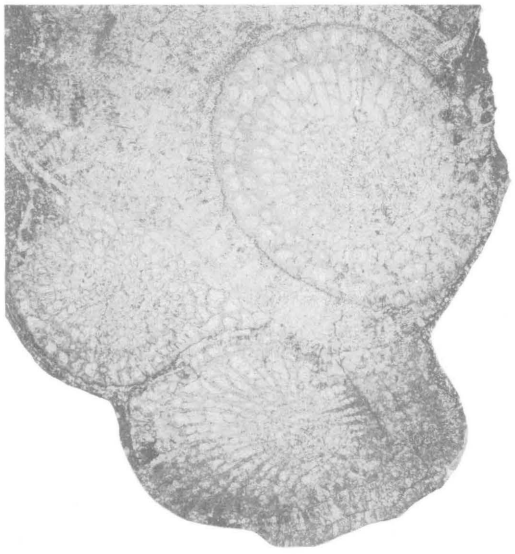
3–5. Paratypes, USNM 137813–137815; transverse thin sections of specimens with open interiors, cardinal septum toward top of plate in each figure.

6, 7. Holotype, USNM 137810; transverse and longitudinal thinsections; cardinal septum toward top of plate in figure 6.

8, 9. Paratypes, USMN 137816 and 137817; transverse and longitudinal thin sections of specimens with marginarium of medium width.



BRIANTELASMA MAINENSE N. SP.



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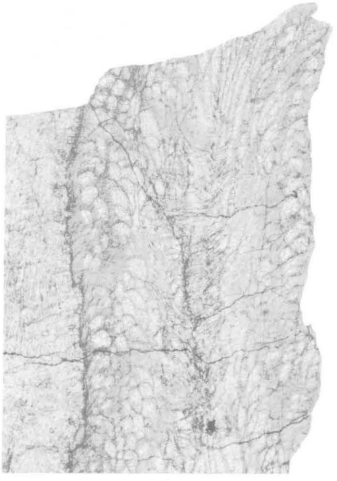

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LYRIELASMA ANNULATUM N. SP.

PLATE 2

[All figures × 4]

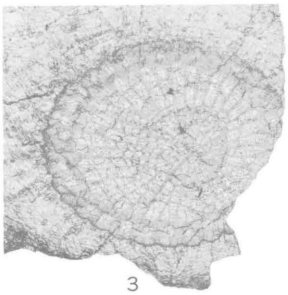
FIGURES 1–6. *Lyrielasma annulatum* n. sp., Beck Pond limestone (p. 10).

1. Paratype, USNM 137820; transverse thin section of three specimens encrusted by stromatoporoid.
2–5. Paratypes, USNM 137821–137824; longitudinal thin sections; figures 2, 4 and 5 are encrusted by stromatoporoids.
6. Paratype, USNM 137828; transverse thin section of specimens encrusted by stromatoporoid.

PLATE 3

FIGURES 1–5. *Lyrielasma annulatum* n. sp. (×4), Beck Pond limestone (p. 10).
1–3. Paratypes, USNM 137825–137827; transverse thin sections; figures 1 and 3 encrusted by stromatoporoid.
4, 5. Holotype, USNM 137819; longitudinal and transverse thin sections.

6–11. *Amplexiphyllum nanum* n. sp. (×6), Beck Pond limestone (p. 5).
6. Paratype, USNM 137807; transverse thin section.
7, 8. Paratype, USNM 137808; transverse thin sections of ephebic and early neanic portions.
9–11. Holotype, USNM 137806; transverse thin sections of ephebic and late neanic stages and longitudinal thin section (apparent inner wall on fig. 9 is due to strongly down-bent tabulum).



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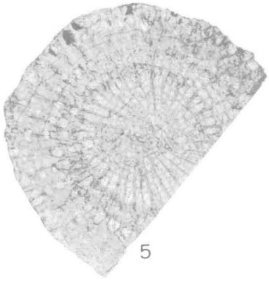

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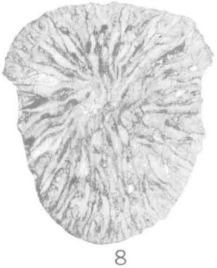

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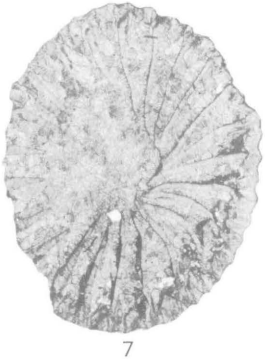

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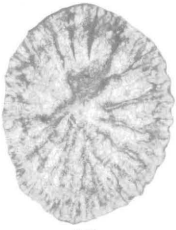

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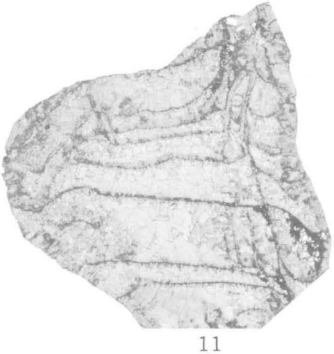
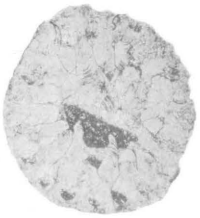


11

LYRIELASMA ANNULATUM N. SP. AND
AMPLEXIPHYLLUM NANUM N. SP.

1



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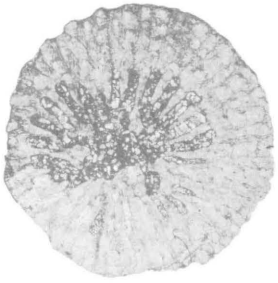

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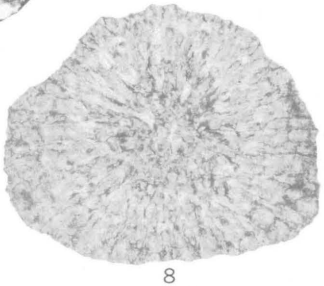

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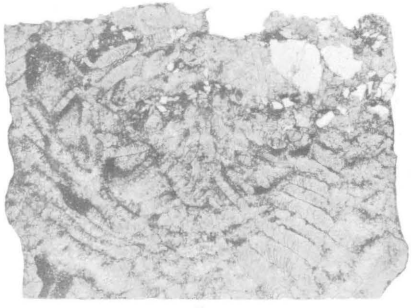


7

TRYPLASMA RHOPALIUM N. SP. AND *TRYPLASMA* CF. *T. RHOPALIUM*

PLATE 4

FIGURES 1–7. *Tryplasma rhopalium* n. sp. (×2), Beck Pond limestone (p. 13).
1, 2 Holotype, USNM 137831; longitudinal and transverse thin sections showing tabulae and dilated septal spines (×6).
3. Paratype, USNM 137832, locality 3601; transverse thin section through the lower part of the calice (×6).
4, 5. Paratype, USNM 137833; longitudinal and transverse thin sections (×6).
6, 7. Paratype, USNM 137834; transverse and longitudinal thin sections of large individual (×5).

8–9. *Tryplasma* cf. *T. rhopalium*, Keyser limestone, Keyser, W. Va. (p. 14). USNM 137836; transverse and longitudinal thin sections (×5).

PLATE 5

FIGURES 1–7. *Favosites* sp. (×2), Beck Pond limestone (p. 15).

1, 2. *Favosites* type 1, USNM 137837; longitudinal and transverse thin sections of nearly complete corallum.

3, 4. *Favosites* type 2, USNM 137838; longitudinal and transverse thin sections of fragment.

5, 6. *Favosites* type 3, USNM 137839; longitudinal and transverse thin sections of part of corallum.

7. *Favosites* type 4, USNM 137840; thin section of fragment of growing tip of ramose corallum.

8. *Pleurodictyum* cf. *P. problematicum* (×2), Moose River sandstone; USNM 137842; basal view of corallum mold and vermiform tube.

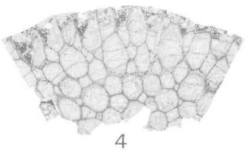
9–14. *Zaphrentis cf. Z. phrygia* (×2), Moose River sandstone.

9–12. USNM 137845; views of calice molds showing septal plan, fossula and carinae.

13. USNM 137843; side view of mold showing thickness of calice wall.

14. USNM 137844; basal view of calice mold showing fossula, carinae and septal plan.


1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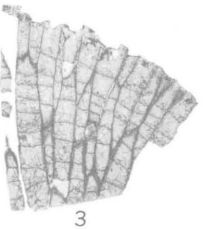
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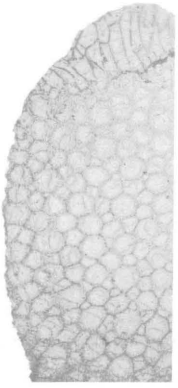
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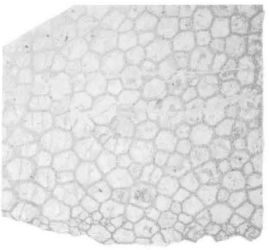
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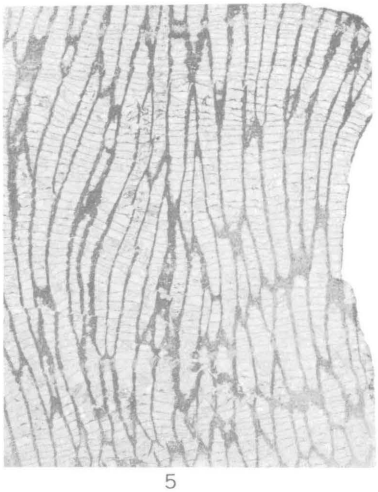
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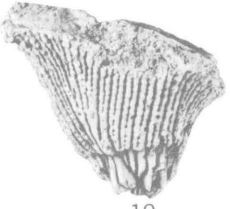
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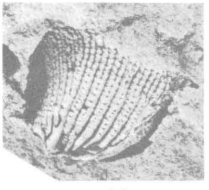
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14

FAVOSITES SP., *PLEURODICTYUM* CF. *P. PROBLEMATICUM*, AND *ZAPHRENTIS* CF. *Z. PHRYGIA*