Middle Devonian Rugose Corals of the Central Great Basin

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By C. W. MERRIAM

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A stratigraphic-paleontologic study of middle Middle Devonian rugose corals and their use in geologic correlation

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MIDDLE DEVONIAN RUGOSE CORALS OF THE CENTRAL GREAT BASIN

By C. W. MERRIAM

ABSTRACT

Great Basin Middle Devonian rugose corals here described and illustrated comprise 20 genera and subgenera of coral zones F and G. The entire Devonian column of this province is subdivided on the basis of Rugosa into nine zones, A through I in ascending stratigraphic order. Of these genera and subgenera, 13 have not been found in the lower Middle Devonian below coral zone F; none of them are recognized above coral zone G and the *Stringocephalus* zone. A coral evolutionary burst in Great Basin coral zone D is separated from that of zone F by a barren zone (coral zone E) with few Rugosa. The final Devonian burst of Rugosa, that of the Phillipsastraeidae in Upper Devonian coral zone I, is separated from zone G by another interval of sparse Rugosa in coral zone H, wherein the stromatoporoids predominate.

Most of the described Rugosa, those of middle Devonian coral zone F (unit 4 of the Nevada Formation at Lone Mountain), occur in the Antelope–Roberts Mountains facies belt. This belt is distinguished on the basis of lithology and faunas from both the Monitor–Simpson Park facies belt on the west and the Diamond Mountains facies belt on the east.

Rugosa of coral zone F characterize the Cockalorum Wash Formation in the southernmost Fish Creek Range. This new geologic unit includes more siltstone and gritty sandstone than either unit 4 of the Nevada Formation at Lone Mountain or the Woodpecker Limestone Member of the Nevada Formation in the Diamond Range, both of which are approximately correlative with the upper beds of zone F. The Cockalorum Wash Formation lies in a highly complex structural relation to contiguous rocks and is without exposed stratigraphic top or bottom.

Digonophyllidae and Ptenophyllidae related to species of western Canada and the Rhine Valley of Germany are the distinctive solitary rugose corals of Great Basin coral zones F and G. Among the digonophyllids are *Mesophyllum (Lekanophyllum)* and *Digonophyllum (Mochlophyllum);* the Ptenophyllidae are represented by *Acanthophyllum.* Of the abundant colonial Rugosa, yardarm-carinate *Hexagonaria* of the *H. fisherae* group is common throughout the Antelope–Roberts Mountains facies belt and is especially abundant locally in the Cockalorum Wash Formation as an incipient patch reef builder.

Of special stratigraphic and correlation value are the colonial genera *Sociophyllum, Utaratuia,* and *Taimyrophyllum* in coral zone F, occurring also in the correlative Hume and Nahanni Formations of western Canada.

Coral zone G is best represented in the Diamond Mountains facies belt, where it is typified by a 30-foot band in the Nevada Formation bracketing the top of the Woodpecker Limestone Member and the base of the Bay State Dolomite Member. In coral zone G occur the lowest *Stringocephalus, Rensselandia, Heliolites,* and the rugose corals *Digonophyllum (Mochlophyllum) alhambraensis, Cyathophyllum (Moravophyllum) alhambraensis,* and species of *Mesophyllum, Cystiphylloides,* and *Acanthophyllum.* Great Basin coral zone G lacks the distinctive colonial Rugosa of coral zone F.

Middle Devonian strata of southeastern Alaska include the *Stringocephalus* zone and contain Digonophyllidae and Ptenophyllidae similar to those of Great Basin coral zones F and G. The middle Middle Devonian coral-bearing formations of eastern North America have fewer paleontologic ties with the Great Basin than do those of southeastern Alaska, western Canada, and Europe.

Great Basin coral zone G at the bottom of the *Stringocephalus* zone is correlative with the Rhine Valley Givetian. Coral zone F below the *Stringocephalus* zone is considered later Eifelian, approximately correlative with the Junkerberg Schichten of the Eifel district, Germany.

INTRODUCTION

Middle Devonian rugose corals of the Great Basin are best known in a 20-mile-wide linear belt extending southward 125 miles from the Roberts Mountains through the Antelope Range to the south end of the Hot Creek Range, Nev. (figs 1, 4). Within the prevailingly carbonate lithofacies of this Antelope–Roberts Mountains belt, exposures containing abundant corals have a patchy distribution, suggesting that environments conducive to prolific coral growth were restricted to scattered and relatively small areas of Devonian sea bottom. Elsewhere these Middle Devonian rocks are either sparsely fossiliferous, or the common fossils are brachiopods, Mollusca, and trilobites with an occasional solitary rugose coral or tabulate. Tentaculites are numerous locally. Strata with abundant Rugosa may be either limestone or dolomite in favorable coral growth sites. However, in this Middle Devonian interval the greatest development and diversity of a potentially reef-forming coral biota appear to be in dolomitic limestone facies, as for example in unit 4 of the Nevada Formation and in Devonian coral zone F at Lone Mountain.

PURPOSE AND SCOPE

The main purposes of this long-term investigation are to describe, classify, and illustrate the rugose corals of Great Basin Middle Devonian coral zones F and G and to elucidate their stratigraphic occurrence. Conclusions regarding stratigraphic order and zonation of enclosing rocks are supported by detailed geologic

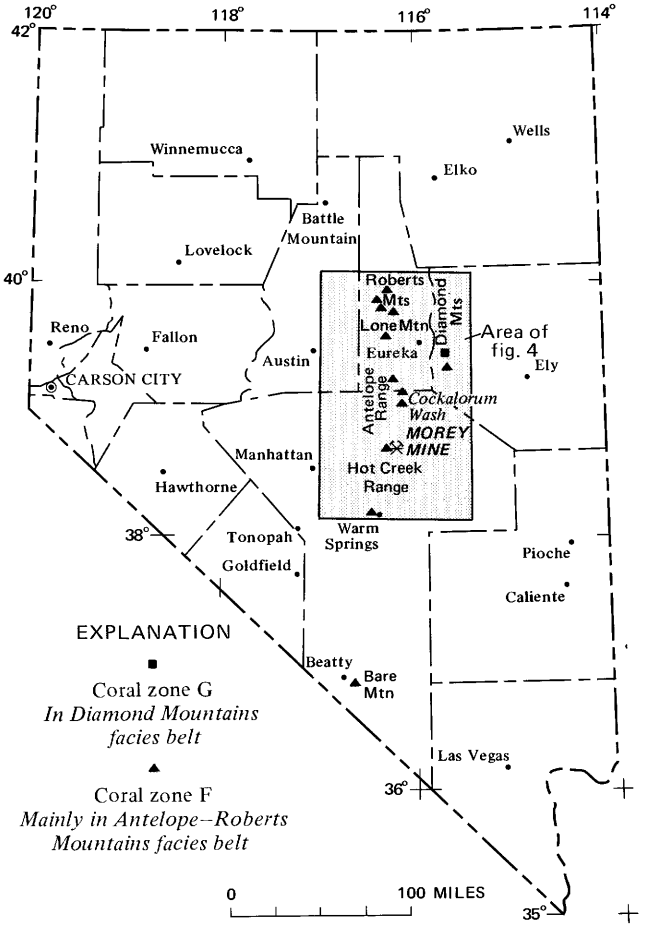


FIGURE 1.—Distribution of Middle Devonian rocks containing Rugosa of coral zones F and G.

mapping at Lone Mountain and in parts of the Cockalorum Wash quadrangle by Merriam and in the Pinto Summit quadrangle, southern Diamond Mountains by Nolan, Merriam, and Blake (1973). Finally, the Middle Devonian coral-bearing strata here dealt with are correlated by means of Rugosa and certain key brachiopods with those of western Canada, southeastern Alaska, and the Rhine Valley of Germany.

HISTORY OF INVESTIGATION

This coral study is an outgrowth of stratigraphic and paleontologic investigations of Devonian rocks in the Roberts Mountains region that began in 1932 (Merriam, 1940). Rugose corals collected throughout the Silurian and Devonian rock of this structurally complex area were especially useful in identifying, mapping, and subdividing rocks of these systems. A long-term descriptive and taxonomic investigation of Great Basin Devonian Rugosa was initiated in subsequent years, as reconnaissance geologic mapping and stratigraphic work proceeded to the south at Lone Mountain and Antelope Valley (Merriam, 1963).

During the 1950's geologic mapping and stratigraphic investigation by Nolan and Merriam under the Kobeh Valley project gave added impetus to these paleontologic studies. Since 1963, the opportunity has presented itself to concentrate upon and bring this coral research to completion.

Prior to this study a number of rugose corals from Lone Mountain and the Eureka mining district were described by the late E. C. Stumm (1937, 1938) in reports based upon study of Smithsonian Institution collections. These collections were made largely by C. D. Walcott and associates during initial mapping of the Eureka district in 1880 (Hague, 1892), supplemented in later years by Edwin Kirk of the U.S. Geological Survey and by the writer. General advances in knowledge of Devonian Rugosa within the past 25 years by many contributors throughout the world made research on Great Basin corals far more rewarding than would have been possible before 1940.

A monographic study of Lower and lower Middle Devonian Rugosa of the central Great Basin was completed in 1969 (Merriam, 1973), a work dealing with the faunas of coral zones A, B, C, and D. The present contribution completes description of Middle Devonian rugose corals through coral zone G of Givetian age. Comparative research has been carried on concurrently with similar Middle Devonian Rugosa of southeastern Alaska. Recently published investigations of Middle Devonian rugose corals of western Canada by Lenz (1961), by McLaren (in McLaren and Norris, 1964), and by Pedder (1964) have facilitated meaningful paleontologic comparison with coral assemblages of the northern Cordilleran seaways.

ACKNOWLEDGMENTS

Acknowledgment is made to the Smithsonian Institution for loan of type specimens figured by the late E. C. Stumm. Other collections made use of in this study are from the Confusion Range, Utah, made by R. K. Hose, U.S. Geological Survey; from the Hot Creek Range, Nev., by F. J. Kleinhampl and H. W. Dodge of the U.S. Geological Survey; and from the Bare Mountain area, Nevada, by H. R. Cornwall and F. J. Kleinhampl. A collection from Red Canyon, Roberts Mountains, was loaned by J. G. Johnson.

Ellis Yochelson, of the U.S. Geological Survey, Washington, D.C., provided identifications of gastropod genera associated with the described Rugosa in the newly named Cockalorum Wash Formation.

Thin sections used in connection with this report were prepared mainly by Robert Shely of the Menlo Park center; those of the Red Canyon corals were made

in Washington, D.C., by William Pinckney. All photographs of corals are the work of Kenji Sakamoto.

GREAT BASIN DEVONIAN CORAL ZONES

Devonian rugose corals of the central Great Basin range upward from the Rabbit Hill Limestone of Early Devonian (Helderberg) age to Late Devonian beds in the upper part of the Devils Gate Limestone. No Rugosa have been found in the uppermost Devonian of this region. Figure 2 presents the Great Basin Devonian coral zones and illustrates the composite nature of the coral sequence. Unfortunately no individual stratigraphic section has been found that includes all coral evidence of zones in continual sequence.

The proposed Great Basin Devonian coral zones, nine in number (Merriam, 1973b), are designated by capital letters in stratigraphic order A through I. In reference sections where each is defined, six of the coral zones correspond to mappable lithologic units. Coral zones B and C fall within a single map division, unit 1 of the Nevada Formation. Coral zone G occupies a narrow band bracketing the topmost beds of the Woodpecker Limestone Member of the Nevada and the lowermost beds of the overlying Bay State Dolomite Member.

Coral zones A, B, and C are of Early Devonian age; coral zone D is Early and early Middle Devonian. Zones E, F, G, and probably the lower half of zone H are Middle Devonian. Coral zone I is Late Devonian; the highest Devonian of this region, in the lower part of the Pilot Shale or its limestone equivalent, has yielded no Rugosa. For convenience the lettered primary coral zones are further divided into subzones as D_1, D_2, and D_3. In this instance, subzone D_1 has a rugose coral assemblage regarded as late Early Devonian, D_2 is considered Early or early Middle Devonian, and D_3 is Middle Devonian.

Following the major burst of rugose coral evolution (Merriam, 1973a) in Late Silurian limestone environments of the Great Basin (Silurian coral zone E), the Rugosa of Helderbergian coral zone A became greatly restricted in number of families. In most exposures of the Helderbergian Rabbit Hill Limestone and the correlative part of the Beacon Peak Dolomite Member of the Nevada Formation, coral zone A is characterized by *Syringaxon* (fig. 3); this abundant small solitary form is associated with *Pleurodictyum* and the favositids. *Australophyllum* and *Billingsastraea* are present but very uncommon in this zone. Coral zones B and C are characterized by solitary Halliidae. Large endemic unnamed members of this family in zone B probably gave rise to *Papiliophyllum* of zone C, associated here with other Halliidae such as *Aulacophyllum* and *Odontophyllum*. The siphonophrentids appear in the record at this time with *Siphonophrentis (Breviphrentis)*, which becomes the most abundant coral in succeeding coral zone D. *Papiliophyllum* persists into D_1, as the last of the Halliidae. Subzone D_2 is marked by another major burst of rugose coral differentiation in which *Siphonophrentis (Breviphrentis)*, *Bethanyphyllum*, *Billingsastraea*, an early subgenus of *Hexagonaria*, *Cystiphylloides*, and *Mesophyllum* are common. Digonophyllidae including *Mesophyllum and Zonophyllum* first appear at this time. The large *Mesophyllum (Arcophyllum)* is introduced in subzone D_3.

Rugosa are poorly represented in coral zone E by *Disphyllum* and cyathophyllids in what is called the "barren zone". Coral zone F introduces several new groups to populate an interval of great rugose coral proliferation, tapering off in coral zone G when the *Stringocephalus* brachiopod facies came to predominate.

Coral zone H, like zone E, has yielded few Rugosa. Massive stromatoporoids and *Amphipora* predominate in zone H and the lower part of the Devils Gate wherein they became major carbonate builders. Newly introduced Phillipsastraeidae predominate in coral zone I of the higher Devils Gate, following the disappearance of Digonophyllidae, Ptenophyllidae, and the colonial genera of late Middle Devonian time. This marks the ultimate evolutionary burst of Devonian rugose corals in the Great Basin province. None have been found in the uppermost Devonian rocks.

FACIES BELTS OF THE CENTRAL GREAT BASIN DEVONIAN

Distribution and geographically changing abundance of Devonian rugose corals in the central Great Basin clearly reflect east-west facies changes. On the basis of lithology and of biofacies, three north-south-trending facies belts are recognized in this region, in order as follows from west to east: (1) Monitor–Simpson Park facies belt, (2) Antelope–Roberts Mountains facies belt, and (3) Diamond Mountains facies belt (fig. 4). West of the Antelope–Roberts Mountains belt, known rugose corals are mainly small solitary forms of the genus *Syringaxon* in Lower Devonian limestones of the roughly parallel Monitor–Simpson Park belt; Middle Devonian Rugosa are almost unknown in this westerly belt. East of the Antelope–Roberts Mountains belt, the Middle Devonian strata of the Diamond Mountains belt are less rich in corals, and the underlying Lower Devonian dolomites and sandstones have yielded almost no identifiable fossils.

The locally coral-rich Antelope–Roberts Mountains belt probably extends southward beyond the Hot Creek Range, for colonial Rugosa typical of this belt occur at Bare Mountain 90 miles south of Warm Springs (fig. 4), which is the southernmost coral locality in the Hot Creek Range.

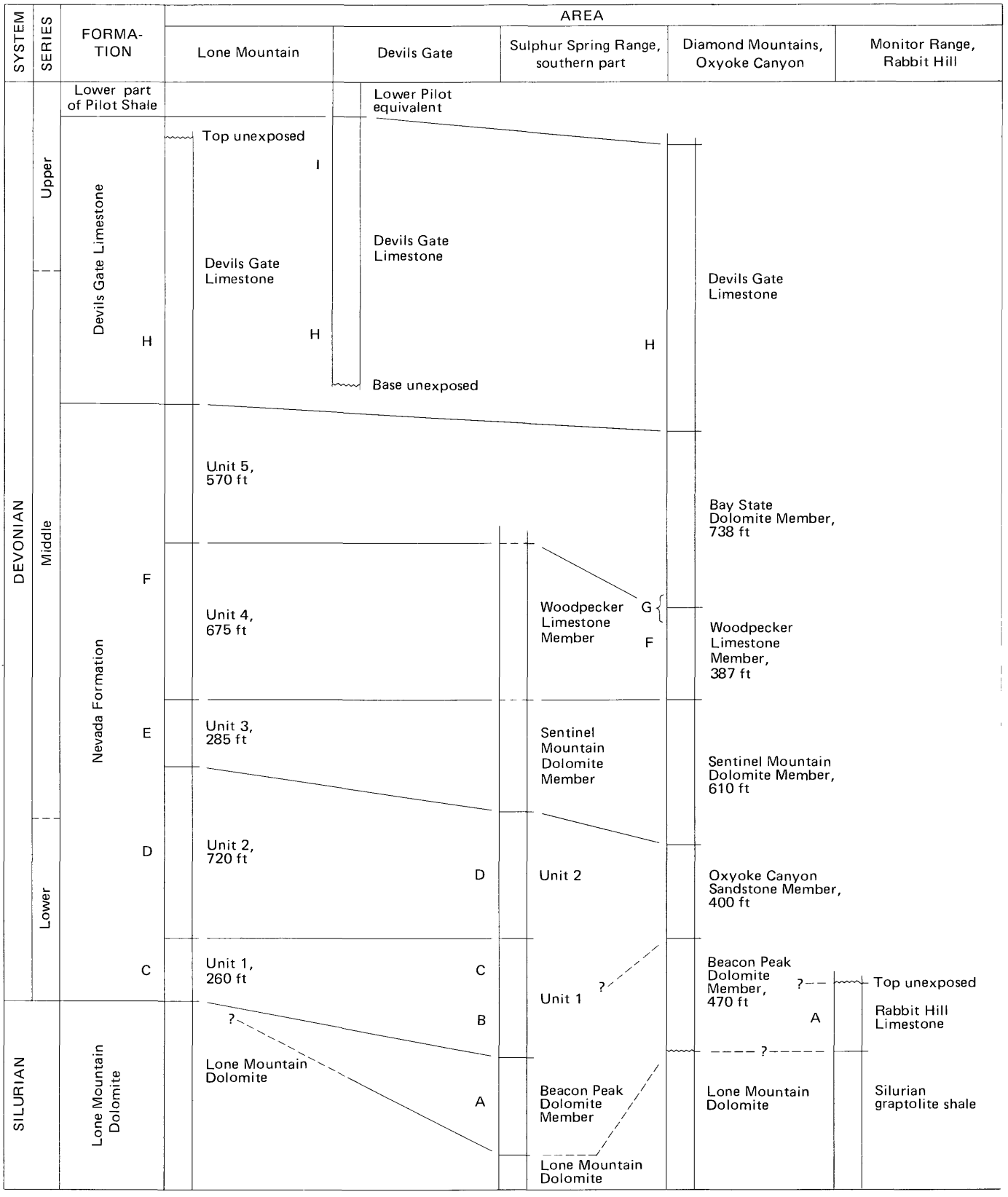
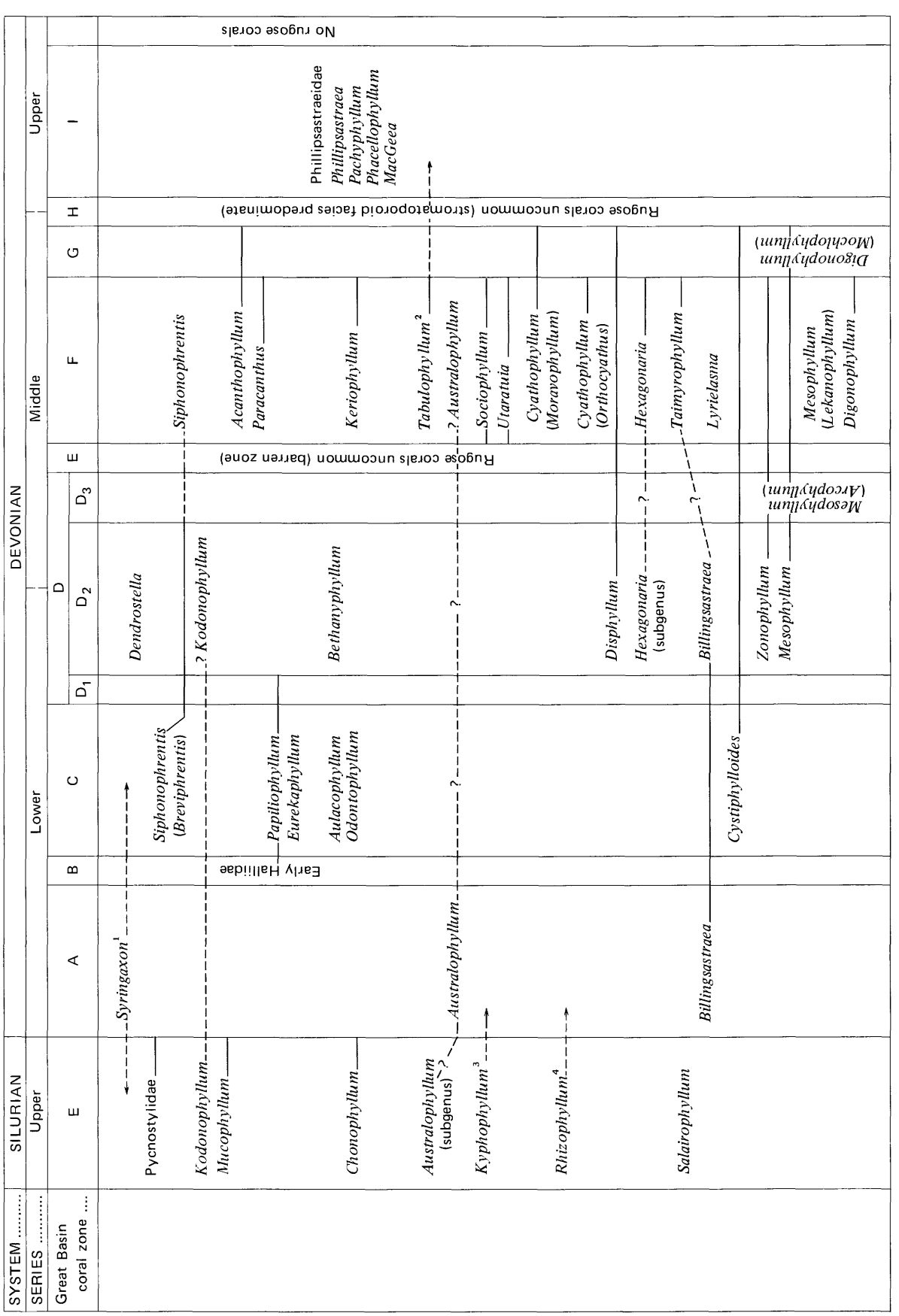


FIGURE 2.—Great Basin Devonian coral zones A through I in relation to Devonian stratigraphic units of the central Great Basin. See figure 4 for location of sections.



[1] In other regions *Syringaxon* occurs in Silurian and Devonian strata.
[2] *Tabulophyllum* occurs in Upper Devonian strata of other regions.
[3] In other regions *Kyphophyllum* occurs in beds of possible earliest Devonian age.
[4] *Rhizophyllum* occurs in Lower Devonian strata of eastern Europe.

FIGURE 3.—Characteristic rugose coral genera and their stratigraphic ranges in Great Basin Devonian coral zones.

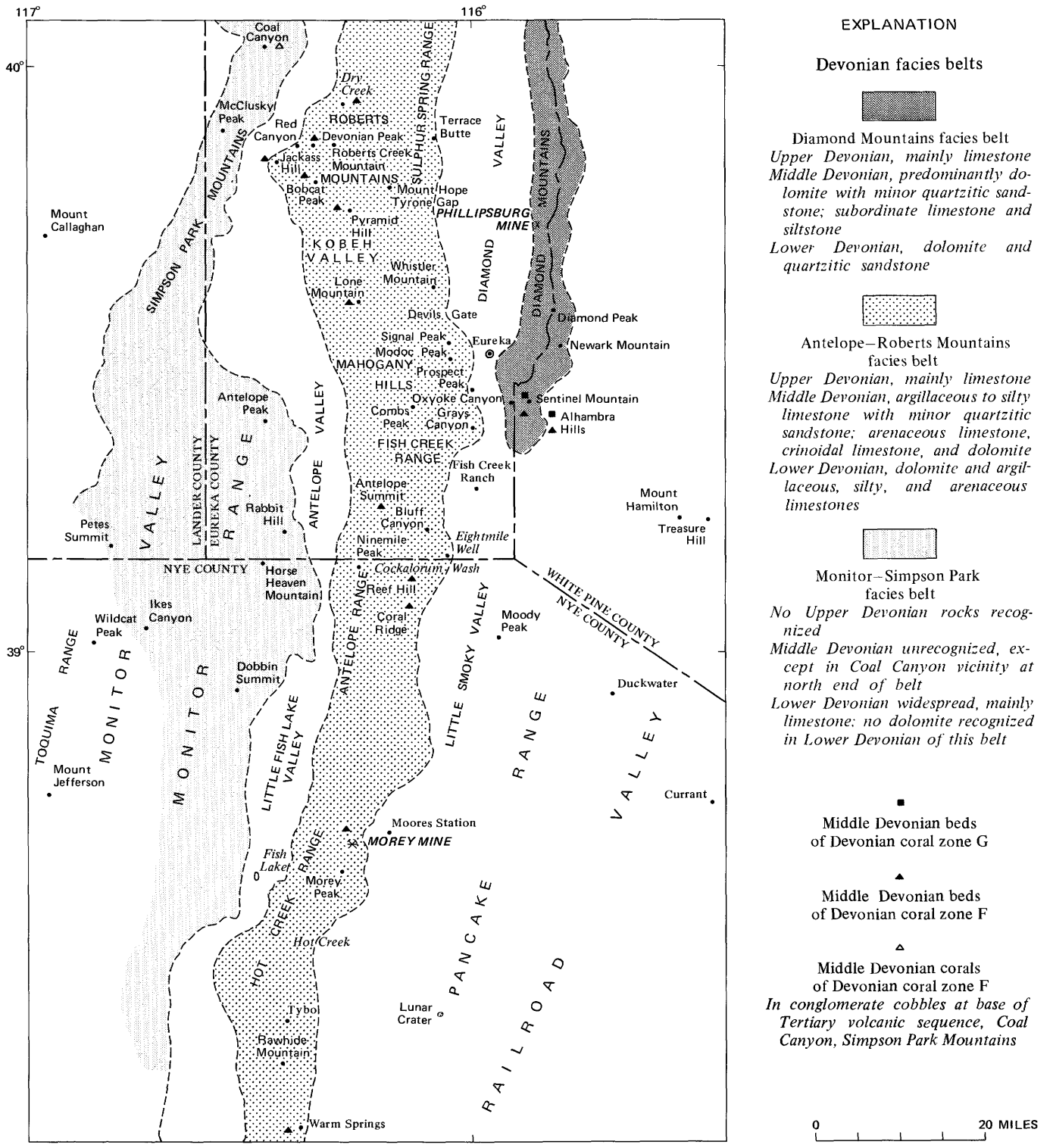


FIGURE 4.—Devonian facies belts and Middle Devonian rugose coral-collection sites in the central Great Basin.

In the eastern Great Basin, beyond the limits of this study, the prevailingly dolomitic Middle Devonian rocks have been little explored for rugose corals. The Simonson dolomite and lower part of the Guilmette Formation in western Utah contain solitary Rugosa of Middle Devonian age; however, the Middle and the Lower Devonian dolomites of the eastern Great Basin generally appear to contain few Rugosa in coral biotas which are probably less diverse taxonomically than are those in the Antelope–Roberts Mountains belt of the central Great Basin.

The reference stratigraphic section of the Antelope–Roberts Mountains facies belt is situated at Lone Mountain, Eureka County, Nev. (figs. 2, 4, 5). Here the Nevada Formation is subdivided lithologically as map units numbered 1 through 5 in ascending stratigraphic order. The coral zones here employed are those previously used (Merriam, 1973b). In accordance with this proposed scheme, the Great Basin Devonian coral zones, nine in number, are lettered A through I in ascending sequence. The rugose corals here described occur in coral zones F and G, which in the European scale are approximately upper Eifelian and Givetian. A majority of the described forms come from Nevada unit 4 and Devonian coral zone F at Lone Mountain.

Reference section of the Diamond Mountains Devonian belt is in upper Oxyoke Canyon southeast of Eureka, Nev. Here the rocks bearing the corals of Devonian coral zone G are well exposed at the base of the Bay State Dolomite Member and the top of the Woodpecker Limestone Member of the Nevada Formation. At Lone Mountain, unit 5 of the Nevada occupies the approximate stratigraphic interval of the Bay State.

RUGOSE CORALS AND STRATIGRAPHY OF MIDDLE DEVONIAN CORAL ZONES F AND G IN THE CENTRAL GREAT BASIN

Rugose coral study material used in this report is classified in 53 taxa (table 1), of which 45 percent is assigned to formally named species and subspecies. The remainder is provisionally designated specifically by letter, in most instances being represented in our collections by few individuals or by incomplete specimens. Of these taxa, 54 percent is colonial genera, a figure reflecting the especially vigorous coral growth activity during this interval of Devonian time in the Cordilleran belt of western North America.

The formal taxonomy of Rugosa in Great Basin Devonian coral zones F and G is dealt with elsewhere in this report.

RUGOSE CORALS AND STRATIGRAPHY OF MIDDLE DEVONIAN CORAL ZONES F AND G IN THE ANTELOPE–ROBERTS MOUNTAINS FACIES BELT

Most of the Rugosa collected from zones F and G of the Middle Devonian section in the Antelope–Roberts Mountains facies belt occur in Great Basin Devonian coral zone F. A coral assemblage from Red Canyon in the Roberts Mountains may possibly pertain to coral zone G, as discussed later.

Geologic mapping provides stratigraphic control in several areas from whence came the rugose corals of the Antelope–Roberts Mountains belt. In the Roberts Mountains, in the Antelope Valley area, and southward, the mapping is of a reconnaissance nature (Merriam and Anderson, 1942; Merriam, 1963; Kleinhampl and Ziony, 1967). More detailed mapping has in recent years been done at Lone Mountain and the important Devils Gate area as special stratigraphic projects supplementary to geologic mapping of the Whistler Mountain 15-minute quadrangle. Throughout this belt, thrust faults are major geologic structures that together with later high-angle faults and rapid facies change, greatly complicate stratigraphic interpretation. Complex faulting of coral-bearing Devonian strata called for detailed mapping of parts of the Cockalorum Wash quadrangle in an attempt to clarify stratigraphic relations (fig. 6).

REFERENCE SECTION AND CORAL ZONE F AT LONE MOUNTAIN

Ordovician, Silurian, and Devonian rocks in continuous sequence at Lone Mountain form an east-dipping homocline which includes most of the exposed bedrock (fig. 5). The lower pediment slopes of this mountain are underlain in part by Devonian and Silurian beds and in part by graptolitic beds of the Ordovician Vinini Formation differing greatly in facies from the Ordovician Pogonip Group and the Hanson Creek Formation in the main homoclinal block. Associated with the Vinini are fusulinid-bearing Permian limestones. Although good exposures of bedrock are few and widely scattered on the pediments, it is fairly evident that the Vinini and associated Permian strata lie in thrust fault relation to the normal carbonate rocks of the homocline.

Strata in the Devonian reference section at Lone Mountain are the Nevada Formation overlain by the Devils Gate Limestone of the east-dipping homocline. The Nevada Formation of Early and Middle Devonian age rests conformably upon the Silurian Lone Moun-

TABLE 1.—*Rugose corals of Middle Devonian coral zones F and G and their areas of occurrence*

	Lone Mountain	Roberts Mountains						Antelope Range (north end)	Southern Fish Creek Range		Hot Creek Range		Southern Diamond Mountains		Bare Mountain	Confusion Range, Utah
		Pyramid Hill	Bobcat Peak	Devonian Peak	Jackass Hill	Red Canyon	Dry Creek		Reef Hill	Coral Ridge	Morey Peak area	Warm Springs	Oxyoke Canyon	Alhambra Hills		
Siphonophrentis (Siphonophrentis) sp. b	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....
Cystiphylloides sp. a	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....
iddingsi n. sp	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
sp., cf. *C.* sp. b	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....
sp. c	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....
Zonophyllum sp. r	....	....	....	....	....	×	....	....	....	....	....	....	....	....	....	....
Digonophyllum (Digonophyllum) occidentalis n. sp	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....
sp. c	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×
(Mochlophyllum) alhambraensis n. sp	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....
(Mochlophyllum) alhambraensis subsp. *robertsensis* n. subsp	....	....	....	....	....	×	....	....	....	....	....	....	....	....	....	....
Mesophyllum (Mesophyllum) sp. f	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
n. sp	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....
(Mesophyllum)? sp. k	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
(Lekanophyllum) sp. l	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
(Lekanophyllum) cf. sp. l	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....
Acanthophyllum sp. a	....	....	....	....	....	....	....	....	....	....	....	....	×	×	....	....
robertsensis n. sp	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....
sp. c	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....
sp. p	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....
sp	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Acanthophyllum? sp	....	....	....	....	....	×	....	....	....	....	....	....	....	....	....	....
Paracanthus nevadensis n. gen., n. sp	....	....	....	....	....	×	....	....	....	×	....	....	....	....	....	....
cf. *P. nevadensis*	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....	....
Paracanthus? sp. f	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Cyathophyllum (Moravophyllum) alhambraensis n. sp	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....
(Moravophyllum) sp. l	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
(Moravophyllum) sp	×	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....
(Moravophyllum)? sp	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....	....
(Orthocyathus) flexum (Stumm)	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Keriophyllum mclareni n. sp	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
? *kobehense* (Stumm)	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
? sp., cf. *K. kobehense* (Stumm)	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Sociophyllum eurekaensis n. sp	×	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....
eurekaensis subsp. b	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....
? sp	....	....	....	....	....	....	....	×	....	....	....	....	....	....	....	....
Utaratuia eurekaensis n. sp	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Tabulophyllum antelopensis n. sp	....	....	....	....	....	....	....	×	....	....	....	....	....	....	....	....
Australophyllum prismatophylloides (Stumm)	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Hexagonaria fisherae (Merriam)	×	×	....	×	cf.	....	cf.	....	....	....	....	....	....	....	....	....
fisherae subsp. *cockalorumensis* n. subsp	....	....	....	....	....	....	....	....	×	×	....	....	....	....	....	....
fisherae subsp. *antelopensis* n. subsp	....	....	....	....	....	....	....	×	....	×	....	....	....	....	×	....
meeki n. sp	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....	....
sp., cf. *H. meeki* n. sp	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....
sp. b (Merriam, 1940)	....	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....
sp. c	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....	....
sp. f	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....	....
? sp. h	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....
sp. n	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....
sp. r	....	....	....	....	....	×	....	....	....	....	....	....	....	....	....	....
sp. w	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....
Taimyrophyllum nolani n. sp	×	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Disphyllum sp	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....
Lyrielasma antelopensis n. sp	....	....	....	....	....	....	....	×	....	....	....	....	....	....	....	....

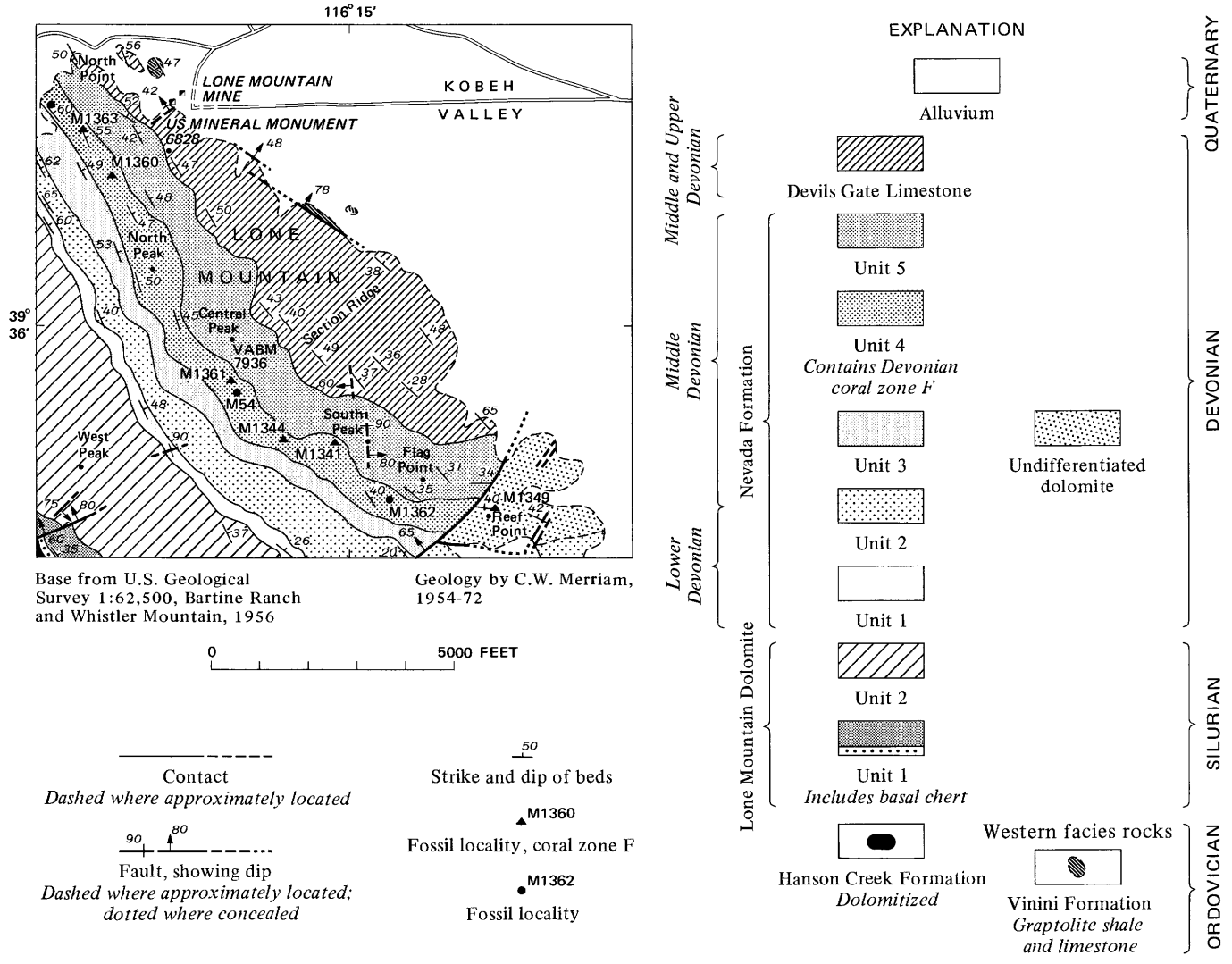


FIGURE 5.—Northeastern part of Lone Mountain, Eureka County, Nev., showing principal collection sites for coral zone F in unit 4 of the Nevada Formation.

tain Dolomite and is overlain without recognized break by the Devils Gate. For mapping purposes the Nevada is subdivided as five lithologic units numbered in ascending order 1 through 5 and shown in figure 5. Unit 1 and the lowermost part of unit 2 are Early Devonian. Middle Devonian Rugosa occur in the middle and upper parts of unit 2 and upward through unit 4. Unit 3 has yielded only poorly preserved disphyllid and cyathophyllid corals. Unit 5, a dolomite member aproximately equivalent to the Bay State Dolomite Member in the Diamond Mountains belt, includes *Stringocephalus* beds at Lone Mountain but has yielded no identifiable Rugosa at this locality.

Great Basin Devonian coral zone D brackets unit 2 of the Nevada Formation and in this area is further subdivided as subzones D_1, D_2, and D_3. Of these subzones, D_1, containing advanced *Papiliophyllum*, is viewed as late Early Devonian. D_2, with *Breviphrentis*, *Bethanyphyllum*, *Mesophyllum*, *Zonophyllum*, *Billingsastraea*, and *Hexagonaria*, is considered to be late Early or early Middle Devonian, and D_3, with *Arcophyllum*, is assigned to the Middle Devonian (early Eifelian). Rugosa of coral zones A through D are treated in a separate paper on Lower and lower Middle Devonian rugose corals of the central Great Basin (Merriam, 1973b).

Unit 4 at Lone Mountain rests conformably on the flaggy and heavy-bedded gray limestones of unit 3, which includes thick lenses of rather fine grained crinoidal limestone. Corals and other shell fossils are fragmentary and poorly preserved in these partly bioclastic limestones. In the Diamond Mountains belt the rocks of this interval have been named the Sentinel Mountain Dolomite Member, are dolomitized, and have yielded no identifiable fossils, but otherwise have somewhat the gross lithologic appearance of unit 3.

Lithology and fossils of unit 4 of the Nevada Formation make possible a twofold division of the unit at Lone Mountain. Of the 675 feet of this unit (fig. 7), the upper 250 feet are distinguished by thicker bedding and more prominent massive weathering in places and are in considerable part dolomitic. Corals, especially the colonial Rugosa of coral zone F, are abundant in the dolomites of local growth sites and are generally silicified. The lower 425 feet of unit 4 shows less tendency to become dolomitized at Lone Mountain and comprises thinly bedded and flaggy limestones with occasional beds more than 1 foot thick. Much of this limestone is very fine textured and medium dark to light gray on fresh surface, weathering light gray to buff gray with pinkish streaks. There are some argillaceous partings, but these are less numerous than in the shaly members of unit 2. Silicified brachiopods, tentaculites, and other fossils are numerous and excellently preserved in many beds. Rugose corals are less common than in the upper 250-foot division and are mainly the smaller solitary forms. Locally these lower beds are loaded with tentaculites of the *Nowakia* type. The "*Martinia kirki* zone" of Merriam (1940, p. 56) is essentially the lower 425 feet of unit 4 at Lone Mountain. Rugose corals of coral zone F are most numerous in the upper 250-foot, partly dolomitic division of unit 4.

No identifiable rugose corals have been collected at Lone Mountain above unit 4 of the Nevada Formation. Except for an occasional thick *Stringocephalus* bed, the overlying dark- and light-gray saccharoidal dolomites of unit 5 are sparsely fossiliferous. These resistant dolomites form most of the main ridge of Lone Mountain and are approximately equivalent lithologically and faunally to the Bay State Dolomite Member in the Diamond Mountains belt. Above the dolomites of unit 5, the thick-bedded limestones of the Devils Gate Limestone contain a great abundance of stromatoporoids of both the massive types and of *Amphipora*, apparently to the exclusion of most Rugosa.

Rugose corals of zone F collected during the course of this study from the upper 250-foot interval of unit 4 of the Nevada Formation at Lone Mountain are as follows:

Cystiphylloides iddingsi n. sp.
Mesophyllum sp. f
Mesophyllum (*Lekanophyllum*) sp. l
Keriophyllum mclareni n. sp.
Keriophyllum? cf *K.*? *kobehense* (Stumm)
Acanthophyllum sp.
Paracanthus? sp. f
Cyathophyllum (*Moravophyllum*) sp.
Cyathophyllum (*Moravophyllum*) sp. l
Cyathophyllum (*Orthocyathus*) *flexum* (Stumm)
Sociophyllum eurekaensis n. sp.
Utaratuia nevadensis n. sp.
Taimyrophyllum nolani n. sp.

Among rugose corals collected by C. D. Walcott at Lone Mountain in 1880 and later described by Stumm (1937; 1938) are the following forms that probably came from unit 4 and coral zone F:

Mesophyllum? sp. k
Keriophyllum? *kobehense* (Stumm)
Cyathophyllum (*Orthocyathus*) *flexum* (Stumm)
Australophyllum prismatophylloides (Stumm)
Hexagonaria fisherae (Merriam)

STRATA OF MIDDLE DEVONIAN CORAL ZONE F AND POSSIBLE ZONE G IN THE ROBERTS MOUNTAINS

East-dipping structural blocks of Nevada Formation with abundant Middle Devonian rugose corals are well exposed in the Roberts Mountains (fig. 4) at Devonian Peak, Bobcat Peak, and Pyramid Hill, where these beds were overridden by upper plate rocks of the Roberts Mountains thrust (Merriam and Anderson, 1942). Except for Pyramid Hill, no detailed stratigraphic work has been done here since the initial reconnaissance studies (Merriam, 1940; Merriam and Anderson, 1942). Strata in the middle and upper parts of the Nevada Formation extending northward in the Roberts Mountains from Pyramid Hill to Devonian Peak are similar lithologically and faunally to those at Lone Mountain. Dolomitization is, however, less evident in the uppermost Nevada, within unit 5 the approximate equivalent of the Bay State Dolomite Member. Presence of Devonian coral zone G has not been established with certainty in the Roberts Mountains.

Less adequately investigated are coral-bearing Middle Devonian limestone outliers in overthrust terrane at Jackass Hill in the western Roberts Mountains, exposures at Dry Creek in the northern Roberts Mountains, and in Red Canyon west of Devonian Peak. These isolated exposures have yielded *Hexagonaria*. The Red Canyon coral assemblage may belong to coral zone G.

Devonian Peak.—Within this large east-dipping fault block 2.5 miles west of the top of Roberts Creek Mountain, the beds near the summit of Devonian Peak contain *Hexagonaria fisherae* and the large brachiopod *Warrenella occidentalis* (Merriam). This horizon probably represents coral zone F. Near this horizon, but possibly somewhat higher stratigraphically, the limestones contain *Heliolites and Hexagonaria* sp. b (Merriam, 1940). The Bay State Dolomite Member (correlative with Nevada unit 5) and the overlying basal Devils Gate Limestone were not recognized in this block.

Bobcat Peak.—The thick east-dipping Devonian section on the east slopes of this mountain passes upward through Nevada Formation unit 4 and includes unit 5 as well as the lower part of the Devils Gate Limestone. Coral-rich beds of unit 4 and coral zone F are well

exposed at locality M1342, where the following corals occur:

Siphonophrentis sp. b
Digonophyllum occidentalis n. sp.
Acanthophyllum robertsensis n. sp.
Cystiphylloides sp., cf. *C.* sp. b
Sociophyllum eurekaensis subsp. b
Heliolites sp.
Thamnopora sp. (coarse, thick form)

Higher in the Bobcat Peak section at locality M1365 and below the massive upper beds, *Hexagonaria* cf. *H. meeki* n. sp. occurs in association with large *Warrenella* similar to *W. occidentalis*. *Thamnopora* is abundant near this occurrence.

Pyramid Hill.—In this isolated hill northeast of the Roberts Creek Ranch house an east-dipping, nearly complete section of the Nevada Formation is especially well exposed. Some 300 feet of thick-bedded, massive Devils Gate Limestone that caps this hill rests conformably upon Nevada unit 5. As at Lone Mountain these lower limestones in the Devils Gate contain abundant *Amphipora* together with massive stromatoporoids. Coral zone F assemblages have been collected here from three localities (M1345, M1348, M1350) in Nevada unit 4. The rugose corals are as follows:

Acanthophyllum sp. p
Sociophyllum eurekaensis n. sp.
Taimyrophyllum nolani n. sp.
Hexagonaria fisherae (Merriam)

Jackass Hill.—In this limestone outlier 2.5 miles northeast of Three Bar Ranch, the Nevada Limestone is surrounded by the overthrust Ordovician Vinini Formation. Coral zone F is represented here by carinate *Hexagonaria* similar to *H. fisherae*.

Dry Creek.—In the northernmost Roberts Mountains, carinate *Hexagonaria* of the *fisherae* type representing coral zone F occurs 1.3 miles southeast of Willow Creek Ranch on the west side of Dry Creek.

Red Canyon.—At locality M1339 in Red Canyon 1.9 miles west of the summit of Devonian Peak, limestones of the Nevada Formation have yielded the following:

Paracanthus nevadensis n. gen., n. sp.
Acanthophyllum? sp.
Zonophyllum sp. r
Digonophyllum (*Mochlophyllum*) *alhambraensis* subsp. *robertsensis* n. subsp.
Hexagonaria sp. r
Thamnopora sp. (coarse, thick form)
stromatoporoids

The stratigraphic horizon of this assemblage may be that of *Digonophyllum* (*Mochlophyllum*) *alhambraensis* in the Diamond Mountains, that is coral zone G.

MIDDLE DEVONIAN ROCKS OF CORAL ZONE F IN THE NORTHERN ANTELOPE RANGE

Middle Devonian limestones of unit 4 and coral zone F, both in the Nevada Formation, are well exposed in the northernmost part of the Antelope Range (fig. 4) which lies in the Cockalorum Wash and Horse Heaven Mountain quadrangles. Here between Antelope summit (7,829) and the mouth of Ninemile Canyon, Devonian rocks rest in thrust fault contact with Upper Cambrian and Ordovician beds. Thick-bedded limestones just east of the Ninemile Canyon fault (Merriam, 1963, pl. 2) contain *Hexagonaria* and probably represent unit 4 and coral zone F.

At locality M1347 on the west side of Antelope summit, low-dipping coralline limestones contain the following:

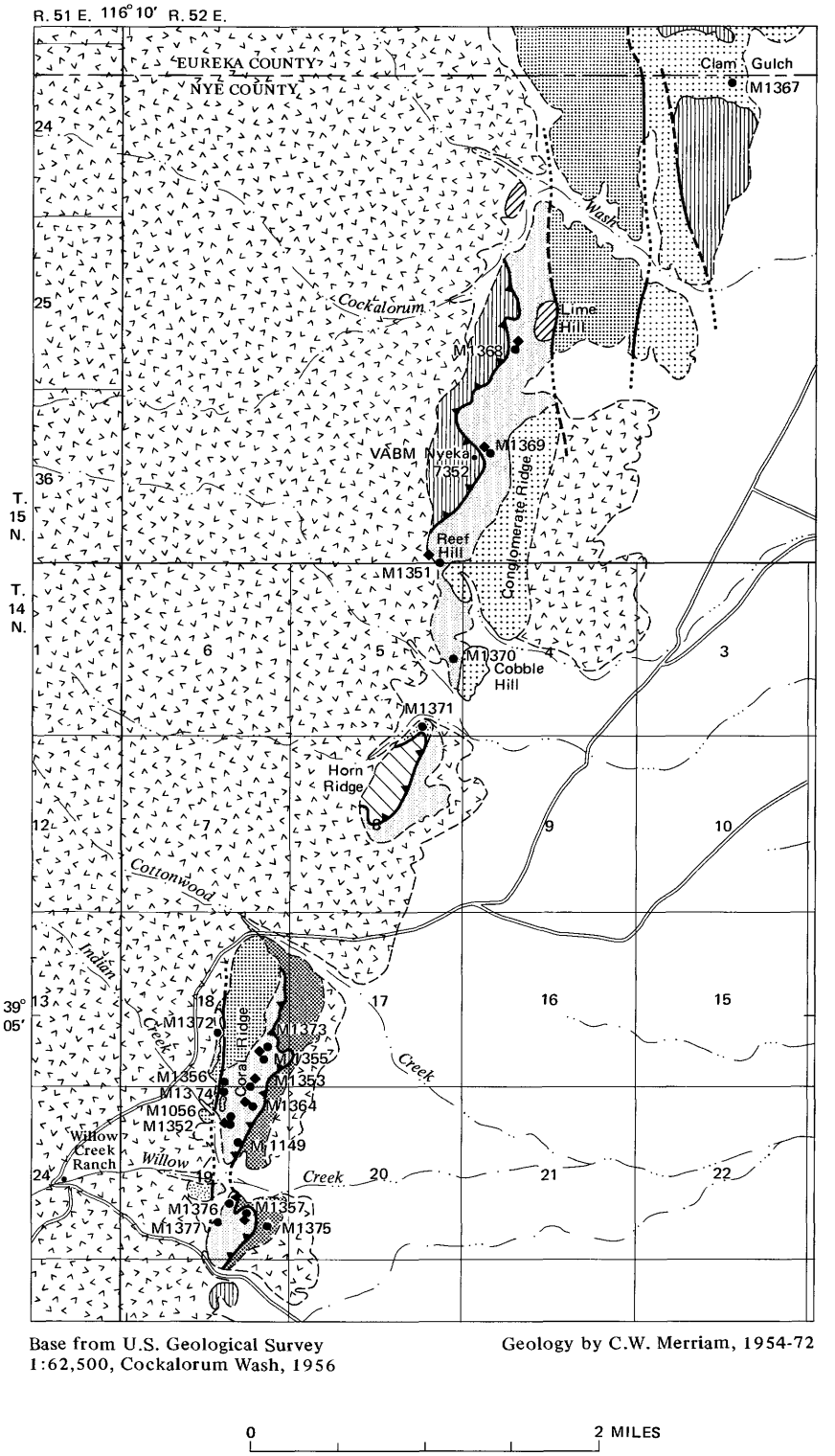
Favosites sp. (massive form)
Tabulophyllum antelopensis n. sp.
Lyrielasma antelopensis n. sp.
Hexagonaria fisherae subsp. *antelopensis* n. subsp.
Warrenella sp.
Atrypa sp.

Three-fourths of a mile north of Antelope summit at locality M30 on the west side of this ridge, platy limestones of unit 4 contain a brachiopod fauna, together with abundant *Receptaculites*, in what is possibly a lower stratigraphic horizon than locality M1347. Among the common fossils here are:

Receptaculites sp. (large platelike form)
Thamnopora sp. (coarse, thick form)
Heliolites sp.
acanthophyllid solitary coral
Sociophyllum? sp.
stromatoporoids (massive)
Schizophoria sp.
Leiorhynchus n. sp., cf. *L. castanea* (large form)
Atrypa sp. (large spiny form)
Warrenella kirki (Merriam)
Dechenella? (pygidium)

MIDDLE DEVONIAN STRATA OF CORAL ZONE F IN THE SOUTHERN FISH CREEK RANGE

A discontinuous outcrop belt of Middle Devonian strata containing zone F corals extends southward 6 miles from Cockalorum Wash to the vicinity of Willow Creek at the south tip of the Fish Creek Range (figs. 4, 6). This new unit, whose formal description as the Cockalorum Wash Formation is given later, is made up of limestones, siltstones, and sandstones. This coral-bearing sequence lies in complexly faulted relation with rocks of other systems and reveals no normal stratigraphic boundary with older or younger Devonian beds. To elucidate the stratigraphy and structure of the new formation, certain parts of the Cockalorum Wash quadrangle have been mapped geologically in some detail (fig. 6). The type section passes through Reef Hill in the northern part of the type area. At Reef Hill large silicified *Hexagonaria* colonies are very numerous in a biohermal limestone near the top of the formation. At the south end of the Devonian outcrop in Coral Ridge near Willow Creek several comparable loci of abundant coral growth occur in these dislocated Cockalorum beds.



Base from U.S. Geological Survey
1:62,500, Cockalorum Wash, 1956

Geology by C.W. Merriam, 1954-72

0 2 MILES

FIGURE 6.—Southernmost part of the Fish Creek Range, Cockalorum Wash quadrangle, showing distribution and structural relations of Cockalorum Wash Formation, which contains faunas of Middle Devonian coral zone F.

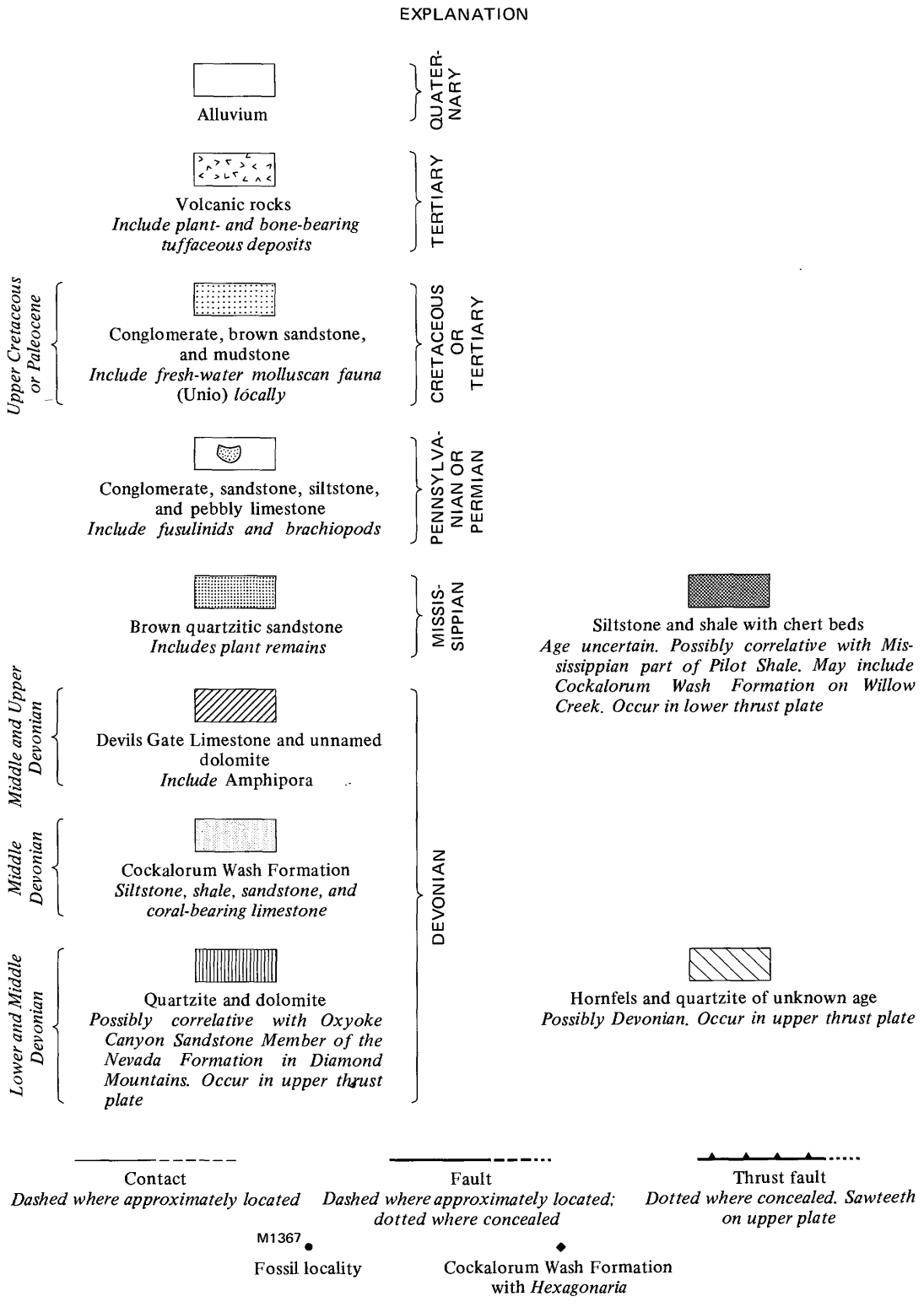


FIGURE 6.—Continued.

COCKALORUM WASH FORMATION

The name Cockalorum Wash Formation (fig. 7) is here applied to some 1,200 feet of limestone, shale, siltstone, and sandstone; it crops out discontinuously in thrust fault slices and high-angle fault blocks in the southernmost Fish Creek Range between Cockalorum Wash and Willow Creek. The type area lies south of Nyeka Hill and west of Conglomerate Ridge at the center of the Cockalorum Wash quadrangle. Beds in the type section dip steeply west, passing upsection from the west base of Conglomerate Ridge westward through Reef Hill (fig. 6). Because no physical, stratigraphic, or paleontologic evidence of overturning exists, these strata are interpreted as becoming younger toward the west, the rich coral beds of Reef Hill therefore being uppermost.

Far less deformed conglomerate and sandstone underlying Conglomerate Ridge are in contact with the Devonian on the west; the relationship is apparently a combination of faulting and stratigraphic overlap. A fragmentary productid brachiopod in a conglomerate cobble suggests that these east-dipping beds are post-early Carboniferous and are probably post-Paleozoic. Six miles north at Fenstermaker Mountain, similar east-dipping conglomerates and coarse sandstones contain abundant poorly preserved plants and fossil wood. Three miles north on the Nye-Eureka County line are *Unio*-bearing land-laid sandstones of Late Cretaceous or Paleocene age (W. A. Cobban and L. S. Russell, written communs., 1968). In general these less-deformed and less-indurated siliceous clastic rocks are distinguishable lithologically from denser plant-bearing coarse gritty brown sandstones of the Carboniferous, also present in fault blocks of this area.

North of the Cockalorum Wash Formation type section, dense white quartzites of uncertain age and derivation are thrust over the Middle Devonian Cockalorum Wash, probably from the west. Whereas these quartzites resemble the Ordovician Eureka Quartzite, it appears more probable they pertain to a sequence of white quartzite and dolomite which crops out 2 miles north-northeast near the county line in a thrust sheet of Devonian rocks correlated with the Oxyoke Canyon Sandstone Member of the Nevada Formation near Eureka.

The lower 600 feet of the Cockalorum Wash Formation comprises light-tan-weathering shales, platy siltstones, and sandstones, with lenses and interbeds of limonite-stained arenaceous pebbly to conglomeratic somewhat platy limestone and light-gray calcarenite. Brachiopod fragments are present in the lower clastic limestones. Abundant small calcitic plates in the calcarenites show a round median canal and have more the appearance of dasycladacean algal debris than of *Amphipora* or crinoidal matter. Many of the carbonate clasts also appear to be of algal origin. Other spherical bodies are possible calcispheres. Minute poorly preserved spherical structures with a suggestion of radial spines may be Radiolaria.

Near the middle of the Cockalorum Wash type section, the light-gray limestone outcrops become thicker bedded in places and finer textured. Calcarenites in this part of the section lack the siliceous pebbles of the lower limestones. Tentaculites are present, together with small gastropods and other fragmentary shell fossils. Calcispheres and calcitic plates with a median canal are less conspicuous. Limestone lenses some 40 feet thick extend laterally at least 300 feet. Separating the limestone beds are noncalcareous tan-weathering platy siltstones and pebbly siliceous sandstones. Gritty sandstone beds contain angular clasts of reworked rock. Limestones predominate within the upper 500 feet. One lenticular limestone body is about 175 feet thick and comprises platy to flaggy weathering medium- to light-gray fine-textured limestone. These beds contain fragmentary brachiopods, gastropods, and tentaculites. Calcispheres are common in the calcarenites. Tentaculites of the *Nowakia* type are abundant in some layers.

The important coral-bearing limestone underlying Reef Hill at the top of the type section is about 150 feet thick; this unit consists of flaggy to platy medium- and light-gray limestones, mostly fine textured, ranging from aphanitic to fine-grained calcarenite. The abundant corals are silicified. Where the coral heads are most numerous, at locality M1351, there is no evidence of inclined bedding to suggest moundlike organic growth with bottom relief, as in the case of a more typical bioherm.

On the west side of Cobble Hill, 0.5 mile south of Reef Hill, the interbedded fine-textured gray limestones, tan siltstones, and cherty shales are strongly deformed. No corals or other shell fossils were found here; poorly preserved probable Radiolaria are present in the aphanitic limestones. An exploration trench at locality M1366 exposes contorted tan and light-gray weathering siltstones containing eurypterid claws nearly identical with those from the Morey Peak area 35 miles to the south, where they are associated with other well-preserved eurypterid body plates. The eurypterid claw beds and associated limestones of the Cockalorum Wash quadrangle are considered part of the Middle Devonian Cockalorum Wash Formation.

In Coral Ridge east of Willow Creek Ranch, the coral-bearing Cockalorum Wash Formation has been mapped along the ridge north and south of Willow Creek for 1.5 miles. Eurypterid claws and tentaculites occur here also in the siltstones and platy limestones.

The limestones and clastic beds dip steeply or are in places nearly vertical, and they appear on Willow Creek to have been thrust over dark shales and siltstones with chert interbeds. The shales and siltstones of the lower plate have yielded no fossils, but they may represent part of the Upper Devonian and Lower Mississippian Pilot Shale like that in a comparable structural setting 9 miles north at Bluff Canyon in the Fish Creek Range (fig. 4).

The Reef Hill fauna consists mainly of a single form *Hexagonaria fisherae* subsp. *cockalorumensis*, which occurs in great abundance, together with a large massive *Favosites*. Interbeds with rather sparse brachiopods yield *Leiorhynchus* sp. and a large species of *Warrenella* resembling *W. occidentalis* (Merriam).

The following is a combined faunal list including fossils from several localities of the Cockalorum Wash Formation in the northern part of Coral Ridge:

Favosites sp. (massive form in large cylindrical colonies)
Heliolites sp. (massive)
Thamnopora sp. (coarse variety)
chaetetids
Cyathophyllum (*Moravophyllum*)? sp. (large solitary form)
Paracanthus nevadensis n. gen., n. sp.
Paracanthus cf. *P. nevadensis* n. gen., n. sp.
Hexagonaria fisherae subsp. *antelopensis* n. subsp.
Hexagonaria meeki n. sp.
Hexagonaria sp. c
Hexagonaria sp. f
massive stromatoporoids
Leiorhynchus (several types)
Atrypa sp. (fine-ribbed, no spines, fairly large)
Warrenella? sp.
Dechenella sp. (pygidium)
Ptomatis sp., or *Knightites* (*Retispira*) sp.
Porcellia sp., cf. *P. nais* (Hall)
Pleurotomaria-like genus (lacks slit band of *Pleurotomaria;* surficially resembles *P. capillaria*)

MIDDLE DEVONIAN STRATA OF THE HOT CREEK RANGE

Carbonate facies of the Antelope–Roberts Mountains Devonian belt reappear 30 miles south of Cockalorum Wash in the Hot Creek Range. Near Warm Springs (fig. 4) at the south end of this range, faunas of Great Basin Devonian coral zone F are well represented. In the Morey Peak area of the middle Hot Creek Range, small coral collections suggest either coral zone F or G.

Dark-gray to black carbonaceous limestones at locality M1354 just southwest of Warm Springs have yielded abundant silicified fossils, among which are the following:

Favosites sp. (massive form)
Thamnopora sp. (coarse, thick form)
chaetetids
Heliolites sp. (massive form)
Paracanthus sp., cf. *P. nevadensis* n. gen., n. sp.
Hexagonaria sp. w
Hexagonaria sp. n
Warrenella sp., cf. *W. occidentalis* (Merriam)
Atrypa sp. (large, no spines)
Leiorhynchus sp.
tentaculites

This assemblage pertains to coral zone F. Although the dark-gray and black limestones here differ considerably in appearance from unit 4 of the Nevada Formation at Lone Mountain, they are probably correlative. Nearly identical black limestones occur in the same interval at Bare Mountain, 90 miles south of Warm Springs.

Gray limestones north of Morey Peak at locality M1338 contain *Mesophyllum* (*Lekanophyllum*) cf. *M.* (*L.*) sp. l and *Cystiphylloides* sp. c. This and other types of *Mesophyllum* from limestones and dolomites of the Morey Peak area probably represent coral zone F. *Hexagonaria*? sp. h occurs at locality M1358, about 2 miles north of the Morey mine. In this vicinity the Devonian rocks contain eurypterid claws and body plates. Detailed mapping and stratigraphy may demonstrate that some of these beds are a southward continuation of the Cockalorum Wash Formation.

MIDDLE DEVONIAN RUGOSE CORALS OF THE DIAMOND MOUNTAINS BELT

Geologic mapping of the Pinto Summit quadrangle by T. B. Nolan (Nolan and others, 1973) and stratigraphic investigation under the Kobeh Valley project demonstrate that the depositional facies in the lower part of the Devonian in the Diamond Mountains belt (fig. 4) differ widely from those of the Antelope–Roberts Mountains belt on the west (Nolan and others, 1956). Nearly unfossiliferous partly sandy dolomites and orthoquartzite having a combined thickness of about 850 feet constitute the Beacon Peak Dolomite Member and Oxyoke Canyon Sandstone Member in the Oxyoke Canyon area (fig. 7). These eastern facies seemingly occupy the approximate time-rock interval of units 1 and 2 of the Nevada Formation in the Lone Mountain section (figs. 2, 7), where they are rich in fossils of Early and early Middle Devonian ages (Merriam, 1973b). West to east lithofacies changes are less profound within the overlying intervals of units 4 and 5. There are, however, significant faunal differences, as the more diagnostic rugose corals of unit 4 and coral zone F at Lone Mountain have not been recognized in the presumably equivalent Woodpecker Limestone Member of the Diamond Mountains belt. Moreover, the characteristic Rugosa of coral zone G that occupy basal beds of the Bay State Dolomite Member and topmost beds of the Woodpecker Limestone Member in the Diamond Mountains belt do not appear where they would be expected near the boundary of units 4 and 5 of the Nevada Formation in the Antelope–Roberts Mountains belt.

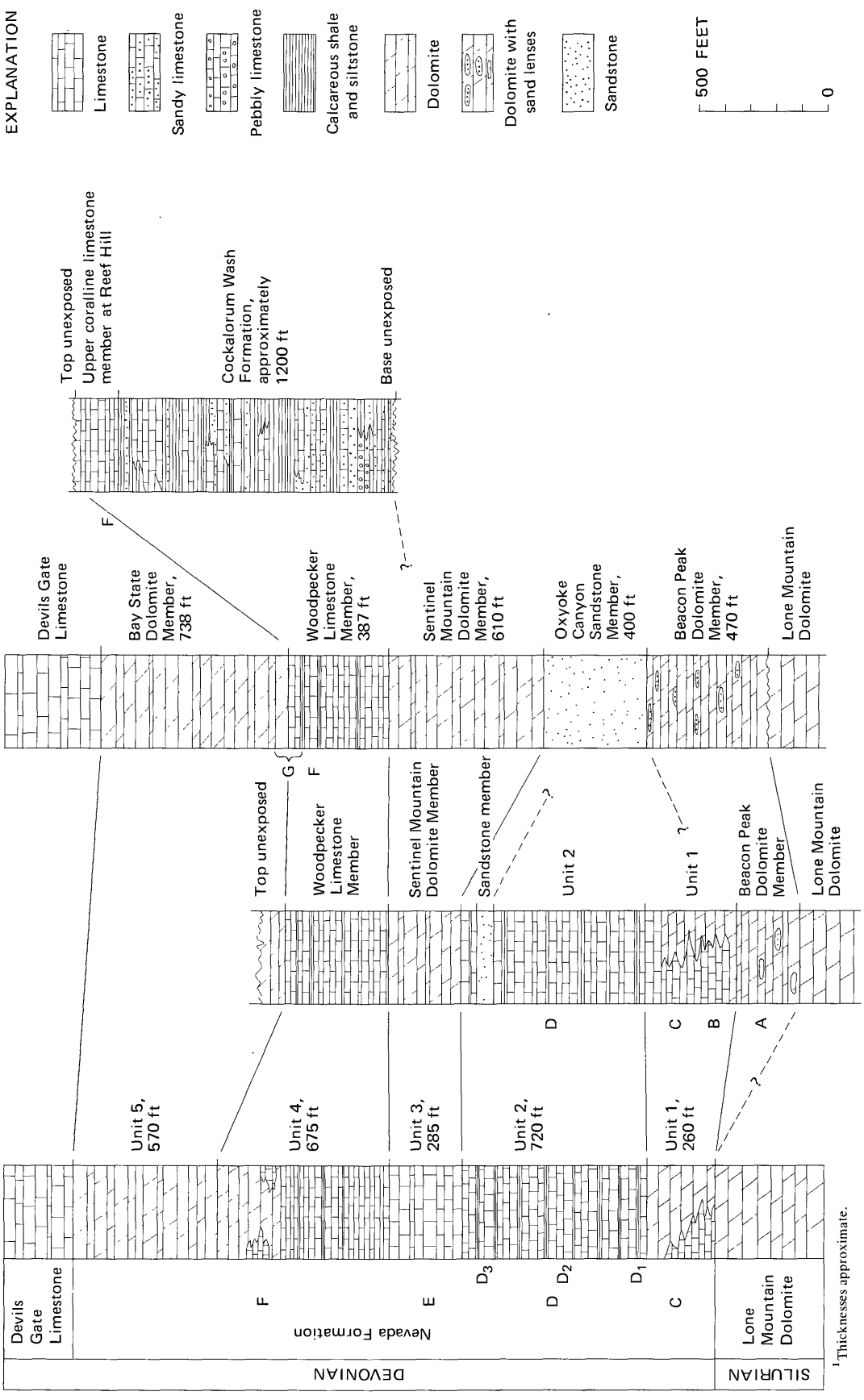


FIGURE 7.—Relations of Devonian rocks of the southern Diamond Mountains to those of the Sulphur Spring Range, Lone Mountain, and the Cockalorum Wash area. See figure 4 for location of sections.

GREAT BASIN DEVONIAN CORAL ZONE G

The Great Basin Devonian coral zone G (fig. 7) includes the lowest strata with *Stringocephalus* and occupies a 30-foot silty dolomite and limestone interval bracketing the top of the Woodpecker Limestone Member and the base of the Bay State Dolomite Member of the Nevada Formation (Nolan and others, 1956, p. 47). The following is a combined list of fossils in Great Basin Devonian coral zone G:

Thamnopora sp. (coarse, thick form)
Heliolites sp. (massive form)
Syringopora sp.
chaetetids
Cystiphylloides sp. a
Digonophyllum (*Mochlophyllum*) *alhambraensis* n. sp.
Mesophyllum n. sp.
Acanthophyllum sp. c
Cyathophyllum (*Moravophyllum*) *alhambraensis* n. sp.
Disphyllum sp.
Stringocephalus sp. a
Stringocephalus sp. b
Rensselandia n. sp.
Amphipora? sp.
stromatoporoids (massive)
tentaculites

Notably lacking are the colonial Rugosa of coral zone F, among which are *Hexagonaria*, *Taimyrophyllum*, *Sociophyllum*, and *Utaratuia*.

Strata of Great Basin coral zone G are well exposed in the Pinto Summit quadrangle on the southwest side of Sentinel Mountain, in the upper Oxyoke Canyon, and at the south end of the Alhambra Hills on the east side. The lowermost Bay State in Oxyoke Canyon is a light-gray silty dolomite containing abundant large *Stringocephalus* sp. b with which are associated *Thamnopora* sp., *Acanthophyllum* sp. c, *Mesophyllum* n. sp., *Cyathophyllum* (*Moravophyllum*) sp., *Disphyllum* sp., and stromatoporoids. Solitary acanthophyllids are the only Rugosa found in the underlying Woodpecker Limestone Member.

The lowermost bed in the Bay State Dolomite Member of the Alhambra Hills is a medium-gray silty dolomite bed probably correlative with a light-gray silty dolomite exposed in Oxyoke Canyon; beneath this bed is dark-gray limestone containing the very large cylindrical *Digonophyllum* (*Mochlophyllum*) *alhambraensis*, *Cyathophyllum* (*Moravophyllum*) *alhambraensis*, *Cystiphylloides* sp. a, *Heliolites* sp., *Syringopora* sp., *Stringocephalus* sp. a, and *Rensselandia* n. sp. Mapped with the uppermost Woodpecker Limestone Member, these limestones are of special importance because they locally contain abundant diagnostic *Rensselandia*, known elsewhere at the bottom of the *Stringocephalus* zone. Here, as in Oxyoke Canyon, only the solitary acanthophyllids have been found in the Woodpecker beneath the 30-foot interval of coral zone G.

MIDDLE DEVONIAN STRATA OF BARE MOUNTAIN, SOUTHERN NYE COUNTY, NEVADA

The southernmost known exposures carrying faunas of coral zone F in the Antelope–Roberts Mountains belt are at Bare Mountain near Beatty, Nye County, Nev., 90 miles south of Warm Springs (Cornwall and Kleinhampl, 1960). Here in Tarantula Canyon (locality M1359) black, carbonaceous limestones containing these fossils resemble the limestones with a correlative assemblage at Warm Springs. The fossils are as follows:

Favosites sp. (massive form)
Thamnopora sp.
Alveolites sp.
Hexagonaria fisherae subsp. *antelopensis*
Atrypa sp.
Crurithyris sp. (large form)
Cyrtina sp.
Schizophoria sp. (large form)
stromatoporoids (massive)

GREAT BASIN MIDDLE DEVONIAN RUGOSA AND THEIR BEARING UPON GEOLOGIC CORRELATION WITH DISTANT REGIONS

Great Basin Middle Devonian Rugosa are especially valuable for correlation of their enclosing rocks with Devonian rocks in western Canada, southeastern Alaska, and the more remote Eifel district of Germany. As might be anticipated paleogeographically, fairly close paleontologic ties exist to the north with coral-bearing strata of the central Mackenzie River region west of Great Bear Lake and northwest of Great Slave Lake. Less evident are genetic affinities to rugose corals of the continental interior and eastern North America. In fact, these studies demonstrate that the overall generic makeup of eastern Middle Devonian rugose coral assemblages differs appreciably from that of the western or Cordilleran faunas. Vagaries of Devonian faunal spread and provincial biogeography may be invoked to explain closer similarity of some Cordilleran Rugosa to species of the more distant Rhine Valley and Eifel district.

The Stringocephalus *zone.*—Intercontinental and provincial correlation of Great Basin Middle Devonian rugose coral-bearing strata gains support through supplementary evidence from study of two distinctive brachiopod groups: the widely distributed *Stringocephalus* and the more localized *Leiorhynchus castanea* (Meek) faunas of the Cordilleran belt.

Since recognition by Kirk (1927) of the importance of *Stringocephalus* as a Great Basin zone fossil, this large terebratuloid has been found to be largely confined to the Bay State Dolomite Member of the Nevada Formation in the Eureka district and the approximately correlative unit 5 of nearby areas. At Lone

Mountain this genus ranges upward into lowermost beds of the overlying Devils Gate Limestone. *Stringocephalus* seems to be similarly restricted vertically elsewhere in the Great Basin, in Alaska, and in western Canada (McLaren, 1962). As in western Canada, the other large and distinctive terebratuloid, *Rensselandia*, occurs also in the Eureka district at the bottom of the *Stringocephalus* zone in coral zone G. In connection with proposed correlation with the European Devonian, the Great Basin *Stringocephalus* zone is provisionally regarded as essentially equivalent in time-stratigraphic sense to the Rhine Valley Givetian. It is, however, recognized that some authorities have suggested that *Stringocephalus* may be confined to the middle and upper parts of the standard Givetian. The lowest beds of coral zone G are perhaps the most important paleontologic datum in the Great Basin Devonian column.

Leiorhynchus castanea.—The key fossil *Leiorhynchus castanea* (Meek) is a common brachiopod in the Woodpecker Limestone Member of the Nevada Formation of the Diamond Mountains belt, the member which underlies the Bay State Dolomite Member and the *Stringocephalus* zone. *Warrenella kirki* is sparsely represented here with abundant *L. castanea*. *Leiorhynchus castanea* has not been found even though expected, in unit 4 of the Nevada Formation west of the Diamond Mountains belt at Lone Mountain, where unit 4 occupies the Woodpecker interval below *Stringocephalus* and contains the abundant Rugosa of coral zone F. *Warrenella kirki* is a common brachiopod here, unaccompanied by *L. castanea*. Facies may explain these east-to-west faunal changes, for the bulk of the zone F coral assemblage and especially the colonial genera have not been found in the easterly Woodpecker. As shown by McLaren (1962, fig. 1), the vertical range of *Leiorhynchus castanea* is greater in western Canada, this species overlapping the range of *Stringocephalus* and probably passing upward into younger beds.

DISTRIBUTION AND CORRELATION VALUE OF RUGOSA

Internally complex, specialized solitary corals of the families Digonophyllidae and Ptenophyllidae differentiated rapidly in both Europe and western North America, reaching evolutionary peaks during the intervals of Great Basin Middle Devonian coral zones F and G. Although of wide value for geologic correlation, these families are little known if indeed represented in eastern North America. *Cystiphylloides*, a diverse cosmopolitan genus well represented both east and west, has by some workers (Stumm, 1961) been classified with Digonophyllidae; however, *Cystiphylloides* lacks many true digonophyllid features and is here, by preference, reassigned to the Family Cystiphylloidae.

The distinctive colonial genera *Utaratuia*, *Taimyrophyllum*, and *Sociophyllum* remain undocumented thus far in eastern North America but are otherwise significant in this connection. *Sociophyllum* and *Taimyrophyllum* are typically Old World genera.

Species of the generalized, long-ranging *Disphyllum* are common both east and west in North America but at present do not have great correlation significance. Somewhat more useful is *Tabulophyllum*, typically Upper Devonian but present in the Cordilleran Middle Devonian and in that of eastern North America.

The ubiquitous, worldwide *Hexagonaria*, a structurally and taxonomically very diverse genus with multitudes of local subgenera and species, has at present rather limited use for definitive geologic correlation.

The complex Family Phillipsastraeidae, as here construed, has no recognized ancestors in the Great Basin Middle Devonian. Earlier Old World representatives of this group are reported, especially in Australia. Distinctive Phillipsastraeidae are the predominating Rugosa of Late Devonian coral zone I in the Great Basin, presumably having been introduced in Frasnian time from other faunal provinces.

CORRELATION WITH RUGOSE CORAL DEPOSITS OF WESTERN CANADA

Digonophyllidae similar to species of Great Basin Devonian coral zones F and G are known from the Hume Formation of the central Mackenzie River, from correlative beds on the arctic Anderson River, and from the Horn Plateau Formation northwest of Great Slave Lake. *Acanthophyllum* of the contemporaneously evolving Ptenophyllidae is recorded from Hart River, Yukon Territory, and probably occurs also in the Hume Formation. The distinctive colonial genera *Sociophyllum*, *Utaratuia*, and *Taimyrophyllum* characterize the Hume as well as the beds of Great Basin Devonian coral zone F. *Sociophyllum* occurs also on Hart River, Yukon Territory.

The Nahanni Formation west of Fort Simpson and Great Slave Lake also yields *Sociophyllum*, *Utaratuia*, and *Taimyrophyllum* related to the Hume species, and the two formations are doubtless in considerable part correlative (Pedder, 1964). Also present in the Hume is *Australophyllum* resembling *A. prismatophylloides* of Great Basin coral zone F. Of the few described Hexagonarias from northwest Canada, none appear closely related to carinate *Hexagonaria* of Great Basin coral zone F.

HUME FORMATION

The stratigraphy of the widely distributed coral-bearing Hume Formation in the central Mackenzie River area has been elucidated by Bassett (1961), and its coral faunas studied by Lenz (1961) and more

recently by Pedder (1964). Bassett's (1961, fig. 3) comparative stratigraphic columns between Fort Good Hope and Norman Wells show the Hume overlain conformably by the Hare Indian Formation and underlain disconformably by the Bear Rock Formation. Resting conformably upon the Hare Indian is the Kee Scarp Limestone which includes the *Stringocephalus* zone and is thus correlative with *Stringocephalus*-bearing Bay State Dolomite Member and coral zone G of the Great Basin. At the bottom of the Devonian column, the dolomitic beds of Bear Rock are sparsely fossiliferous and have not been dated with certainty. Early Middle Devonian is doubtlessly present, but there is evidently no paleontologic basis for correlation with Lower Devonian horizons in the Nevada Formation of the Great Basin.

Leiorhynchus castanea is recorded by Bassett above the Hume in lower beds of the Hare Indian Formation. According to McLaren (1962, fig. 1), this key brachiopod ranges upward in areas of Hume exposure well into the Kee Scarp Limestone, thus overlapping the range of *Stringocephalus*.

As described and illustrated by Pedder (1964), the Hume corals *Sociophyllum glomerulatum*, *Utaratuia laevigata*, and *Taimyrophyllum triadorum* appear to have counterparts in the Great Basin coral zone F species *Sociophyllum eurekaensis*, *Utaratuia eurekaensis*, and *Taimyrophyllum nolani*.

The Hume Formation contains species of *Mesophyllum* illustrated by McLaren, Norris, and McGregor (1962) and by Lenz (1961); these appear analogous to *Mesophyllum (Lekanophyllum)* sp. l and *Mesophyllum* sp. f of Great Basin coral zone F. *Billingsastraea verrilli* (Meek) figured by Pedder (1964) from the Hume and Nahanni has no matching form in Great Basin coral zone F. The most closely related Great Basin corals, *Billingsastraea nevadensis* (Stumm) and its subspecies *arachne* (Stumm), are not conspecific with the northern *verrilli*. These Great Basin corals occur together in unit 2 (coral zone D_2) considerably below coral zone F. *Dendrostella trigemme* of the Hume and Nahanni Formations (Pedder, 1964, p. 434) also has no counterpart in coral zone F. In the Great Basin, *Dendrostella* has thus far been found only in unit 2 and coral zone D_2.

The presence of the *Stringocephalus* zone within the Kee Scarp Limestone and the similarity of the Great Basin coral zone F rugose coral fauna to those of the Hume and Nahanni indicate a probable fairly close correlation and suggest a late Eifelian rather than early Givetian age.

HORN PLATEAU FORMATION

Outcrops of the Middle Devonian Horn Plateau Formation 90 miles northwest of Slave Point, Great Slave Lake (Norris, 1965, p. 78–83, fig. 9), yield rugose corals with affinity to Great Basin species. Of the 12 rugose coral genera present (McLaren and Norris, 1964), five are represented in the Great Basin by different but comparable species. These are *Sociophyllum redactum* (McLaren), *Mesophyllum (Lekanophyllum)* cf. *punctatum* (Wedekind), *M. (Lekanophyllum) nebracis* (McLaren), *Cystiphylloides spinosum* McLaren, and *Disphyllum salicis* McLaren. *Stringocephalus*, *Leiorhynchus castanea*, and *Warrenella* are not reported. The Horn Plateau *Sociophyllum* and the digonophyllid species may be compared with *Sociophyllum eurekaensis* and with *Mesophyllum (Lekanophyllum)* sp. l of Great Basin coral zone F. Lacking in the Horn Plateau fauna are the compound Rugosa *Utaratuia* and *Taimyrophyllum*, which characterize the Hume, Nahanni, and Great Basin coral zone F.

McLaren (in McLaren and Norris, 1964, p. 5) concluded that the Horn Plateau fauna suggests a middle to late but not latest Givetian age. The Horn Plateau fauna shows no very close resemblance to the Great Basin coral zone G of Givetian age at the bottom of the *Stringocephalus* zone.

RUGOSE CORALS AND CORRELATION WITH MIDDLE DEVONIAN STRATA OF SOUTHEASTERN ALASKA

Middle Devonian stratigraphy and faunas of southeastern Alaska are best known at San Alberto Bay near Craig on the west side of Prince of Wales Island (Eberlein and Churkin, 1970). Here the presence of *Stringocephalus* was recorded by Kirk (1927, p. 219), and the beds have yielded rugose corals of the families Digonophyllidae and Ptenophyllidae, as well as the colonial *Hexagonaria* and *Australophyllum*. Within the Alberto Islands, *Stringocephalus* occurs fairly high stratigraphically in the east-dipping Devonian section, which passes up section to the east through these islands and across southern Wadleigh Island, where it continues above into the Upper Devonian. Below *Stringocephalus*, these rocks contain Digonophyllidae of the three genera *Digonophyllum*, *Mesophyllum*, and *Arcophyllum*, and *Acanthophyllum* of the Ptenophyllidae. Also present are colonial Rugosa of the genera *Australophyllum*, *Xystriphyllum*, and *Loyolophyllum*.

The abundant Rugosa in certain parts of the San Alberto Bay vicinity are large maturely subcylindrical members of the *Paracanthus* group. Those from Fern Point, San Fernando Island, 4 miles southwest of the Alberto Islands, resemble *Paracanthus nevadensis* n. sp. of Great Basin coral zone F and beds possibly pertaining to coral zone G.

Whereas none of these southeastern Alaska corals appears conspecific or very closely related to Hume or

Great Basin species, it is probable they occupy the time-stratigraphic interval of Great Basin coral zones F and G. *Australophyllum* from the Alberto Islands on the west occurs low in this section and resembles *Australophyllum prismatophylloides* of Great Basin coral zone F. From the same locality and horizon comes a large complex *Arcophyllum* quite similar to *A. dachsbergi* (Vollbrecht) of middle Middle Devonian age in the Eifel district of Germany. It is probable these Alberto Islands Middle Devonian beds range upward from the Eifelian Stage into the *Stringocephalus*-bearing Givetian. *Sociophyllum* occurs high in this column, presumably below the top of the Middle Devonian.

Many scattered island exposures of gently dipping Middle Devonian coral-bearing strata occur at Karheen Passage, 20 miles north of the Alberto Islands. The *Stringocephalus* datum has not been found in this vicinity; the stratigraphic sequence is somewhat obscure and can not at present be correlated in detail with that of San Alberto Bay. Among the rugose corals are *Digonophyllum*, *Acanthophyllum*, *Hexagonaria*, and *Dendrostella*. The Karheen *Hexagonaria* is noncarinate, unlike those most characteristic of Great Basin coral zone F. *Dendrostella* cf. *D. rhenana* resembles the Rhine Valley Givetian (Glinski, 1957) typical *rhenana* and is similar also to *Dendrostella trigemme* from the Hume and Nahanni Formations of western Canada (Pedder, 1964).

Of more diagnostic colonial Rugosa in the Hume, Nahanni, and Great Basin coral zone F, the genus *Utaratuia* has not been found in southeastern Alaska, and *Sociophyllum* is known only from scrappy material at a single locality. A thamnastraeoid to aphroid colonial genus collected by Eberlein and Churkin (1970) at Sunny Hay Mountain, 4.5 miles east of Craig, reveals features of both *Billingsastraea* and *Taimyrophyllum*. This interesting coral does not appear to be related either to the Hume and Nahanni *Billingsastraea verrilli* or to *Taimyrophyllum* in Great Basin coral zone F, the Hume, or the Nahanni.

In summary, the southeastern Alaska Middle Devonian rugose coral-bearing rocks of Eifelian and Givetian age have yielded stratigraphically significant Digonophyllidae as well as *Acanthophyllum* of the Ptenophyllidae. However, the more diagnostic colonial genera of Great Basin coral zone F and the Hume and the Nahanni of western Canada remain unrecognized or poorly represented. *Stringocephalus* is known locally, but the key brachiopod, *Leiorhynchus castanea*, has not been identified in these beds of the Pacific Border province, where rocks and faunas generally of the Silurian and Devonian Systems differ somewhat from those of the main Cordilleran seaways.

CORRELATION WITH RUGOSE CORAL DEPOSITS OF THE RHINE VALLEY, GERMANY

Paleontologic comparison of Great Basin Middle Devonian rugose corals with those of the Rhine Valley is especially meaningful in terms of intercontinental geologic correlation. Coral research by Schlüter, Wedekind, Vollbrecht, Birenheide, Glinski, and others since the 1880's makes possible fairly detailed comparisons of internal structure with certain specialized Great Basin solitary genera. In the Eifel district especially, the stratigraphic occurrence of Middle Devonian Rugosa has been intensively investigated by stratigraphers and coral specialists. The Belgian Couvinian Rugosa, although recently elucidated by Tsien (1969), are less understood by modern standards than are those of the more easterly Eifelian.

Among Rhine Valley Middle Devonian Rugosa, the closest affinity to Great Basin forms is in the larger specialized Digonophyllidae and Ptenophyllidae of the Eifel district. Both families appear to have peaked in the standard Eifelian, within the stratigraphic interval Nohner Schichten to Junkerberg Schichten. Although continuing on into the Rhine Valley Givetian, the Ptenophyllidae are seemingly less important than the digonophyllids towards the end of Middle Devonian time.

Among Digonophyllidae in the Great Basin coral zone F, *Mesophyllum (Lekanophyllum)* sp. 1, although not conspecific with either, may be compared with *Mesophyllum (Lekanophyllum) punctatum* (Wedekind) and *lissingenense* (Schlüter) of the Gerolstein area. *Digonophyllum (Mochlophyllum) alhambraensis* of Great Basin coral zone G resembles *maximum* (Schlüter) of the Eifelian Junkerberg Schichten. Of the Ptenophyllidae, species of *Acanthophyllum* in coral zone F reveal similarities to *Acanthophyllum heterophyllum* (Birenheide, 1961) of the Eifelian Junkerberg Schichten.

Keriophyllum, represented by the solitary *K. mclareni* in Great Basin coral zone F, has a counterpart in *Keriophyllum heiligensteini* Wedekind, possibly of the Eifelian Junkerberg (Birenheide, 1962a, p. 108). According to Birenheide (1962a, p. 108; 1963, p. 390) the type species of this complex genus is a synonym of *Cyathophyllum (Peripaedium) turbinatum* Goldfuss, also of the Eifelian Junkerberg Schichten.

Colonial Rugosa of the Rhine Valley have less in common with those of western North America, although Eifel district *Sociophyllum* and carinate *Hexagonaria* are worthy of comparison with Great Basin species. *Sociophyllum eurekaensis* n. sp. of coral zone F is comparable with, but not conspecific with, *S. elongatum*

(Schlüter) of the Eifel district Givetian in the range from Ahbach Schichten to Cürten Schichten. According to Birenheide (1962b, p. 53), *Sociophyllum* is present also in the upper Eifelian of Europe, which is the favored age of Great Basin coral zone F.

Great Basin carinate *Hexagonaria* of coral zone F is comparable with, but not conspecific with, carinate members of this genus in the Middle Devonian of the Eifel district. Among Eifel species is the Paffrath *Hexagonaria hexagona* (Goldfuss), representing the type species as interpreted by Stumm (1948a, p. 14, pl. VI, figs. 1, 2). Stratigraphic range of this form is unknown.

In summary, Great Basin Devonian coral zone G at the bottom of the *Stringocephalus* zone must accordingly be interpreted as Givetian in terms of the Rhine Valley standard. Coral zone F lies below the Great Basin *Stringocephalus* beds. With its digonophyllids of Eifelian stamp, a possible Eifelian *Keriophyllum* (or *Peripaedium)*, archaic *Siphonophrentis*, and carinate *Hexagonaria*, Great Basin coral zone F is believed to harmonize better with later Eifelian than with early Givetian of the Eifel district. Coral zone F may be approximately correlative with the German Junkerberg Schichten.

MIDDLE DEVONIAN RUGOSE CORALS OF EASTERN NORTH AMERICA COMPARED WITH THOSE OF THE GREAT BASIN

Great Basin Middle Devonian rugose coral faunas of zones F and G show few convincing resemblances to coral biotas of inferred equivalent age in eastern North America and the continental interior. It appears to be true, however, that older Middle Devonian beds in the interval of Great Basin coral subzones D_2 and D_3 contain Rugosa with somewhat closer gross resemblances to eastern species. Such, for example, are the abundant *Siphonophrentis*-like corals and the Bethanyphyllidae of D_2 that exhibit a degree of convergent morphologic similarity and possible evolutionary parallelism suggesting age equivalence. Yet among these analogs, none are conspecific or very closely related genetically. As noted under the discussion "Great Basin Devonian Coral Zones," the Great Basin D_2 corals constitute both Early and early Middle Devonian elements, of which the Digonophyllidae appearing first in this subzone have their genetic ties, not with eastern North America, but with the Eifelian of Europe. Subzone D_3 of the Great Basin is by itself considered Eifelian without reservation.

A considerable number of Great Basin Middle Devonian rugose coral groups are thus far unrecorded in eastern North America. Among these are the European specialized Digonophyllidae and Ptenophyllidae, as well as the Old World colonial *Sociophyllum* and *Taimyrophyllum* and the thus-far exclusively western North America *Utaratuia* of coral zone F.

Rugose coral genera common to Great Basin coral zone F and the Middle Devonian of the East are *Tabulophyllum, Cystiphylloides, Disphyllum,* and *Hexagonaria.* On the other hand, several strongly yardarm carinate colonial genera of the eastern Middle Devonian, such as *Cylindrophyllum, Eridophyllum,* and certain species doubtfully placed in *Billingsastraea* (Ehlers and Stumm, 1951) remain unidentified in the Great Basin. To these may be added the profusely yardarm carinate, usually solitary *Heliophyllum* so prominent in the eastern coralline Middle Devonian. Less-carinate species in the Horn Plateau Formation of western Canada have been assigned to *Heliophyllum* by McLaren in McLaren and Norris, (1964).

Tabulophyllum, more often a Late Devonian genus, appears first in Great Basin coral zone F. In the Michigan column, *Tabulophyllum* occurs in the Middle Devonian Bell Shale and Alpena Limestone (Stumm, 1962) that fall approximately within the interval of Great Basin coral zones F and G. The long-ranging and generalized *Disphyllum* has at present little correlation value.

Cystiphylloides, abundant in the eastern Middle Devonian, and by some workers classified with the Digonophyllidae (Stumm, 1961), has numerous analogs in the western Devonian. Unidentified in the west are the specialized cystimorphs that are allied to *Cystiphylloides* but differ in the presence of heavy stereoplasmic deposits; among these are *Cladionophyllum* Stumm and *Edaphophyllum* Simpson.

Great Basin carinate *Hexagonaria* bears among western Rugosa the closest structural resemblance to eastern Middle Devonian species. In general the strongly yardarm carinate Hexagonarias appear to outnumber those with smooth septa in the Lower Devonian, and especially in the lower Middle Devonian of the east. Although carinate *Hexagonaria* persists here and there into younger Middle Devonian of the east, those with smoother septa become more evident upward. In the Late Devonian (Frasnian) of Europe, Hexagonarias with smooth septa appear to predominate (Sorauf, 1967).

Carinate *Hexagonaria* resembling that of Great Basin coral zone F is abundantly represented in the central lowland Devonian west of the Appalachians from the Middle Devonian Jeffersonville Limestone of Kentucky to the Middle Devonian beds of Michigan (Stumm, 1948a; 1964; 1970).

CLASSIFICATION OF GREAT BASIN MIDDLE DEVONIAN RUGOSE CORALS IN CORAL ZONES F AND G

Described rugose corals of the Great Basin Lower and Middle Devonian (coral zones A through G) are classified in 14 families. Those of the Lower and lower Middle Devonian, or coral zones A through D of Merriam (1973b), constitute 11 families, the three families unrepresented (Ptenophyllidae, Cyathophyllidae, and Spongophyllidae) being first recognized in coral zones F and G. The eight families of Rugosa that characterize zones F and G do not include Laccophyllidae, Kodonophyllidae, Stauriidae, Halliidae, Bethanyphyllidae, and Chonophyllidae present in the lower zones A through D. Especially important stratigraphically are the abundant Halliidae and Bethanyphyllidae of zones B through D; above these zones they are unknown in this western province. Digonophyllidae, appearing in the higher beds of zone D, assume increasing importance upward stratigraphically to peak in zones F and G, together with the Ptenophyllidae. Disphyllidae, well established in early Middle Devonian beds of coral zone D, continue to diversify upward as the genera *Hexagonaria* and *Taimyrophyllum* of coral zone F in which they peak.

The classification adopted (Merriam, 1973b) is for the greater part in accord with that of Hill (1956), the most authoritative thus far published. Departures from Hill's arrangement include proposal of a new subfamily, Siphonophrentinae, under the Streptelasmatidae, restoration of Stumm's Family Cystiphylloidae, use of the Family Endophyllidae in a more inclusive sense, and restoration of the Family Cyathophyllidae of Dana. For the very complex Digonophyllidae, Hill's scheme (1956, p. F314–F320) would appear to be the most satisfactory proposed thus far, except for inclusion of *Cystiphylloides* as a subgenus of *Mesophyllum.*

Order Rugosa Edwards and Haime 1850
- Family Streptelasmatidae Nicholson 1889 (in Nicholson and Lydekker 1889 as Streptelasmidae)
  - Subfamily Siphonophrentinae, new subfamily
    - Genus *Siphonophrentis* O'Connell 1914
      - Subgenus *Siphonophrentis* O'Connell 1914
        - *Siphonophrentis (Siphonophrentis)* sp. b
- Family Cystiphylloidae Stumm 1949
  - Genus *Cystiphylloides* Chapman 1893
    - *Cystiphylloides* sp. a
    - *Cystiphylloides iddingsi* n. sp.
    - *Cystiphylloides* sp. c
- Family Digonophyllidae Wedekind 1924
  - Subfamily Zonophyllinae Wedekind 1924
    - Genus *Zonophyllum* Wedekind 1924
      - *Zonophyllum* sp. r
  - Subfamily Digonophyllinae Wedekind 1924
    - Genus *Digonophyllum* Wedekind 1923
      - Subgenus *Digonophyllum* Wedekind 1923
        - *Digonophyllum (Digonophyllum) occidentalis* n. sp.
        - *Digonophyllum (Digonophyllum)*? sp. c
      - Subgenus *Mochlophyllum* Wedekind 1923 (as a genus)
        - *Digonophyllum (Mochlophyllum) alhambraensis* n. sp.
        - *Digonophyllum (Mochlophyllum) alhambraensis* subsp. *robertsensis* n. subsp.
    - Genus *Mesophyllum* Schlüter 1889
      - Subgenus *Mesophyllum* Schlüter 1889
        - *Mesophyllum (Mesophyllum)* sp. f
        - *Mesophyllum (Mesophyllum)*? sp. k
      - Subgenus *Lekanophyllum* Wedekind 1924 (as a genus)
        - *Mesophyllum (Lekanophyllum)* sp. l
- Family Ptenophyllidae Wedekind 1923
  - Genus *Acanthophyllum* Dybowski 1873
    - *Acanthophyllum* sp. a
    - *Acanthophyllum robertsensis* n. sp.
    - *Acanthophyllum* sp. c
    - *Acanthophyllum* sp. p
    - *Acanthophyllum?* sp.
  - Genus *Paracanthus* new genus
    - *Paracanthus nevadensis* n. gen., n. sp.
    - *Paracanthus?* sp. f
- Family Cyathophyllidae Dana 1846
  - Genus *Cyathophyllum* Goldfuss 1826
    - Subgenus *Moravophyllum* Kettnerova 1932 (as a genus)
      - *Cyathophyllum (Moravophyllum) alhambraensis* n. sp.
      - *Cyathophyllum (Moravophyllum)* sp. l
    - Subgenus *Orthocyathus* n. subgen.
      - *Cyathophyllum (Orthocyathus) flexum* (Stumm)
  - Genus *Keriophyllum* Wedekind 1923
    - *Keriophyllum mclareni* n. sp.
    - *Keriophyllum? kobehense* (Stumm)
- Family Spongophyllidae Dybowski 1873
  - Genus *Sociophyllum* Birenheide 1926b (as subgenus of *Stringophyllum)*
    - *Sociophyllum eurekaensis* n. sp.
    - *Sociophyllum eurekaensis* subsp. b
  - Genus *Utaratuia* Crickmay 1960
    - *Utaratuia eurekaensis* n. sp.
- Family Endophyllidae Torley 1933
  - Genus *Tabulophyllum* Fenton and Fenton 1924
    - *Tabulophyllum antelopensis* n. sp.
  - Genus *Australophyllum* Stumm 1949
    - *Australophyllum prismatophylloides* (Stumm)
- Family Disphyllidae Hill 1939
  - Genus *Hexagonaria* Gürich 1896
    - *Hexagonaria fisherae* (Merriam)
    - *Hexagonaria fisherae* subsp. *cockalorumensis* n. subsp.
    - *Hexagonaria fisherae* subsp. *antelopensis* n. subsp.
    - *Hexagonaria meeki* n. sp.
    - *Hexagonaria* sp. c
    - *Hexagonaria* sp. f
    - *Hexagonaria?* sp. h
    - *Hexagonaria* sp. n
    - *Hexagonaria* sp. r
    - *Hexagonaria* sp. w
  - Genus *Taimyrophyllum* Chernychev 1941
    - *Taimyrophyllum nolani* n. sp.
- No family assignment
  - Genus *Lyrielasma* Hill 1939
    - *Lyrielasma antelopensis* n. sp.

SYSTEMATIC AND DESCRIPTIVE PALEONTOLOGY

Descriptive terms applicable to rugose coral structure have been adequately defined and stabilized by Hill (1935, 1956). Hill's terminology is widely accepted and, with minor modifications, is adopted for purposes of this report.

In general, the diagnoses and descriptions here presented take into account only gross features of the corallum. Fine skeletal structure (Kato, 1963; Wang, 1950) was observed in thin sections of a few well-preserved corals; the study of minute structural features did not, however, contribute materially to the taxonomic results. More often than not, silicification has destroyed original trabecular details which might otherwise be useful.

Among the described corals are several that are designated provisionally by letter in preference to a formal species name. These lettered taxa have undoubted stratigraphic value, but study material is at present considered inadequate for specific naming.

Family STREPTELASMATIDAE Nicholson 1889
(in Nicholson and Lydekker 1889 as Streptelasmidae)
Subfamily SIPHONOPHRENTINAE, new subfamily

Reference form.—*Siphonophrentis gigantea* (Lesueur) 1821. Middle Devonian, New York.

Diagnosis.—Streptelasmatidae with narrow to wide septal stereozone, amplexoid septa and a weak to prominent fossula; tabulae mostly complete, straight or domed, with axial and peripheral sag. Normally no dissepiments.

Remarks.—Nondissepimented solitary corals of this subfamily are especially characteristic of the North American Early and early Middle Devonian and include *Siphonophrentis* in the strict sense, *Siphonophrentis (Breviphrentis)* of Great Basin Devonian coral zones C and D and *Heterophrentis* and *Compressiphyllum* of the Onondaga Limestone of eastern North America. *Nevadaphyllum* and *Homalophyllum* may also belong in this family. Members of this group are quite uncommon above Great Basin coral zone D and are unknown above zone F.

Genus Siphonophrentis O'Connell 1914

1914. *Siphonophrentis* O'Connell, p. 190.
1949. *Siphonophrentis* O'Connell. Stumm, p. 12-13.
1950. *Siphonophrentis* O'Connell. Wang, p. 214.
1956. *Siphonophrentis* O'Connell. Hill, p. F270.
1960. *Siphonophrentis* O'Connell. Oliver, p. 87.

Type species—*Caryophyllia gigantea* Lesueur 1821; by original designation. Onondaga Limestone, New York.

Diagnosis.—Oliver's diagnosis (1960, p. 87) is as follows:

> Simple ceratoid to cylindrical corals with amplexoid septa withdrawn from axis except on and just above upper surfaces of tabulae. Tabulae dome-shaped, flat, or concave axially, depressed at the fossula. No axial structure or dissepiments.

Remarks.—*Siphonophrentis* in the strict sense commonly develops very elongate solitary coralla of large size. *Breviphrentis* Stumm (1949, p. 13) of the Great Basin Early and early Middle Devonian (coral zones C and D) is regarded by the writer (Merriam, 1973b) as a subgenus of *Siphonophrentis;* it differs from *Siphonophrentis (Siphonophrentis)* by having narrow, very elongate coralla of markedly segmented appearance because of the shelving indentations and rejuvenescence flanges.

Siphonophrentis (Siphonophrentis) sp. b

Plate 1, figures 16, 17

Figured material.—USNM 166423. Roberts Mountains; Bobcat Peak locality M1342. Unit 4 of the Nevada Formation.

Diagnosis.—Large *Siphonophrentis* having septal stereozone of medium width and closely spaced, mostly complete tabulae which bend downward sharply at periphery.

Transverse thin section.—Major septa 44, the longest extending about one-half the distance to the axis; minor septa short, one-third to one-half length of major septa. Stereozone about 3 mm wide, which is great for this genus; some septa thickened stereoplasmically through most of their length. No fossula observed. One segment of a transverse thin section reveals what appear to be three small, closely spaced, peripherally concave dissepiments in sequence near the stereozone.

Longitudinal thin sections.—Some closely spaced tabulae complete, but most extend only part of the width; a few short tabellae near periphery. Abrupt peripheral sag adjoining the stereozone. Tabulae thickened stereoplasmically on distal surfaces. Several very small dissepimentlike structures in a small segment of one thin section near stereozone.

Fine structure.—Trabecular structure poorly defined; peripheral stereozone reveals fine lamellar texture.

Comparison with related forms.—This large species resembles *Siphonophrentis (Siphonophrentis) gigantea* (Lesueur), the type species, more closely than *Siphonophrentis (Breviphrentis) invaginatus* (Stumm) of the lower part of the Nevada Formation. *Siphonophrentis (Siphonophrentis)* sp. b differs from *S. gigantea* by having a peripheral tabular sag, longer minor septa, and a wider stereozone. *S. gigantea* possesses a fossula not recognized in *S.* sp. b.

Occurrence.—Middle Devonian coral zone F. Roberts Mountains, Bobcat Peak locality M1342. Unit 4 of the Nevada Formation. Study material consists of one incomplete corallum.

Family CYSTIPHYLLOIDAE Stumm 1949

Genus Cystiphylloides Chapman 1893

1859. *Cystiphyllum aggregatum* Billings, p. 137, text fig. 28.
1893. *Cystiphylloides* Chapman, p. 46.
1937. not *Cystiphylloides* Yoh, p. 50–54, pl. V, figs. 1–4.
1940. *Cystiphylloides* Chapman (in part). Stumm, p. 39 (in part); not pl. 19, figs. 1–7; not pl. 20, figs. 14–15.
1956. *Mesophyllum (Cystiphylloides)* Chapman, 1893. Hill, p. F319 (in part), fig. 219–6.

Type species.—*Cystiphyllum aggregatum* Billings, 1859. Onondaga Limestone, Devonian, near Simcoe, Ontario, Canada. The taxonomic problems relating to this genus have been dealt with elsewhere (Merriam, 1973b).

Diagnosis.—Dendroid to phaceloid and solitary cystiphylloid Rugosa in which single corallites range from trochoid to maturely cylindrical. Mature dissepimentarium of medium width, composed mostly of small to medium-sized, partly subglobose dissepiments in the type species. Border between tabularium and dissepimentarium fairly well defined but not sharp, with change from small steep dissepiments to large axially inclined tabellae. Tabularium medium wide to wide. Septa and septal spines or crests commonly absent in mature coralla of some species.

Remarks.—A dendroid colonial *Cystiphylloides* from the Onodaga Limestone of Ontario, Canada, placed in Billings' type species *aggregatum* reveals almost no septal spines or crests. Great Basin forms here classified as *Cystiphylloides* may have weak to stout peripheral crests and scattered spines internally. *Cystiphylloides* of the Devonian parallels structurally the Silurian genus *Cystiphyllum*, which commonly, but not always, has radially alined trabecular septal spines; these are usually more slender and more numerous than the stronger crests and spines which characterize some species of *Cystiphylloides*. Other Silurian cystiphyllids like *Hedstroemophyllum* have strong internal spines. Peripheral wall crests do not appear to be a feature of true *Cystiphyllum*. As there are no recognized fine structure distinctions, the Silurian forms are in some instances difficult to separate. Many of the Devonian forms of *Cystiphylloides*, as that genus is here construed, are axially quite excentric, as in "*Nardophyllum*" Wedekind 1925 and "*Wedekindophyllum*" Stumm 1949, the generic validity of which is doubtful. Such marked excentricity has not been observed among the Silurian cystiphyllids. None of the Silurian forms are known to be colonial, like some species of Devonian *Cystiphylloides*.

Stumm's Family Cystiphylloidae seems to be at present a more appropriate receptacle for these Devonian cystiphyllids than either Cystiphyllidae or Digonophyllidae (Hill, 1956); assignment to the Digonophyllidae as a subgenus of *Mesophyllum* is open to question. *Cystiphylloides*, as here construed, rather conclusively does not belong in synonymy with *Plasmophyllum*, where the genus has recently been placed by Birenheide (1964, p. 17).

Cystiphylloides sp. α

Plate 1, figures 1–3

Figured material.—USNM 166417. Diamond Range, Alhambra Hills locality M1337; topmost beds in the Woodpecker Limestone Member of the Nevada Formation.

Diagnosis.—*Cystiphylloides* with excentric axis; peripheral stereozone with well-developed septal wall crests. Septa spines present on inner dissepiment and upper tabellar surfaces.

External features.—A fairly large, maturely ceratoid to subcylindrical species, known only as a solitary coral having subdued but heavy rugae and well-defined longitudinal grooves. No external spines or excrescences observed.

Transverse thin sections.—Stout septal wall crests in a narrow stereozone, numbering about 112 in a mature section of 52 mm diameter. Major and minor septa poorly differentiated. Medium-size dissepiments predominating; tabellae of about the same size range and configuration as dissepiments. Scattered small septal spines lacking radial alinement. Patches of stereoplasmic filling present within the tabularium and at periphery. Corallite axis somewhat excentric, but less so than in earlier growth stages.

Longitudinal thin sections.—Tabularium not sharply set off from dissepimentarium. Tabularium width less than one-third of corallite diameter. Dissepiments mostly elongate, mostly of medium size for the genus, and of fairly uniform pattern; tabellae of same size range as dissepiments, numbering six to eight, transversely alined in plane of section, some with nearly horizontal bases. Tabellar sag in early ephebic stage revealing the excentric corallite axis. Peripheral stereozone excessively thickened in places; stereoplasmic festoons extend here and there across the tabularium. Sporadic septal spines, mostly slender, standing normal to inner dissepiment surfaces and projecting upward from tabellae.

Fine structure.—Steroplasmic thickenings minutely lamellar. Septal crests and spines showing no trabecular structure.

Comparisons with related forms.—This species differs from *C. spinosum* McLaren (in McLaren and Norris, 1964, pl. IX) by having a wider tabularium, stronger wall crests, and a more excentric axis. *Cystiphylloides iddingsi* n. sp. has larger tabellae and dissepiments and is externally spinose; *C.* sp. c has much larger tabellae and dissepiments and lacks the wall crests. *Cystiphylloides* in the Great Basin Early and early Middle

Devonian lack the septal spines and crests and are less prone to be axially excentric. Certain of these older forms are colonial.

Occurrence.—Middle Devonian coral zone G. Diamond Range, Alhambra Hills locality M1337; Eureka mining district, Nevada. Uppermost beds of Woodpecker Limestone Member. Study material comprises one large nearly complete corallum and smaller fragmentary coralla.

Cystiphylloides iddingsi n. sp.

Plate 1, figures 4, 15

1884. *Cystiphyllum* n. sp. Walcott, p. 106 (in part).
1940. Cystilphylloid sp. a. Merriam, p. 56.

Type material.—Holotype USNM 166418a; paratype USNM 166418b. Lone Mountain, Eureka County, Nev.; unit 4 of the Nevada Formation.

Diagnosis.—*Cystiphylloides* having stout, elongate wall crests, large tabellae, marked axis excentricity, and external spines.

External form.—Mature growth stages of 50 mm diameter with subcylindrical form. Rugate exterior with cycles of tubular, tapering spines 4 millimeters or more long. Weak longitudinal grooves largely masked by epitheca. Calice deep, with V-shaped profile and highly excentric axis. Broken septal ridges well defined on calice wall.

Transverse thin sections.—In a mature growth stage of 31 mm diameter, large wall crests 3 mm long extend from a narrow stereozone. Inner dissepiments and tabellae very large for the genus. Corallite axis about halfway between center and wall.

Longitudinal thin sections.—Dissepiments mostly elongate and having steeper axial inclination than the very large elongate tabellae, distribution of which reflects the excentric conical calice shape. Irregular stereoplasmic fillings in tabularium and extending peripherally.

Fine structure.—In transverse section, the elongate wall crests reveal divergent fibrilar structure extending from a median dark line, without suggestion of trabecular fiber grouping.

Comparison with related forms.—*Cystiphylloides* sp. a has smaller and much more numerous dessepiments and tabellae, a wider tabularium, and more numerous septal spines internally. *Cystiphylloides* sp. c lacks the wall crests of sp. a and of *C. iddingsi*, revealing no septal spines internally.

Occurrence.—Middle Devonian coral zone F. Lone Mountain, Eureka County, Nev., localities M1341, M1362. Unit 4 of the Nevada Formation. Study material consists of 24 incomplete coralla.

Cystiphylloides sp. c

Plate 1, figures 5, 6

Figured material.—USNM 166419. Middle Devonian, Morey Peak area locality M1338; Hot Creek Range, Nev.

Diagnosis.—Cystiphylloid, with a few large and very elongate dissepiments poorly differentiated from tabellae, a very narrow stereozone, and no septal crests or spines.

External features.—Mature corallum subcylindrical with broad subdued rugae; no external spines or longitudinal grooves observed.

Transverse thin section.—No septal spines or wall crests. The few large internal dissepiments with globose traces; outer dissepiments flattened. Axis excentric. No stereoplasmic fillings.

Longitudinal thin section.—Disposition of the very large elongate dissepiments reflecting the V-shaped calice profile and excentric position of the axis.

Fine structure.—Narrow peripheral stereozone with a weakly fibrous rather than lamellar structure; no trabecular spines.

Comparison with related forms.—See *Cystiphylloides* sp. a and *C. iddingsi* n. sp. This form is suggestive of Silurian *Microplasma*, but lacks the distinctive trabecular wall structure of that genus.

Occurrence.—Probably Middle Devonian coral zone F. Hot Creek Range, Morey Peak area, locality M1338, north of Morey Peak. Study material is one incomplete corallum.

Family DIGONOPHYLLIDAE Wedekind 1924

Subfamily ZONOPHYLLINAE Wedekind 1924

Genus Zonophyllum Wedekind 1924

This genus, of which the type species is *Zonophyllum duplicatum* Wedekind 1924, of the German lower Middle Devonian, includes Digonophyllidae with thick, commonly stumpy septal crests and longer incomplete stereoplasmically thickened septa. Septa may be irregularly thickened and connected laterally in stereoplasmic festoons. The taxonomy of this genus has recently been treated elsewhere (Merriam, 1973b).

Zonophyllum sp. r

Plate 1, figures 7, 8

Figured material.—USNM 166420. Nevada Formation; Roberts Mountains, Red Canyon locality M1339.

Diagnosis.—*Zonophyllum* with thickened, nonuniform stumpy septa in outer part of mature dissepimentarium and a complex peripheral dissepiment pattern in which some septa abort short of the wall.

External features.—Corallum small, ceratoid, with deep calice having a V-shaped profile.

Transverse thin section.—Septa about 28 in a corallite of 26-mm diameter; septa not clearly differentiated as

major and minor, somewhat wavy and irregularly thickened. Longest septa extending more than one-third the distance to axis. Many peripheral dissepiments small, some terminating against a single septum in digonophyllid fashion. Some outer dissepiments thickened stereoplasmically on axial sides. Complex peripheral herringbone patterns where minor septa are suppressed.

Longitudinal thin section.—Tabularium comprising three to seven tabellae, which are larger than dissepiments. Dissepiment columns in some coralla exceeding nine on each side. Stereozone of medium width. Outer dissepiments partly small and subglobose.

Comparison with related forms.—Septa are more uniformly developed than in *Zonophyllum duplicatum* Wedekind the type species; likewise the *Zonophyllum* species of lower beds in unit 2 of the Nevada Formation and coral zone D have less uniform septa and stereoplasmic festoons not present in the available material of *Z.* sp. r.

Occurrence.—Middle Devonian, possibly coral zone G. Roberts Mountains; locality M1339, Red Canyon. Study material consists of one incomplete corallum.

Subfamily DIGONOPHYLLINAE Wedekind 1924

Genus Digonophyllum Wedekind 1923

Type species.—*Digonophyllum schulzi* Wedekind 1923; lower Middle Devonian Nohner Schichten, Eifel district, Germany.

Diagnosis.—Digonophyllidae with major septa radially continuous and elongate, approaching the axis. Tabularium relatively narrow, not sharply differentiated. Pattern of dissepiments complex; normal dissepiment traces anguloconcentric, commonly becoming highly irregular peripherally, with scattered minute dissepiments that terminate against a single septum. Some minor septa discontinuous peripherally. A lonsdaleioid band and scattered strip carinae present in some species. Septa thickened radially, especially within the tabularium.

Remarks.—*Digonophyllum* includes large maturely subcylindrical corals. Septal thickening extends from the tabularium toward the periphery in varying degree. Some species have no appreciable septal stereozone. The symmetry is entirely radial, and there is usually no recognizable fossula in mature growth stages.

Digonophyllum with continuous major septa probably grades into *Mesophyllum*, which, as here construed, has radially discontinuous septa grading into nearly aseptate cystimorphs. Birenheide (1964) elected to suppress the genus *Digonophyllum* as a synonym of *Mesophyllum* in a taxonomic scheme differing sharply from that proposed by Hill (1956, p. F314–F321) for the digonophyllids. Hill advocated adoption of some digonophyllid taxa as subgenera of either *Digonophyllum* or *Mesophyllum*, a course that appears reasonable at present in preference to Birenheide's suppression of *Digonophyllum* and use of *Mesophyllum* as a subgenus of *Plasmophyllum*.

Members of the Family Ptenophyllidae Wedekind 1923 that includes *Acanthophyllum* parallel structurally and are associated with the digonophyllids. Both may have a peripheral lonsdaleioid band, but that of *Acanthophyllum* is more regular and uniform. Ptenophyllidae differ by having a wider and better differentiated tabularium with partly straight tabulae, as well as an axial whorl of long major septal terminations commonly thickened terminally in lobose fashion. Ptenophyllidae have continuous septa and lack the peripheral strip carinae of digonophyllids.

Digonophyllum (Digonophyllum) occidentalis n. sp.

Plate 3, figures 10, 11

Type material.—Holotype USNM 166431. Roberts Mountains, Bobcat Peak locality M1342.

Diagnosis.—*Digonophyllum*, with excessively thickened septa, some of which are laterally in contact within the tabularium. Lonsdaleioid band wide, with small outermost dissepiments.

Transverse thin sections.—Septal count about 104 in a corallite of 40-mm diameter. A few septa extending to the axis and a few traceable to the periphery as crests. Nonuniform lonsdaleioid band 8 mm wide in places; within the band, the largest dissepiments in the middle, the outer zone 2 mm wide is made up of small dissepiments. Thickened septa somewhat wavy; inner dissepiment surfaces also coated by stereoplasm. No appreciable septal stereozone.

Longitudinal thin sections.—Tabularium narrow, comprising one to three flattened tabellae. Calice deep, with V-shaped profile.

Fine structure.—Longitudinal sections reveal trabecular septal structure, the trabeculae being inclined peripherally.

Comparison with related forms.—This species differs from *D. schulzi* Wedekind, the type species, by having more thickened septa and a wide lonsdaleioid band and by lacking strip carinae. It differs from *Digonophyllum* sp. c by having a lonsdaleioid band, longer septa, and a less complex pattern of normal dissepiments. *D. occidentalis* n. sp. is closest to *D. (Mochlophyllum) alhambraensis* that has less thickened septa in the tabularium and thinned major septa in the lonsdaleioid band, some of which reach the wall.

Occurrence.—Middle Devonian coral zone F. Roberts Mountains; Bobcat Peak locality M1342. Unit 4 of the Nevada Formation. Study material consists of five incomplete coralla.

Digonophyllum sp. c

Plate 2, figures 11, 12

Figured material.—USNM 166428. Confusion Range, Utah. Locality M1343, Simonson Dolomite.

Diagnosis.—*Digonophyllum* with septa thickened throughout and considerably withdrawn from axis. Dissepiment traces in a highly irregular pattern without lonsdaleioid band. Tabularium poorly differentiated.

Transverse thin section.—Septal count about 80 in a corallite of 40-mm diameter. Major septa extending more than one-half the distance to axis; some minor septa exceeding one-half the length of major septa. Septal stereoplasmic thickening extending laterally upon inner surfaces of dissepiments.

Longitudinal thin section.—Flat tabellae similar in size and shape to larger dissepiments. Upper tabellar and inner dissepiment surfaces with stereoplasmic coating.

Fine structure.—Stereoplasmic thickenings faintly lamellar, but without trabecular features.

Comparison with related forms.—*Digonophyllum* sp. c differs from *D. schulzi* Wedekind, the type species, by having shorter major septa thickened throughout, whereas those of *schulzi* are thickened only in the tabularium. *D. schulzi* has a few strip carinae not present in *D.* sp. c. *Digonophyllum?* sp. b has longer excessively thickened septa and a distinct lonsdaleioid band.

Occurrence.—Confusion Range, Utah. Fish Spring quadrangle, locality M1343, northwest of Ibex. Middle Devonian, upper beds of Simonson Dolomite. Study material is one incomplete corallum.

Subgenus Mochlophyllum Wedekind 1923 (as a genus)

Type species.—*Mesophyllum maximum* Schlüter 1889, by monotypy. Lower Middle Devonian, Eifel district, Germany.

Diagnosis.—Very large, maturely subcylindrical *Digonophyllum* with greatly narrowed tabularium at maturity, long thickened continuous major septa, dilated especially in the tabularium, a very complex, irregular pattern of normal dissepiments, and a nonuniform lonsdaleioid band.

Remarks.—The largest individuals of *Digonophyllum (Mochlophyllum)* may have sporadic strip carinae peripherally, but not to the extent developed in *Mesophyllum (Arcophyllum)* of Markov (1926) and in the probably equivalent *Cosmophyllum*[1] of Vollbrecht (1922). Very small outermost lonsdaleioid dissepiments are characteristic of the subgenus *Mochlophyllum.*

[1] *Cosmophyllum* Vollbrecht (1922) is a homonym and should probably be superseded by *Arcophyllum*, the name *Cosmophyllum* having been used in 1851 for a member of the Orthoptera.

Digonophyllum (Mochlophyllum) alhambraensis n. sp.

Plate 3, figures 1–5

Type material.—Holotype USNM 166429. Diamond Range, Alhambra Hills locality M1337. Topmost beds of Woodpecker Limestone Member of the Nevada Formation.

Diagnosis.—Very large *Mochlophyllum* with septa thinned peripherally in lonsdaleioid band and lacking strip carinae.

External features.—Very large coralla of this species with nearly cylindrical shape at maturity; deep calice having V-shaped profile and narrow brim. Rugae fairly heavy; no longitudinal grooves observed, as the holotype is largely encased by a stromatoporoid.

Transverse thin sections.—Septal count 142 in a corallite of 67-mm diameter. Some major septa approaching the axis and some passing peripherally to the wall; minor septa usually not extending peripherally as far as major septa. Septal thickening greatest in major septa, especially toward the tabularium; septa thinned where present in lonsdaleioid band. Lonsdaleioid band as much as 7 mm wide, with very small dissepiments near wall. No strip carinae. Some dissepiments thickened stereoplasmically on inner surfaces. Some minor septa discontinuous peripherally. Stereozone very narrow.

Longitudinal thin sections.—Normal dissepiments in as many as 26 columns of medium to small size on each side. Tabularium narrow and poorly differentiated, comprising two or three tabellae.

Fine structure.—Stereoplasmic thickenings minutely lamellar and lacking distinctly trabecular features.

Comparison with related forms.—This new species differs from the type species *D. (Mochlophyllum) maximum* (Schlüter) by having more uniformly and evenly thickened major septa, by lacking strip carinae, and by having more thinned major septa continuing peripherally to the wall.

Occurrence.—Middle Devonian coral zone G. Diamond Range; Alhambra Hills locality M1337. Topmost beds of the Woodpecker Limestone Member. Study material is one very large incomplete corallum and fragments of other coralla.

Digonophyllum (Mochlophyllum) alhambraensis subsp. robertsensis n. subsp.

Plate 3, figures 6, 7

Type material.—Holotype USNM 166430. Roberts Mountains; Red Canyon, locality M1339. Middle Devonian, Nevada Formation.

Diagnosis.—Mochlophyllum with septa less thickened than with *alhambraensis* s.s. and having fewer large lonsdaleioid dissepiments.

Transverse thin section.—Septal count about 98 in a corallite of 46-mm diameter. Lonsdaleioid band 2–5 mm wide. Septa somewhat wavy and unevenly thickened; minor septa with peripheral discontinuities. Outer lonsdaleioid dissepiments mostly small. Septal stereozone narrow; many major septa traceable to wall. No septal grooves externally.

Longitudinal thin section.—Tabularium very narrow. Dissepimentarium having as many as 26 columns of medium and small normal dissepiments on each side. Calice, deep, with V-shaped profile.

Comparison with related forms.—This subspecies differs from *alhambraensis* s.s. by having thinner septa, fewer large dissepiments, and a narrower lonsdaleioid band.

Occurrence.—Middle Devonian coral zone F or G. Roberts Mountains; Red Canyon, locality M1339. Nevada Formation. Study material is one incomplete corallum.

Genus Mesophyllum Schlüter 1889

1956. *Mesophyllum* Schlüter 1889. Hill, p. F318.

Type species.—*Mesophyllum defectum* Schlüter 1889. Middle Devonian; Eifel district, Germany.

Diagnosis.—As here interpreted, this genus includes Digonophyllinae in which nonuniformly discontinuous, mostly thinned septa become obsolete peripherally in a wide band of irregularly lonsdaleioid dissepiments with or without local groupings of strip carinae.

Remarks.—Corals assigned to *Mesophyllum* range in structure from maturely subcylindrical cystimorphs with only a few weak internal traces of septa and scattered or no strip carinae to forms with numerous, but discontinuous or broken and some fairly strong, continuous, irregularly thickened septa and abundant strip carinae. It is probable that *Mesophyllum* intergrades with *Digonophyllum*. *Cystiphylloides* is not here classified as a subgenus of *Mesophyllum*, as was done by Hill (1956, p. 319), being assigned to the Family Cystiphylloidae of Stumm (1949).

In classification of Great Basin Devonian Rugosa (Merriam, 1973b), *Mesophyllum* is adopted as a genus with subgenera, more or less in accord with the scheme proposed by Hill (1956, p. F317–F320). At present this arrangement seems to be a reasonably good rationalization of the taxonomic dilemma in this complex coral group. Birenheide's (1964) exceedingly detailed systematics are, on the other hand, a considerable departure from Hill's, with the classifying of *Mesophyllum* as a subgenus of *Plasmophyllum*.

Of the seven subgenera of *Mesophyllum* listed by Hill (1956) only two, *Mesophyllum (Mesophyllum)* and *Mesophyllum (Lekanophyllum)*, are pertinent here.

Mesophyllum (Mesophyllum) sp. f

Plate 1, figures 13, 14

Figured material.—USNM 166422. Lone Mountain, Eureka County, Nev.; locality M1341.

Diagnosis.—*Mesophyllum* s.s. having an irregular, nonuniform lonsdaleioid band and groups of thin, broken, wavy septa extending in places to the wall.

Transverse thin section.—The thin, broken, wavy septa very unevenly developed and in places difficult to distinguish within a complex dissepimental network. Larger, more even lonsdaleioid dissepiments patchy and separated here and there by a network comprising smaller uneven dissepiments and wavy septal crests. Some septa extending to the wall.

Longitudinal thin section.—Except for scattered large lonsdaleioid dissepiments peripherally, the dissepiments mainly of small to medium size, generally smaller than the tabellae.

Comparison with related forms.—*Mesophyllum (Lekanophyllum)* sp. l differs by having a more uniform lonsdaleioid band and better developed septa. It is, however, possible these are merely variants of a single species, a problem calling for quantitative analysis of a large suite of specimens from the same bed.

Occurrence.—Middle Devonian coral zone F. Lone Mountain, locality M1341. Unit 4 of the Nevada Formation. Study material is one incomplete corallum.

Mesophyllum (Mesophyllum)? sp. k

Plate 1, figures 9–11

1884. *Cystiphyllum* n. sp Walcott, p. 106 (in part).
1938. (?)*"Cyathophyllum" kobehense* Stumm, pl. 59, fig. 1a only.

Figured material.—USNM 96213c. Lone Mountain, Eureka County, Nev. Nevada Formation.

Diagnosis.—Small trochoid rugose coral with peripheral band of lonsdaleioid dissepiments and somewhat wavy, little-thickened septa, most of which extend more than half the corallite radius.

External features.—Single known individual of this form showing early neanic axial rejuvenescence by oblique offset. A single large axial offset developed in mature calice. Septal grooves very weakly defined.

Transverse thin section.—Somewhat wavy, little-thickened septa numbering 58; minor septa nearly as long as major septa. All septa considerably withdrawn from axis. Only a few septa discontinuous peripherally. The longitudinal section of this form not known.

Remarks.—The possibility that this form should be assigned to *Digonophyllum* rather than *Mesophyllum* has been considered in view of the radial continuity of most septa. The single specimen here figured, collected by Walcott in 1880, is one of those initially referred by him to *Cystiphyllum*. It is among Stumm's labeled

paratypes (USNM 96213c) of "*Cyathophyllum*" *kobehense* Stumm. A thin section (pl. 1, fig. 10) cut from the proximal half of the broken corallite (pl. 1, fig. 9) does not agree in structural detail with Stumm's transverse thin section of *kobehense* (Stumm, 1938, pl. 59, fig. 1a), which lacks lonsdaleioid features and was cut from another coral. A transverse thin section (pl. 4, fig. 7) of Stumm's holotype of "*Cyathophyllum*" *kobehense* (USNM 96213a) recently cut does not appear to represent the same genus and species and is herein classified as *Keriophyllum*? *kobehense* (Stumm). It is possible that *Mesophyllum (Mesophyllum)*? sp. k may be an immature corallite of either *Mesophyllum (Lekanophyllum)* sp. l or *Mesophyllum (Mesophyllum)* sp. f, a problem which will require study of large suites of associated specimens from unit 4 of the Nevada Formation.

Occurrence.—The specimen here designated as *Mesophyllum (Mesophyllum)*? sp. k was recognized by Stumm as among those collected at Lone Mountain by Walcott (1884, p. 106) and referred by him to *Cystiphyllum*. Preservation of the fossil indicates that it probably came from unit 4 and coral zone F, where it was probably associated with *Cystiphylloides* sp. b, as suggested by Walcott's discussion.

Subgenus Lekanophyllum Wedekind 1924 (as a genus)

1924. *Lekanophyllum* Wedekind, p. 29, 35; text figs. 36–48.
1940. *Lecanophyllum* Wedekind. Lang, Smith, and Thomas, p. 75.
1949. *Lecanophyllum* Wedekind. Stumm, p. 47; pl. 22, figs. 14, 15.
1956. *Mesophyllum* (*Lekanophyllum*) Wedekind. Hill, p. F318, fig. 219–2a–c.

Type species.—*Lekanophyllum punctatum* Wedekind 1924; by subsequent designation Lang, Smith, and Thomas. Lower Middle Devonian, Eifel district, Germany.

Diagnosis.—*Mesophyllum* with a moderately wide to wide lonsdaleioid band, numerous fairly continuous and continuous major septa withdrawn from the axis and a fairly wide, but not sharply differentiated, tabularium in which the tabellae are mostly larger than the dissepiments.

Remarks.—The proportion of more or less continuous septa in the radial sense is greater in *Lekanophyllum* than in *Mesophyllum* s.s., which may also have strip carinae not recognized in the former. Septa are more likely to be thickened in *Lekanophyllum* than in *Mesophyllum* s.s. *Mesophyllum (Atelophyllum)* Wedekind 1925 appears to differ little from subgenus *Lekanophyllum*, except possibly for thinner septa of species which have been classified in *Atelophyllum*. (See McLaren and Norris, 1964, pls. VIII, X–XII.)

Mesophyllum (Lekanophyllum) sp. l

Plate 1, figure 12

Figured material.—USNM 166421. Lone Mountain, Eureka County, Nev., locality M1340.

Diagnosis.—*Lekanophyllum* with wide fairly uniform lonsdaleioid band and numerous wavy, partly discontinuous septa considerably withdrawn from the axis. Minor septa poorly differentiated.

External features.—Mature corallum subcylindrical; epitheca with longitudinal grooving.

Transverse thin section.—Septal count 62 is in section of 29 mm diameter. Septa wavy, withdrawn from axis, partly discontinuous radially and poorly differentiated as major and minor. Wall crests absent; septal spines uncommon in peripheral part of dissepimentarium. Wall thin, with epitheca revealing distinct longitudinal grooves. Many of the outermost lonsdaleioid dissepiments small, the largest being in the middle of the band. Tabularium less than one-third the corallite diameter. Longitudinal section unknown.

Comparison with related forms.—*Mesophyllum (Lekanophyllum) punctatum* (Wedekind), the lectotype, has more numerous septa, better differentiated as major and minor and a narrower lonsdaleioid band, its septa are more broken radially. A species from the Horn Plateau Formation of western Canada compared with *M. (L.) punctatum* by McLaren (in McLaren and Norris, 1964, p. 23, pl. 8, figs. 3, 4) also has a narrower lonsdaleioid band and somewhat thicker septa which are differentiated. Similar Horn Plateau corals assigned to *Atelophyllum nebracis* McLaren (in McLaren and Norris, 1964, p. 24, pls. 10–12) have a lonsdaleioid band like that of the Nevada form here described, but have more thickened, poorly differentiated septa.

Occurrence.—Middle Devonian coral zone F. Lone Mountain locality M1340. Unit 4 of the Nevada Formation. Study material consists of one nearly complete corallum and fragmentary coralla.

Family PTENOPHYLLIDAE Wedekind 1923

Genus Acanthophyllum Dybowski 1873

1873. *Acanthophyllum* Dybowski, p. 339.
1923. *Ptenophyllum* Wedekind, p. 26–34; text figs. 2, 5–6.
1924. *Ptenophyllum* Wedekind, p. 35–44; text figs. 49–62.
1949. *Acanthophyllum* Dybowski. Stumm, p. 20; pl. 9, figs. 1–7.
1956. *Acanthophyllum* Dybowski. Hill, p. F303 (in part); fig. 207–1a–b, not fig. 207–1c–d.
1961. *Acanthophyllum* Dybowski. Birenheide, p. 77–146; pls. 1–7.

Type species.—*Cyathophyllum heterophyllum* Edwards and Haime 1851; by subsequent designation Schlüter 1889.

Diagnosis.—Large maturely subcylindrical rugose corals having a wide calice brim and many columns of normal and subordinate lonsdaleioid dissepiments;

long, somewhat thickened, lamellar and continuous septa terminating axially in a more or less twisted whorl; a discrete, sharply differentiated tabularium comprising close-spaced tabulae, some of which are complete.

Remarks.—The pattern of dissepiment traces is anguloconcentric internally, but peripherally may become complex and irregular, passing in some species into a lonsdaleioid band; small to minute dissepiments that terminate against a single septum are characteristic. Axial terminations of septa are commonly lobose, as in the type species *A. heterophyllum*. Minor septa are usually more than half the length of major septa and are thinner. *Acanthophyllum* includes loosely colonial species.

Certain members of the Family Digonophyllidae bear a superficial convergent resemblance to *Acanthophyllum* and other Ptenophyllidae with which they may be associated. Both families comprise large solitary corals with long, thickened septa and a complex pattern of normal and lonsdaleioid dissepiments. However, the tabularium of digonophyllids is never as well differentiated and rarely has complete tabulae; the digonophyllids do not possess the twisted, lobose axial whorl of the ptenophyllids. A well-defined lonsdaleioid band is more characteristic of the Digonophyllidae than of Ptenophyllidae, and the peripheral strip carinae, so characteristic of some digonophyllids, do not occur in the Ptenophyllidae. Unlike many digonophyllids, none of the Ptenophyllidae have broken or radially discontinuous septa.

Birenheide (1961) critically evaluated the taxonomic status of *Acanthophyllum* and other members of the Ptenophyllidae of Wedekind. In this light several Wedekind ptenophyllid genera appear to be synonyms of *Acanthophyllum*. Birenheide reclassified certain other Wedekind genera as subgenera under *Acanthophyllum*.

Ptenophyllidae like *Acanthophyllum* are quite characteristic of Eifelian Stage Middle Devonian in Europe. In the Great Basin these corals occur in Devonian coral zone F, continuing upward in diminishing numbers into coral zone G. No Ptenophyllidae are known here below coral zone F. Digonophyllidae appear earlier in Great Basin Devonian coral subzone D_2 of possible earliest Eifelian age and are common in coral zone G of Givetian age.

Acanthophyllum sp. α

Plate 2, figures 3–6

Figured material.—USNM 166425a, b, c. Diamond Range localities M6, M53, M204 and S8; Oxyoke Canyon and Alhambra Hills. Woodpecker Limestone Member of the Nevada Formation.

Diagnosis.—*Acanthophyllum* with thickened septa, very numerous, mostly small dissepiments, and lacking a lonsdaleioid band.

Transverse thin sections.—Septal count 72 in a corallite of 31-mm diameter; septal thickening of some individuals extending into axial whorl. Dissepiment pattern mostly simple concentric to anguloconcentric. Stereozone narrow.

Longitudinal thin sections.—Normal dissepiments mostly small; columns on each side occasionally exceeding 18. Tabularium comprising combinations of partly straight, close-spaced tabulae and flat tabellae.

Comparison with related forms.—Acanthophyllum sp. a differs from *A. robertsensis* n. sp. by having thickened septa and much more numerous and smaller normal dissepiments and by lacking the lonsdaleioid band of *robertsensis*.

Occurrence.—Higher beds of coral zone F. Diamond Range, upper beds of the Woodpecker Limestone Member of the Nevada Formation. Oxyoke Canyon localities M6, M53; Alhambra Hills localities M204, S8. Study material comprises seven incomplete coralla.

Acanthophyllum robertsensis n. sp.

Plate 2, figures 1, 2

1940. *Tabulophyllum nevadense* Stumm. Merriam, p. 58; pl. 14, fig. 6.

Type material.—Holotype USNM 166434a; paratype USNM 166424b. Roberts Mountains; Bobcat Peak locality M1342.

Diagnosis.—Large *Acanthophyllum* with well-developed lonsdaleioid band, septa of axial whorl thinned, and a discrete tabularium with flat tabellae and close-spaced tabulae, some of which are nearly straight. Calice fairly deep, with V-shaped profile.

Transverse thin sections.—Septal count 72 in a corallite of 38-mm diameter. Septa thin or very little thickened, fairly straight; minor septa two-thirds the length of major septa. Tabular extensions of major septa very long and unthickened within the irregularly twisted axial plexus. Normal dissepiments mostly of simple form, concentric to anguloconcentric and straight, closely spaced in places. Lonsdaleioid band up to 6 mm wide, with three or more cycles of medium and large dissepiments. Peripheral stereozone well developed, but rather narrow.

Longitudinal thin sections.—Tabularium sharply set off, about one-third of corallite diameter; tabulae close-spaced (two per millimeter). Tabularium comprising various combinations of incomplete tabulae, which are peripherally straight and slightly arched axially, with wide, flat tabellae. Innermost dissepiments generally small and nearly vertical; normal dissepiments in 9–14 columns on each side.

Comparison with related forms.—This species lacks the septal thickening of *A. heterophyllum*, the type species; it also has a better developed, wider lonsdaleioid band and a less complex, more uniform pattern of concentric normal dissepiments. The coral figured by Merriam (1940, pl. 14, fig. 6) from the same area as "*Tabulophyllum nevadense* Stumm" is conspecific with *Acanthophyllum robertsensis* n. sp. and is a loosely colonial form with a slightly wider stereozone.

Reproductive offsets.—The coral referred to above figured by Merriam has a lateral offset which probably developed from the calice rim.

Occurrence.—Middle Devonian, coral zone F. Roberts Mountains, Bobcat Peak locality M1342. Unit 4 of the Nevada Formation. Study material consists of three incomplete solitary coralla and a partial colonial corallum.

Acanthophyllum sp. c

Plate 2, figures 7, 8

Figured material.—USNM 166426. Diamond Range; Oxyoke Canyon, locality M6.

Diagnosis.—Small *Acanthophyllum* lacking a lonsdaleioid band, having thickened septa and a wide tabularium for the genus.

Transverse thin section.—Septal count 66 in a corallite of 25 mm diameter. Dissepiments small, with fairly uniform concentric pattern. Stereozone narrow. Axial segments of septa little thickened in whorl.

Longitudinal thin section.—Tabularium wide and less sharply differentiated than normal for this genus, made up of rather flat tabellae. Dissepiments mostly small and fairly uniform, disposed in six or more columns on each side.

Fine structure.—Trabeculae in thickened septa flat or inclined peripherally at a low angle.

Comparison with related forms.—This form differs from *Acanthophyllum* sp. a by having a narrower and more uniform dissepimentarium, and from *A. robertsensis* n. sp. by having thicker septa and a wider tabularium and by lacking the lonsdaleioid band.

Occurrence.—Middle Devonian coral zone G. Diamond Range; Oxyoke Canyon locality M6. Basal beds of the Bay State Dolomite Member of the Nevada Formation. In upper Oxyoke Canyon the light-buff-colored silty dolomite at locality M6 contains large valves of *Stringocephalus* and digitate favositids in association with this species and other solitary rugose coral genera. Study material is one incomplete corallum.

Acanthophyllum sp. p

Plate 4, figures 9–11

Figured material.—USNM 166433a, b. Roberts Mountains; Pyramid Hill localities M1345, M1348.

Diagnosis.—Large *Acanthophyllum* with septa considerably thickened in tabularium, thinning in places near the periphery. Tabularium sharply differentiated, with closely spaced, uneven tabulae, some of which are complete.

Transverse thin section.—Septal count 128 in a corallite of 54 mm diameter. Most major septa passing into the twisted axial whorl, where they are considerably thickened in lobose fashion and laterally in contact. No septal thickening in some peripheral segments. Septal stereozone very narrow; longitudinal grooves faintly developed. Minor septa less thickened than major septa. Normal dissepiments concentric to anguloconcentric in a simple pattern. No lonsdaleioid band.

Longitudinal thin section.—Tabularium in sharp boundary with dissepimentarium, narrow, about one-fourth the corallite diameter; tabulae undulant, some nearly complete and closely spaced (3–5 per mm). Dissepimentarium wide, with as many as 26 columns on each side.

Fine structure.—Trabecular structure with steep peripheral inclination shown faintly in longitudinal section.

Comparison with related forms.—*Acanthophyllum* sp. p differs from *A. heterophyllum*, the type species, by having a narrower tabularium, more uniformly thickened septa, and a simpler dissepiment pattern. It differs from *A. robertsensis* n. sp., which has a lonsdaleioid band and unthickened septal ends in the tabularium. *Acanthophyllum* sp. a differs by having a wider tabularium.

Occurrence.—Middle Devonian coral zone F. Roberts Mountains; Pyramid Hill localities M1345, M1348. Unit 4 of the Nevada Formation. Study material consists of three incomplete coralla.

Acanthophyllum? sp.

Plate 2, figures 9, 10

Figured material.—USNM 166427. Roberts Mountains, Red Canyon, locality M1339.

Diagnosis.—*Acanthophyllum*-like solitary corals with many columns of small, normal dissepiments, a tabularium comprising close-set, partly straight tabulae, an incipient axial whorl, and no lonsdaleioid band.

Transverse thin section.—Septal count 84 in a corallite of 28-mm diameter. Most minor septa not extending to edge of tabularium. Axial whorl weakly developed for this genus. Dissepiment traces simple, concentric, rather crowded peripherally. Stereozone very thin.

Longitudinal thin section.—Dissepiment columns as many as 18 on each side; outer dissepiments very small, their size increasing toward the tabularium. Closely space tabulae, three or four per millimeter; some tabu-

lae nearly complete, others combined with wide, flat tabellae. Tabular sag characteristic.

Fine structure.—Trabeculae well developed in thickened septa, either flat or with low peripheral inclination.

Comparison with related forms.—This form has a well-differentiated tabularium with more complete tabulae than is usual for the genus, but the axial whorl is less developed than normal for *Acanthophyllum*. Whereas the tabulae are more like those of *A. robertsensis* n. sp. than other forms of *Acanthophyllum* here described, it differs from *A. robertsensis* n. sp. in weakness of the axial whorl and absence of a lonsdaleioid band. Small size of the outer dissepiments distinguishes the form in question from all others here dealt with.

Occurrence.—Middle Devonian coral zone F or G. Roberts Mountains, Red Canyon, locality M1339. Nevada Formation.

Genus Paracanthus, new genus

1867. *Aulophyllum*? *Richardsoni* Meek, p. 81, pl. 11, figs. 3, 3a.
1891. (?)*Cyathophyllum Richardsoni* Meek. Whiteaves. p. 200, pl. 27, figs. 3, 4.
1945. *Mictophyllum richardsoni* (Meek). Smith, p. 34 (in part), pl. 5, figs. 10–12.

Type species.—*Aulophyllum*? *Richardsoni* Meek 1867. The Ramparts, MacKenzie River, Canada. Middle Devonian.

Diagnosis.—Solitary Ptenophyllidae with septa thickened in outer part of dissepimentarium, thinning toward axis, lacking the complex axial whorl of *Acanthophyllum*. Tabularium wide, comprising fairly continuous straight tabulae with flattened tabellae; not sharply differentiated from dissepimentarium. A weak fossula present in some coralla.

Remarks.—*Paracanthus* n. gen. differs from *Acanthophyllum* by its lack of the complex axial whorl of septal terminations, by having more restricted septal thickening, and by possessing a wider tabularium that is less sharply differentiated at the margin. Unlike *Acanthophyllum*, some species show a suggestion of a fossula. *Mictophyllum* Lang and Smith differs by having obsolete or very short minor septa and little thickening of septa. *Sterictophyllum* Pedder (1965) has a much wider septal stereozone.

Paracanthus nevadensis n. gen., n. sp.

Plate 4, figures 14–19; plate 6, figures 4–7

Type material.—Holotype, NSNM 166434; paratypes, USNM 166435a, b, c. Roberts Mountains; Red Canyon, locality M1339.

Diagnosis.—*Paracanthus* with fairly smooth, slightly undulant septa in which the greatest thickening is within the peripheral half. Dissepiment pattern fairly simple concentric-anguloconcentric, crowded peripherally with a few irregular dissepiments near the wall. Peripheral dissepiments small, steeply inclined.

Transverse thin sections.—Septal count 72 in a corallite of 33-mm diameter (holotype). A few major septa reach the axis; minor septa about one-half the length of major septa. Where the dissepiments are crowded peripherally, stereoplasm also pervading dissepiments. Septal stereozone usually narrow, but widened moderately in places. A few modified chevron septal traces near the wall. Fossula defined by union of two major septa in the tabularium.

Longitudinal thin sections.—Tabularium very wide. Small, vertical to steeply inclined dissepiments in six to 10 columns on each side, with sporadic large dissepiments. Tabularium with numerous flat tabellae that are larger than most dissepiments.

Fine structure.—Well-defined, rather coarse trabecular structure shown in longitudinal sections; large trabeculae nearly horizontal in widened parts of septal stereozone.

Comparison with related forms.—*Paracanthus richardsoni* (Meek) from the Mackenzie River Ramparts, Canada (Smith, 1945, p. 34, pl. 5, figs. 11–12). has fewer septa and more slender, subcylindrical corallites. *Paracanthus*? sp. f from Lone Mountain has shorter septa and a slightly narrower tabularium, with more of the nearly complete, straight tabulae.

Occurrence.—Middle Devonian coral zone F or G. Roberts Mountains; Red Canyon, locality M1339. Nevada Formation. Study material consists of six incomplete coralla.

Paracanthus? sp. f

Plate 4, figures 12, 13

Figured material.—USNM 166436. Lone Mountain, locality M1344.

Diagnosis.—Small *Paracanthus*-like coral with very wide, flattened tabellae with intercalated straight, complete tabulae.

Remarks.—This coral differs from *Paracanthus nevadensis* n. gen., n. sp. by having shorter septa and more of the wide straight tabulae; trabeculae at the periphery are more steeply inclined away from the axis.

Occurrence.—Middle Devonian coral zone F. Lone Mountain, locality M1344. Unit 4 of the Nevada Formation. Study material consists of a partial corallum and fragmentary coralla.

Family CYATHOPHYLLIDAE Dana 1846

Genus Cyathophyllum Goldfuss 1826

1826. *Cyathophyllum* Goldfuss, p. 54; pl. 15, fig. 13.
1846. *Cyathophyllum* Dana (in part).
1940. *Cyathophyllum* Goldfuss, Lang, Smith, and Thomas, p. 44 (in part).
1949. *Cyathophyllum* Goldfuss. Stumm, p. 22; pl. 10, fig. 9.
1956. ?*Cyathophyllum* Goldfuss. Hill, p. F278.
1963. *Cyathophyllum* Goldfuss. Birenheide, p. 369.

Type species.—*Cyathophyllum dianthus* Goldfuss 1826; by subsequent designation Dana 1846. Devonian, Eifel district, Germany. Uncertainties persist regarding internal characteristics of the holotype of *dianthus* (Stumm, 1940, p. 23; Hill, 1956, p. F278). Stumm chose Goldfuss' (1826) pl. 15, figure 13 as lectotype, which is not known to have been sectioned. "*Cyathophyllum dianthus*" Lonsdale, a Silurian coral, is excluded. Birenheide (1963, p. 377, pl. 26, fig. 1, pl. 50, figs. 19a–b, pl. 51, fig. 22) selected and figured a neotype of *C. dianthus* Goldfuss from the Givetian Loogher Schichten of the Eifel district.

Diagnosis.—Solitary and colonial rugose corals having wide mature corallites numerous long major lamellar septa, some of which reach the axis, a wide dissepimentarium comprising many columns of prevailingly small globose dissepiments, and a tabularium made up of combinations of tabellae with straight tabulae, of which some are nearly complete. A fossula present in some mature corallites of solitary species.

Remarks.—Colonial forms like the type species range in growth habit from phaceloid to loosely cerioid. Colonial forms have no fossula or other evidence of bilateral symmetry. Lamellar stereoplasmic thickenings of septa and a peripheral stereozone are uncommon. *Cyathophyllum* lacks yardarm septal carinae. Some species have decidedly wavy, uneven septa with abundant minor zigzag carinae. Multiple calice platform reproductive offsets are characteristic, these being more commonly peripheral.

Cyathophyllum lends itself to subgeneric classification (Birenheide, 1963, p. 369–403), the following subgenera being recognized here:

1. *Cyathophyllum* (*Cyathophyllum*) Goldfuss 1826
2. *Cyathophyllum* (*Peripaedium*) Ehrenberg 1934
3. *Cyathophyllum* (*Moravophyllum*) Kettnerova 1932
4. *Cyathophyllum* (*Orthocyathus*) new subgenus

Characters used in subgeneric separation include the tendency in certain species to develop minutely wavy septa peripherally with abundant zigzag carinae, the tendency as in *Cyathophyllum* sensu stricto toward minute and complex peripheral branching of septa, and the relative abundance of continuous tabulae in some species, as compared with the tabellae that predominate in other species. Only solitary forms are known in *Moravophyllum;* the other three subgenera are colonial, as known at present. *Moravophyllum* and the new *Orthocyathus* have fairly straight, smooth, thin septa with a minimum of zigzag carinae and no septal branching peripherally.

Heliophyllum, normally but not always a solitary coral, may be distinguished from *Cyathophyllum* by its abundant and prominent yardarm carinae; the solitary *Keriophyllum* of the Nevada Formation differs from *Heliophyllum* by lacking yardarm carinae and having abundant zigzag carinae throughout. Large corallites of *Keriophyllum* may reveal complex peripheral branching of septa similar to *Cyathophyllum* sensu stricto.

Dana's (1946) Family Cyathophyllidae is provisionally adopted for *Cyathophyllum, Keriophyllum,* and other genera for which the family name Zaphrentidae has been used by other authors. The true characterization of the type species of *Zaphrentis* remains to be clarified.

Subgenus Moravophyllum Kettnerova 1932 (as a genus)

1932. *Moravophyllum* Kettnerova, p. 27, 79.
1940. *Moravophyllum* Kettnerova. Lang, Smith, and Thomas, p. 86.
1949. *Moravophyllum* Kettnerova. Stumm, p. 21.
1956. *Moravophyllum* Ketterova. Hill, p. F278.

Type species.—*Moravophyllum ptenophylloides* Kettnerova 1932, by author designation. Late Middle Devonian (Givetian), Celechovice, Moravia.

Diagnosis.—Solitary *Cyathophyllum* with numerous smooth, uniformly thin, fairly straight, uncomplicated septa and a weak fossula in mature growth stages. Tabularium wide, comprising numerous closely spaced tabellae and sporadic tabulae, some being nearly continuous.

Remarks.—Kettnerova's text figure of a neanic transverse section of the type species reveals thickened major septa in two quadrants, which are probably cardinal. Other *Cyathophyllum* subgenera seemingly do not retain at maturity a clear indication of bilateral symmetry like that of mature *Moravophyllum* with its weak fossula.

Cyathophyllum (Moravophyllum) alhambraensis n. sp.

Plate 5, figures 6–10

Type material.—Holotype, USNM 166440; Diamond Range, Alhambra Hills locality M1337. Paratype, USNM 166441; Sulphur Spring Range, locality M1346.

Diagnosis.—*Moravophyllum* with uniformly simple concentric-anguloconcentric pattern of dissepiment traces and a wide, well-differentiated tabularium with subordinate straight, nearly complete tabulae.

External features.—This species fairly large and subcylindrical with well-marked rugae and weak septal grooves. Calice wide, deep, and flat-bottomed.

Transverse thin sections.—Septal count 80 in a corallite of 32-mm diameter; septa smooth, fairly straight, unthickened, the longest slightly withdrawn from the axis. Minor septa mostly two-thirds the major septa length. Stereozone very narrow; septal grooves slightly indented. Epitheca distinct. In places near the wall the anguloconcentric dissepiment pattern somewhat irregular and the septa slightly thickened. Fossula of holotype indistinct.

Longitudinal thin sections.—Tabularium slightly less than one-half the corallite diameter; flattened tabellae predominate with some fairly straight, nearly complete tabulae. Dissepiments mostly small and globose in as many as 15 columns on each side; the peripheral dissepiments inclined axially at low angles; those toward the axis nearly vertical.

Fine structure.—Longitudinal sections show patches of peripherally inclined trabecular structure.

Comparison with related forms.—The type species *M. ptenophylloides* Kettnerova differs by having a wider peripheral zone of nearly flat dissepiments and fewer straight, nearly complete tabulae. The fossula is more clearly defiined in the type species. *Moravophyllum* sp. 1 has a narrower dissepimentarium.

Occurrence.—Middle Devonian coral zone G. Diamond Range, Alhambra Hills locality M1337. Sulphur Spring Range, locality M1346. Topmost beds. Woodpecker Limestone Member of the Nevada Formation. Study material consists of three incomplete coralla.

Cyathophyllum (Moravophyllum) sp. 1

Plate 4, figures 1–4

Figured material.—USNM 166432a, b. Lone Mountain, locality M1344.

Diagnosis.—Small *Moravophyllum* with unusually wide tabularium and relatively narrow dissepimentarium. Fossula present.

Transverse sections.—Septal count 74 in a corallite of 19 mm diameter. Septa smooth, thin, straight to slightly wavy, the longest extending to axis; minor septa more than one-half the length of major septa. Fossular depression defined by union of two major septa near axis.

Longitudinal sections.—Tabularium about one-half the corallite diameter. Dissepiments in about six columns on each side. Tabularium comprising three to nine tabellae, some wide and flat, with occasional nearly complete, uneven tabulae. Calice deep, wide, and flat-bottomed.

Comparison with other forms.—This form differs from *M. ptenophyloides*, the type species, by having a narrower disspimentarium. *Moravophyllum alhambraensis n.* sp. also has the wider dissepimentarium, but with many more columns of small dissepiments.

Occurrence.—Middle Devonian coral zone F. Lone Mountain locality M1344. Unit 4 of the Nevada Formation. Study material consists of four incomplete coralla.

Subgenus Orthocyathus, new subgenus

Type species.—*Cyathophyllum (Orthocyathus) flexum* (Stumm) 1938. Middle Devonian, unit 4 of the Nevada Formation; Lone Mountain, Eureka County, Nev.

Diagnosis.—Colonial *Cyathophyllum* having long, straight, fairly smooth septa with little waviness, and few or no zigzag carinae or other complications. Tabularium comprising a combination of tabellae and nearly straight to slightly arched tabulae. No suggestion of a fossula in mature corallites.

Remarks.—Corallites on distal surfaces of coralla show a very great size range from very wide to very narrow by reason of the numerous interstitial offsets from parental calice brims. Coralla range from openly phaceloid to loosely cerioid, occasionally within the same colony. *Orthocyathus* lacks the peripheral septum complications of *Cyathophyllum* sensu stricto and of the subgenus *Peripaedium.* It differs from subgenus *Moravophyllum* by having the colonial growth habit, by lacking a fossula, and in the frequency of reproductive offsets from the calice brim.

Cyathophyllum (Orthocyathus) flexum (Stumm)

Plate 7, figures 1–8

1884. *Cyathrophyllum* n. sp. Walcott, p. 104.
1938. *Prismatophyllum flexum* Stumm, p. 483; pl. 58, figs. 6a–d; pl. 59, figs. 6a–c.
1940. *"Cyathophyllum" flexum* (Stumm). Merriam, p. 56, 78; pl. 13, figs. 1, 2.

Type material.—Holotype, USNM 96219a; paratypes, USNM 96219b, c, d. Middle Devonian, unit 4 of the Nevada Formation; Lone Mountain, Eureka County, Nev.

Diagnosis.—*Orthocyathus* with largest corallites of great maximum diameter in large coralla that range in habit from openly phaceloid to loosely cerioid. Septa relatively straight, smooth, and uncomplicated peripherally. Tabellae predominating over tabulae.

External form.—As noted by Stumm (1938, p. 483), the coralla of this species vary greatly in external appearance, depending upon degree of openness or compactness of the colony. The holotype is a small not very compact cerioid mushroom-shaped colony showing distally a large number of small interstitial offset corallites. Mature corallites have a wide, deep, rather straight-sided calice with a median boss and a flattened or reflected brim, in some corallites beset with small daughter corallites. The underside of the holotype also reveals offsets that appear to have grown from the sides of the parent as noted by Walcott (1884, p. 104). More compact cerioid colonies (pl. 7, fig. 5) have polygonal mature corallite walls and fewer interstitial corallites. Loose phaceloid colonies (pl. 7, figs. 2, 3, 7, 8) show a great diameter range of the subcylindrical corallites, which expanded less rapidly during growth.

Transverse thin sections.—Septal count of mature corallites averaging about 58, may exceed 60. Septa normally straight, uniformly thin and simple, less commonly undulant; minor zigzag carinae uncommon.

Axial twisting and intersection of longest septa sufficient in some corallites to form a calice boss, but not producing a discrete axial structure as observed in longitudinal sections. Minor septa about two-thirds the length of major septa. Dissepiment traces rather uniformly concentric, with sporadic chevrons peripherally. No lonsdaleioid dissepiments. Wall thin, straight to strongly but evenly curved in cerioid coralla.

Longitudinal sections.—Tabularium one-third to one-half the corallite diameter, comprising more or less flattened tabellae which are overall somewhat arched distally. Globose dissepiments disposed in about 12 columns on each side of which the innermost are inclined axially, the middle four are flat and the outer ones are inclined peripherally, thus indicating reflection of the calice brim. Tabellae larger than most dissepiments. Septa showing no amplexoid axial extensions.

Fine structure.—No initial fine structure is preserved in these silicified corals.

Reproductive offsets.—Offsets probably exceeding seven, developing from the reflexed calice rim, as illustrated in plate 7, figure 2. Offsets also shown by the numerous small interstitial corallites (pl. 7, **fig. 1**), some of which appear to grow from the side of the parent, rather than from an intermediate point on the calice brim.

Comparison to related forms.—No described species closely related to this species are known. It is possible that some forms previously assigned to *Hexagonaria* may belong in this new subgenus of *Cyathophyllum*. Other described species of colonial *Cyathophyllum* fall in other subgenera having structural complexities in the peripheral band. (See Birenheide, 1963.)

Occurrence.—Middle Devonian coral zone F. Lone Mountain localities: M54, M1360, B1363. Unit 4 of the Nevada Formation. Type material collected by C. D. Walcott at Lone Mountain in 1880. Study material comprises five nearly complete coralla and 15 incomplete coralla.

Genus Keriophyllum Wedekind 1923

1923. *Keriophyllum heiligensteini* Wedekind, p. 27, figs. 3a–b.
1940. *Ceriophyllum* Lang, Smith, and Thomas, p. 35.
1949. *Heliophyllum heiligensteini* (Wedekind). Stumm, p. 21, pl. 9, fig. 12.
1956. *Keriophyllum* Wedekind. Hill, p. F278, fig. 190–2a–b.

Type species.—*Keriophyllum heiligensteini* Wedekind, by author designation. Middle Devonian, Heiligenstein, Eifel district, Germany.

Diagnosis.—Solitary rugose corals with numerous long, minutely zigzag septa with elbow carinae and a wide dissepimentarium. Most septa little thickened; the longer major septa typically reaching the axis, but not forming an axial whorl.

Remarks.—No complete longitudinal section of topotype material of the type species *K. heiligensteini* is known to have been figured. Whereas Wedekind (1923, p. 35; 1924, p. 67–70) seems to have considered this genus affiliated with *Heliophyllum*, it lacks the diagnostic yardarm carinae of that genus and is not known to have longitudinal features of the American *Heliophyllum*. Lang, Smith, and Thomas (1940, p. 35) regard *Keriophyllum* as a synonym of *Heliophyllum*. According to Birenheide (1962a, p. 108; 1963, p. 390), on the other hand, *Keriophyllum heiligensteini* Wedekind, the type species, as a synonym of *Cyathophyllum (Peripaedium) turbinatum* Goldfuss, suggesting (McLaren, in McLaren and Norris, 1964, p. 18) that *Keriophyllum* be merged with *Peripaedium*.

Keriophyllum mclareni n. sp.

Plate 5, figures 1–4

Type material.—Holotype, USNM 166437; paratypes, USNM 166438a, b. Lone Mountain, locality M1344.

Diagnosis.—Medium and large *Keriophyllum* with mature septa withdrawn from the axis, a deep calice with rather narrowly V-shaped profile, and a very narrow tabularium. Pattern of small dissepiments and wavy septa complex peripherally.

Transverse thin sections.—Septal count 96 in a corallite of 30-mm diameter. Minutely wavy septa considerably withdrawn from the axis; some not traceable to the wall. Minor septa generally more than one-half the length of major septa. Although there is no discrete lonsdaleioid band, scattered lonsdaleioid dissepiments occur at the periphery. In some mature individuals, the concentric pattern of normal dissepiments so modified as to produce a highly irregular and confused arrangement of these traces, especially towards the periphery. Small elbow carinae numerous along the zigzag septa; some minute nodular thickenings on one side only of the septum; others are actual spines passing outward diagonally. No true yardarm carinae observed. In late mature growth stages, some of the inner parts of septa slightly and uniformly thickened. Stereozone very narrow.

Longitudinal thin sections.—Tabularium very narrow, lacking straight tabulae; tabellae mostly of medium to small size, flattened, numbering two to four across axial zone. Dissepimentarium very wide, having as many as 36 columns of mostly small dissepiments on each side. Trabeculae alined peripherally in such manner as to suggest weak strip carinae in depth.

External features.—Coralla externally quite rugate with very weak longitudinal grooves; trochoid in early ephebic stages. Holotype constricted distally, having

its greatest diameter in earlier adult growth stages. Some large individuals with a more nearly turbinate configuration.

Fine structure.—Longitudinal thin sections revealing well-defined trabeculae that are steeply inclined toward periphery. In outer part of dissepimentarium, trabeculae coalescing to give appearance of strip carinae in some places.

Comparison with related forms.—*Keriophyllum heiligensteini* Wedekind, the type species, has longer major septa. Of described American corals, the nearest is *Heliophyllum borealis* McLaren (in McLaren and Norris, 1964) which has yardarm carinae (lacking in this form), longer septa, and a somewhat wider tabularium.

Occurrence.—Middle Devonian coral zone F. Lone Mountain locality M1344. Unit 4 of the Nevada Formation. Study material consists of six incomplete coralla.

Keriophyllum? kobehense (Stumm)

Plate 4, figure 7

1938. *"Cyathophyllum" kobehense* Stumm, p. 479; pl. 58, fig. 1a, *not* pl. 58, fig. 1b, *not* pl. 59, figs. 1a, 1b.

Type material.—Holotype, USNM 96213a (Stumm, 1938, pl. 58, fig. 1a). Stumm's paratypes, USNM 96213 b, c, d, are probably not conspecific with the holotype. Middle Devonian; Lone Mountain, Eureka County, Nev.

Diagnosis.—Small trochoid to ceratoid rugose coral with numerous long,wavy, thin septa, an irregular pattern of normal dissepiments, and a weakly developed nonuniform lonsdaleioid band.

Transverse thin section.—Septal count 64 in corallite of 18-mm diameter. Many of the major septa reaching the axis. Some discontinuities in the thin, wavy irregular septa; some of the normal dissepiments more nearly straight than concentric. Longitudinal section of this coral unknown.

Remarks.—The true generic relation of this species has not been established. In transverse section, this form shows thin wavy septa resembling those of *Keriophyllum mclareni* n. sp., which also has a few lonsdaileioid dissepiments. Other specimens among Stumm's paratypes of *"Cyathophyllum" kobehense* appear to represent species or genera different from the holotype, of which the transverse section is here figured (pl. 4, fig. 7). Another of Stumm's paratypes (USNM 96213c) here referred to as *Mesophyllum*? sp. 1 is doubtfully conspecific with *kobehense*. (See pl. 1, figs. 9–11.)

Occurrence.—Middle Devonian, probably coral zone F. Lone Mountain; collected by C. D. Walcott in 1880, probably from unit 4 of the Nevada Formation.

Family SPONGOPHYLLIDAE Dybowski 1873

Genus Sociophyllum Birenheide 1962

(as subgenus of Stringophyllum)

1881. *Spongophyllum* Schlüter.
1925. *Spongophyllum*. Wedekind, p. 18–19, 47.
Loipophyllum Wedekind, p. 53, 57.
Neospongophyllum Wedekind, p. 57.
1949. *Spongophyllum semiseptatum* Schlüter. Stumm, pl. 14, figs. 12, 13.
1962. *Stringophyllum* (*Sociophyllum*) Birenheide, p. 53.
1962. *Stringophyllum* (*Neospongophyllum*?). McLaren, Norris, and McGregor, pl. 1, figs. 7, 8.
1964. *Stringophyllum* (*Sociophyllum*) Birenheide. McLaren and Norris, p. 20.

Type species.—*Spongophyllum elongatum* Schlüter 1881; by author designation. Middle Devonian, Eifel district, Germany.

Diagnosis.—Loosely phaceloid Rugosa with maturely cylindrical corallites having a strong lonsdaleioid band, wide tabularium, and partly long, smooth lamellar septa that may be discontinuous radially or aborted.

Remarks.—This distinctive genus so characteristic of the Cordilleran higher Middle Devonian is here viewed as an independent genus rather than a subgenus of *Stringophyllum*, as originally classified by Birenheide (1962b). *Sociophyllum* differs from the cerioid true *Spongophyllum* as typified by *S. sedgwicki* in growth habit, in its stronger lonsdaleioid marginarium, and in greater width and spacing of tabulae.

Sociophyllum eurekaensis n. sp.

Plate 8, figures 6–15

1938. ?*Disphyllum lonensis* Stumm, pl. 59, fig. 4c only.

Type material.—Holotype, USNM 166447; paratypes USNM 166448, 166449. Lone Mountain localities M1340, M1344; Roberts Mountains locality M1348.

Diagnosis.—Slender *Sociophyllum* with very large lonsdaleioid dissepiments; septa of most corallites not clearly differentiated as major and minor. Tabulae wide, having either peripheral or axial sag. Wall crests usually weakly developed.

Transverse thin sections.—Septal count ranging from 24 to 32, with an average of 27 in corallites of about 9-mm diameter. Septa long, smooth, slightly wavy, either withdrawn from axis or, in some corallites, extending to axis. In a few corallites some very short minor septa present; usually no differentiation between major and minor septa. Some septa discontinuous peripherally with wall crests. Septal stereozone usually narrow. Largest lonsdaleioid dissepiments extending more than one-fourth of the corallite circumference.

Longitudinal thin sections.—Tabularium usually exceeding one-half the corallite width. Lonsdaleioid

dissepiments in one or two columns, less commonly three or four; dissepiments ranging from near horizontal to steeply inclined toward the axis. Tabulae rather closely spaced, mostly complete or nearly complete, some with axial sag; some corallites with uniform sequences of complete tabulae that are axially flat with peripheral sag. Complete straight tabulae uncommon. Amplexoid septal projections uncommon. Large dissepiment distribution nonuniform, occurring here and there in groups.

Fine structure.—Slightly thickened septa and stereozone revealing no clearly defined trabecular structure.

Comparison with related forms.—*Sociophyllum elongatum* (Schlüter), the type species, has more septa, including a greater number of minor septa, and all septa tend to be discontinuous. *Sociophyllum glomerulatum* (Crickmay) also has more numerous and more broken septa; in some corallites the septa are largely aborted (Pedder, 1964).

Occurrence.—Middle Devonian coral zone F. Lone Mountain localities: M1340, M1344. Roberts Mountains, Pyramid Hill locality M1348. Unit 4 of the Nevada Formation. Study material comprises 10 partial coralla.

Sociophyllum eurekaensis subsp. b

Plate 8, figures 16–18

Figured material.—USNM 166448. Roberts Mountains, Bobcat Peak, locality M1342.

This subspecies of *S. eurekaensis* differs from the typical form in its fairly uniform development of axially and periaxially straight tabulae with a peripheral tabular depression. Whereas some of the very wide tabulae are complete beneath the depression, most appear to terminate laterally at the inner margin of the peripheral depression that is floored by discrete tabular segments. Thus the tabularium may be said to comprise separate peripheral and axial-periaxial sequences. In transverse section, the very large lonsdaleioid dissepiments are less common in this subspecies.

Comparison with related forms.—A species referred by McLaren (in McLaren and Norris, 1964, p. 19, pl. VII, figs. 2a–c) to *Sinospongophyllum* cf. *S. planotabulatum* Yoh has the tabular features of this form and appears otherwise closely related.

Occurrence.—Middle Devonian coral zone F. Roberts Mountains, Bobcat Peak locality M1342. Unit 4 of the Nevada Formation. Study material consists of four partial coralla.

Genus Utaratuia Crickmay 1960

1960. *Utaratuia* Crickmay, p. 5; pl. 1, figs. 6–9, pl. VIII, fig. 1.
1961. *Utaratuia* Crickmay. Lenz, p. 507; pl. II, figs. 1, 2.
1962. *Utaratuia laevigata* Crickmay. McLaren, Norris, and McGregor, pl. II, figs. 5, 6.
1964. *Utaratuia* Crickmay. Pedder, p. 443.

Type species.—*Utaratuia laevigata* Crickmay, 1960; by author designation. Middle Devonian, Carcajou River, Northwest Territories, Canada.

Diagnosis.—Cerioid rugose corals of cystimorph character with septa very short or absent; dissepiments lonsdaleioid in several columns. Tabularium usually sagging, nonuniform, comprising large tabellae with a few nearly complete tabulae.

Remarks.—*Utaratuia* Crickmay 1960 may be a synonym of *Tabellaephyllum* Stumm 1948b, the type species of which is *T. peculiaris* Stumm from the Martin Limestone of the Bisbee area, Arizona, where it is considered to be of Late Devonian age. Stumm's holotype figures of *T. peculiaris* show no trace of septa or septal crests. In longitudinal section *T. peculiaris* shows a differentiation of the tabularium similar to that of *Utaratuia*. Study of additional material of the Arizona form may call for rejection of *Utaratuia*, especially if some individuals of *Tabellaephyllum peculiaris* are found to possess rudimentary septa. Some corallites of *Utaratuia laevigata* also have almost completely obsolete septa.

Homeomorphic forms are to be expected among unrelated cerioid Rugosa of this kind in which septa are reduced to peripheral crests or lost entirely and in which the dissepiments in consequence tend to become lonsdaleioid. Some species of *Columnaria* and of *Hexagonaria* like *H. rohrensis* Glinski (1955) have correspondingly reduced septa and few columns of dissepiments, but these are not lonsdaleioid and the tabularium is wider. Lonsdaleioid features favor the classification of *Utaratuia* with either Spongophyllidae or Endophyllidae. A better differentiated, more uniform tabularium and greater frequency of straight tabulae are more characteristic of both families than is the case with *Utaratuia*.

Assuming *Utaratuia* and *Tabellaephyllum* to be related, or even congeneric, the range of corals of this kind would be from Eifelian to Frasnian. Comparable morphologic trends occur in *Australophyllum*-like members of the Endophyllidae in the Late Silurian, some corallites of which have completely aborted septa.

Utaratuia eurekaensis n. sp.

Plate 8, figures 1–3

Type material.—Holotype USNM 166466 Lone Mountain, locality M1344.

Diagonsis.—Small form of *Utaratuia* with rather thick wall, strong septal crests, broken outermost

columns of small lonsdaleioid dissepiments, and sporadic complete tabulae.

Transverse thin sections.—Septal count 32 in a corallite of 7-mm diameter. Septa not differentiated as major and minor, mostly not stubby, varying in length from 0.3 to 1 mm. Wall in places with zigzag trace shown by median dark line.

Longitudinal thin sections.—Lonsdaleioid dissepiments in one to three columns on each side, of which the larger are quite elongate. Tabularium with sag, for the most part not sharply differentiated, comprising combinations of large, flat, axially inclined tabellae, horizontal tabellae, and a few complete, nearly horizontal to sagging tabulae. General appearance horizontally that of a cystimorph.

Fine structure.—Thickened wall with well-defined median dark line, but no trabecular structure.

External features.—Large rounded heads 25 cm or more wide in which the rather small corallites are of rather uniform size on the distal surface. Calices deep, without peripheral platform, and with V-shaped profile to rather straight sided.

Comparison with related forms.—*Utaratuia eurekaensis* n. sp. may be conspecific with a Canadian form assigned with query by Lenz (1961, p. 507, pl. II, figs. 1, 2) to *Utaratuia stevensi* (Chapman). *U. laevigata* Crickmay, the type species, has larger corallites with more numerous and generally weaker to obsolete septa and in places a thinner wall.

Occurrence.—Middle Devonian coral zone F. Lone Mountain localities M1344, M1361. Unit 4 of the Nevada Formation. Study material consists of nine incomplete coralla.

Family ENDOPHYLLIDAE Torley 1933

Genus Tabulophyllum Fenton and Fenton 1924

1924. *Tabulophyllum* Fenton and Fenton, p. 30; pl. VI, figs. 8–12.
1928. *Apolythophyllum* Walther, p. 135, 144–145; text figs. 33, 34.
1945. *Tabulophyllum* Fenton and Fenton. Smith, p. 58; pl. 2, figs. 10, 11, pl. 3, fig. 8.
1949. *Tabulophylum* Fenton and Fenton. Stumm, p. 27; pl. 12, figs. 15, 16, 18, 19.
1956. *Tabulophyllum* Fenton and Fenton. Hill, p. 300, fig. 205–1a–c.

Type species.—*Tabulophyllum rectum* Fenton and Fenton 1924; by author designation. Hackberry Stage of Fenton and Fenton (1924), Upper Devonian, Iowa.

Diagnosis.—Ceratoid to subcylindrical solitary rugose corals with very wide tabularium comprising partly complete, fairly straight tabulae. Dissepiments large and mostly lonsdaleioid. Septa smooth, withdrawn from axis at maturity, discontinuous peripherally. No fossula.

Remarks.—The figured original sections of the type species do not illustrate the distinctive transverse lonsdaleioid features of this genus; these characters are better shown in the illustrations of Smith, Stumm, and Hill. Genera which may be confused with *Tabulophyllum* are *Ketophyllum* of the Silurian and members of the Halliidae, such as *Papiliophyllum* and undescribed related forms, in the Lower Devonian. All of these have a well-developed cardinal fossula not possessed by *Tabulophyllum;* the Halliidae mentioned have strong septal thickening in cardinal quadrants persisting into mature growth stages. *Ketophyllum* is commonly of turbinate growth habit.

Diversophyllum (Sloss, 1939, p. 64) differs by having longer septa reaching the axis, more arched and irregular tabulae, and less tendency to produce lonsdaleioid dissepiments. *Sinospongophyllum* Yoh 1937 may be congeneric, but it appears to have a somewhat less developed lonsdaleioid band and perhaps more of a septal stereozone.

Occurrence.—*Tabulophyllum* occurs in the Great Basin higher Middle Devonian beds of unit 4 of the Nevada Formation and coral zone F. More commonly, however, this genus is found in Late Devonian strata, as in Germany (Walther, 1928), southeastern Alaska, and Iowa.

Tabulophyllum antelopensis n. sp.

Plate 6, figures 8–12

Type material.—Holotype, USNM 166442; paratypes, USNM 166443, 166444. Antelope Range, Eureka County, Nev.; locality M1347.

Diagnosis.—*Tabulophyllum* with many complete, fairly straight tabulae; septa considerably withdrawn from axis at maturity. Lonsdaleioid dissepiments partly large, very elongate both longitudinally and circumferentially. Wall crests strong, set in a narrow to medium width stereozone.

Transverse thin sections.—Septal count 66 in a corallite of 26-mm diameter. Major septa extending one-third to more than one-half the distance to the axis. Minor septa thin and discontinuous; major septa very slightly thickened in tabularium. Largest lonsdaleioid dissepiments extending one-fourth the circumference of corallite. In places small normal dissepiments developed adjacent to tabularium. Stereozone less than 1 mm. wide. Septal grooves poorly defined in epitheca.

Longitudinal thin sections.—Tabulae fairly even, mostly complete; spaced four tabulae per millimeter to more than 1 mm apart. Some lonsdaleioid dissepiments 15 mm long. Tabulae ranging from horizontal to those with axial sag and with peripheral sag; axial arching very uncommon. Amplexoid septal projections not observed.

External features.—Mature corallites elongate, subcylindrical with prominent rounded rugae and weak longitudinal grooving. Calice deep and flat-bottomed. This species commonly colonial.

Fine structure.—Septal stereozone minutely lamellar without well-defined trabeculae.

Comparison with related forms.—The septa are more withdrawn from the axis and some of the lonsdaleioid dissepiments larger than in the type species *Tabulophyllum rectum. Tabulophyllum mcconnelli* (Whiteaves) reveals more axial arching of tabulae, somewhat longer septa at maturity, and amplexoid septal features not recognized in the new species. An undescribed species from the Coronados Islands of southeastern Alaska lacks the very elongate dissepiments of *T. antelopensis.*

Occurrence.—Middle Devonian coral zone F. North end of the Antelope Range; locality M1347. Unit 4 of the Nevada Formation. Study material consists of eight partial coralla.

Genus Australophyllum Stumm 1949

1949. *Australophyllum* Stumm, p. 34; pl. 16, figures 1, 2.

Type species. — Spongophyllum cyathophylloides Etheridge 1911; by author designation. Devonian, Queensland, Australia.

Diagnosis.—Cerioid Endophyllidae with medium-wide to narrow, closely spaced, proximally sagging tabulae and a wide to very wide dissepimentarium having several columns comprising scattered to wholly lonsdaileioid dissepiments, many of which are large and elongate.

Remarks.—Cerioid corals of this type with a few lonsdaleioid dissepiments have previously been referred to *Spongophyllum* or classified in the Spongophyllidae. It is recommended that the genus name *Spongophyllum* be restricted to forms with slender corallites, thickened walls, and few dissepiment columns, therein agreeing in general structure with *S. sedgwicki,* the type species, as originally illustrated by Edwards and Haime (1853, pl. 56, figs. 2, 2a–c, 2e). Close spacing of tabulae is more characteristic of *Australophyllum* than of *Spongophyllum.* It is probable that unrelated cerioid Rugosa developed lonsdaleioid features, which by themselves are not always viewed as evidence of close genetic affiliation.

Occurrence.—*Australophyllum* is represented by undescribed subgenera in the Late Silurian. The genus in the strict sense is not known above the late Middle Devonian.

Australophyllum prismatophylloides (Stumm)

Plate 8, figures 4, 5

1884. ?*Cyathophyllum davidsoni* Milne-Edwards. Walcott, p. 104.
1938. *Spongophyllum prismatophylloides* Stumm, p. 482; pl. 58, fig. 5a, pl. 59, figs. 5a–b.
1961. ?*Australophyllum,* cf. *A. cyathophylloides* (Etheridge), Lenz, p. 509, pl. II, figs. 4, 5.

Type material.—Holotype, USNM 96217. Devonian, Nevada Formation; Lone Mountain, Eureka County, Nev.

Diagnosis.—Cerioid rugose coral having long, thin, smooth major septa, irregularly developed and broken minor septa, and very unevenly distributed lonsdaleioid dissepiments of irregular shape.

Transverse thin section.—Septal count about 32 in a corallite of 10-mm diameter. Thin straight or slightly wavy septa extending in part to the axis; minor septa ranging from one-half the length of major septa to discontinuous as septal crests, or entirely aborted. Pattern of dissepiment traces very uneven, ranging from concentric toward axis to lonsdaleioid peripherally. Some lonsdaleioid dissepiments irregularly concave toward the wall. In parts of some corallites all dissepiments irreguarly concave peripherally in lonsdaleioid fashion. Wall thin to slightly thickened.

Longitudinal sections.—No longitudinal thin sections are available. According to Stumm (1938, p. 482) the tabularium is not sharply bounded, is about 5 mm wide, or about one-half the diameter, and is occupied by close-spaced incomplete tabulae.

Comparison with related forms.—*Australophyllum cyathophylloides* (Etheridge), the type species, has a more regular pattern of lonsdaleioid dissepiments and possibly a thicker wall. A species from the Devonian of western Canada compared with *cyathophylloides* by Lenz (1961, p. 509; pl. II, figs. 4, 5) appears to be quite similar to *prismatophylloides.*

Irregularities of the dissepiment pattern make somewhat uncertain the assignment of this species to *Australophyllum.*

Occurrence.—Probably Middle Devonian coral zone F. Collected at Lone Mountain by C. D. Walcott in 1880, probably from unit 4 of the Nevada Formation.

Family DISPHYLLIDAE Hill 1939

Genus Hexagonaria Gürich 1896

1896. *Hexagonaria* Gürich, p. 171.
1900. *Prismatophyllum* Simpson, p. 218.
1940. *Hexagonaria* Gürich. Lang, Smith, and Thomas, p. 69.
1945. *Prismatophyllum* Simpson. Smith, p. 44.
1948a. *Hexagonaria* Gürich. Stumm, p. 11.
1949. *Hexagonaria* Gürich. Stumm, p. 33.
1956. *Hexagonaria* Gürich. Hill, p. F280.
1967. *Hexagonaria* Gürich. Sorauf, p. 24.

Type species.—*Cyathophyllum hexagonum* Goldfuss; by subsequent designation Lang, Smith, and Thomas, 1940, p. 69. Middle Devonian, Eifel district, Germany.

Diagnosis.—Cerioid Disphyllidae forming large compact heads; deep calice pits of distal surface surrounded by inclined platform overlying the dissepimentarium. Tabularium medium to very wide. Dissepiments normal-globose to elongate in several columns, the outer ones flat or inclined at very low angles. Septa long, commonly thin and continuous from wall; zigzag and yardarm carinae common. Tabularium comprising partly complete nonuniform tabulae and tabellae, more commonly with slight arching than with overall sag. Uniformly distributed persistent thickenings of wall and septa uncommon. Lonsdaleioid dissepiments and horseshoe dissepiment columns absent.

Remarks.—Cerioid colonies resembling the disphyllid *Hexagonaria* have arisen in other rugose coral families; among these are the Phillipsastraeidae, Spongophyllidae, Endophyllidae, and Kyphophyllidae. Of these, several of the most similar surficially are among the Phillipsastraeidae, which are distinguished by possessing columns of small horseshoe dissepiments with their associated trabecular bundles and by their more uniform septal thickenings. The other families mentioned have lonsdaleioid features and develop carinae to a lesser extent than do *Hexagonaria* and other members of the Disphyllidae.

Most American Middle Devonian species here interpreted as *Hexagonaria* in the strict sense possess carinae, commonly strong yardarm carinae, in some but not all corallites. These carinae may be restricted to parts of single corallites. Stumm's (1948a) figures of the type species *Hexagonaria hexagona* (Goldfuss) from the Eifel district (Germany) Middle Devonian reveal numerous yardarm carinae. On the contrary, Sorauf's (1967, p. 10, fig. 4) figures of Late Devonian (Frasnian) *Hexagonaria* from Frasnes, Belgium, assigned to *H. hexagona*, reveal no clear indication of yardarm carinae. It is assumed, although by no means established, that the Eifel district material is more nearly representative of the Goldfuss type species. (See Sourauf, 1967, p. 33–36.)

Of uncertain family affiliation and unknown relation to *Hexagonaria* are three noncarinate Devonian groups of *Hexagonaria*-like corals: (1) Aberrant species structurally immediate between *Hexagonaria* and *Columnaria*, (2) the genus *Xystriphyllum*, and (3) a form group of cerioid corals having a few sporadic lonsdaleioid dissepiments. Group 1 is heterogeneous and polyphyletic, occurring in the Devonian of Europe; it comprises thick-walled species with very wide tabulae, a reduced dissepimentarium having few columns, and short, thick wedge-tapering septa (Glinski, 1955). Group 2, including *Xystriphyllum*, has a rather uniformly thickened wall, peripherally thickened, fairly uniform wedge-tapering, smooth septa, usually a narrow tabularium, and steeply inclined to vertical dissepiments peripherally. Group 3 with sporadic, mostly small and irregular lonsdaleioid dissepiments is represented by the species here called *Australophyllum prismatophylloides* (Stumm), possibly a *Hexagonaria* derivative. Lonsdaleioid supporting structures clearly arose in several genetically unrelated stocks. *Australophyllum* of the Endophyllidae differs by possessing a better defined and more uniform lonsdaleioid band.

Occurrence.—Coral species assigned to *Hexagonaria* in the Great Basin have their earliest occurrence in unit 2 of the Nevada Formation (Devonian coral zone D_2) and are not known with assurance above unit 4 (Devonian coral zone F). The *Hexagonaria* of *Hexagonaria kirki* (Stumm) in Nevada unit 2 is considered a subgenus (Merriam, 1973b). The following are the species from Devonian coral zone F here dealt with:

Hexagonaria fisherae (Merriam)
H. fisherae subsp. *cockalorumensis*, n. subsp.
H. fisherae subsp. *antelopensis*, n. subsp.
Hexagonaria meeki n. sp.
Hexagonaria sp. c
Hexagonaria sp. f
Hexagonaria sp. n
Hexagonaria sp. w

Of uncertain stratigraphic horizon, possibly as high as Devonian coral zone G, are *Hexagonaria* sp. r and *Hexagonaria* sp. b (Merriam, 1940).

Hexagonaria has not been recognized during the course of this study in Great Basin rocks above coral zone G of Givetian (Middle Devonian) age. In coral zone I of Frasnian (Late Devonian) age in the upper part of the Devils Gate Limestone, the characteristic abundant colonial Rugosa are thamnastraeoid and aphroid Phillipsastraeidae, which rarely show traces of an outer wall. In western Europe the genus *Hexagonaria* ranges upward from the Belgian Givetian into the middle Frasnian (Sorauf, 1967). Overlying strata of the type area higher middle Frasnian contain the *Phillipsastraea* assemblages. Cerioid corals referred to *Hexagonaria* (McLaren and others, 1962), are reported in Frasnian rocks of western Canada.

"*Prismatophyllum* sp. undet." figured by Stumm (1940, pl. 8, fig. 12) from the White Pine district, Nevada, appears to be a carinate *Hexagonaria*. This material collected by an early-day exploring party is from an unknown stratigraphic position in an area where the Devils Gate Limestone of Frasnian age is well represented and coral faunas of Devonian coral zone I with Phillipsastraeidae are present.

Hexagonaria fisherae (Merriam)

Plate 11, figures 1–3

1938. *Prismatophyllum profundum* (Hall). Stumm, p. 482; pl. 59, figs. 7a–b.

1940. *Prismatophyllum fisherae* Merriam, p. 78, pl. 13, figs. 3, 4.

Type material.—Holotype, USNM 96390. Roberts Mountains; Pyramid Hill. Unit 4 of the Nevada Formation. Figured material, USNM 96218; Lone Mountain, Eureka County, Nev.; collected by C. D. Walcott.

Diagnosis.—Large globular *Hexagonaria* with long septa reaching the axis, numerous zigzag and yardarm carinae, a wide to very wide tabularium, and septa thickened in the dissepimentarium. Corallites mostly slender.

Transverse thin sections.—Septal count ranging from 32 to 40. Outer wall straight to zigzag, usually unthickened. Septa in many places stereoplasmically thickened from wall to tabularium; thinned septum extensions in tabularium wavy to twisted, meeting axially. Septa with rows of closely spaced zigzag carinae which pass into yardarm carinae; other septa lacking carinae or with yardarm carinae only.

Longitudinal thin section.—Unknown for holotype. The Lone Mountain specimen (USNM 96218) with tabularium width more than one-half the corallite diameter; tabulae very nonuniform, wavy, and lacking straight elements, some slightly arched overall with minor axial sag. Dissepiments small, in two to five columns on each side; mostly flat or with very low axial inclination.

Comparison to related forms.—This strongly carinate species differs from *H. fisherae* subsp. *cockalorumensis* by having more widespread septal thickening and more of the zigzag carinae.

Occurrence.—Middle Devonian coral zone F. The type material collected by Merriam at Pyramid Hill, southern Roberts Mountains, in 1937 was not sectioned longitudinally. Although these specimens were float coral heads, they came from the outcrop belt of unit 4 of the Nevada Formation. No material of this species was collected in situ at Lone Mountain, although the Walcott specimen described by Stumm (1938) and here refigured probably came from unit 4 and coral zone F. This species also occurs in unit 4 at Devonian Peak, Roberts Mountains. Study material comprises six coralla.

Hexagonaria fisherae subsp. cockalorumensis n. subsp.

Plate 11, figures 4–6; plate 12, figures 1–7

Type material.—Holotype, USNM 166454; paratype, USNM 166455. Fish Creek Range; Cockalorum Wash area, locality M1351. Middle Devonian, Cockalorum Wash Formation.

Diagnosis.—*Hexagonaria* forming very large globular heads of diameter in excess of 30 cm. Most corallites with septa having numerous yardarm carinae; longer septa of some corallites reaching the axis. Septa usually thin, but in some corallites having patches of localized thickening. Tabularium moderately wide to very wide; dissepiments prevailingly small.

Transverse thin sections.—Septal count ranging from 32 to 40. Septa normally thin, straight in dissepimentarium, commonly with strong yardarm carinae; wavy or twisted in tabularium, reaching the axis in some corallites. Minor septa exceeding one-half of major septal length, extending to tabularium. Zigzag carinae uncommon. Wall thin, usually straight. Concentric dissepiment traces commonly closely spaced in inner part of this band.

Longitudinal thin sections.—Tabularium width ranging from less than one-half to more than one-half the corallite diameter. Dissepiments mostly small, in four to seven columns on each side; some outermost flatter dissepiments commonly elongate. Yardarm carinae with strong diagonal traces in depth. Tabularium comprising mostly very large tabellae with a few nearly straight complete tabulae; slight overall arching common; few tabular elements showing axial sag.

Fine structure.—All study material is silicified and reveals no trabecular structure.

External features.—Large globular mature coralla with modified mushroom shape, with constricted basal immature growth stage (pl. 12, fig. 1). Corallites narrow, of fairly uniform size, with very few small intermural offsets. Calice pits large, deep, fairly steep sided; peripheral calice platform flat or axially inclined. No low flattened mature platelike coralla like those of *Taimyrophyllum*. Reproductive offsets peripheral.

Comparison to related forms.—This subspecies differs from typical *H. fisherae* by having less stereoplasmic septal thickening and fewer zigzag carinae. *Hexagonaria meeki n.* sp. has fewer and even thinner septa, the transverse dissepiment traces are less distinctly concentric, and the tabularium is narrower. *Hexagonaria fisherae* subsp. *antelopensis* differs by having more septa stereoplasmically thickened.

Occurrence.—Middle Devonian coral zone F. Fish Creek Range, Cockalorum Wash area; Reef Hill, locality M1351; Coral Ridge, locality M1352. Cockalorum Wash Formation. Study material comprises 50 complete and partial coralla.

Hexagonaria fisherae subsp. antelopensis n. subsp.

Plate 13, figures 6, 7

Type material.—Holotype, USNM 166456; paratype, USNM 166457. Antelope Range, locality M1347.

Diagnosis.—*Hexagonaria fisherae* with numerous yardarm carinae, few zigzag carinae; most septa somewhat thickened stereoplasmically, long septa extending to axis; a wide tabularium; dissepiments mostly small.

Transverse thin sections.—Septal count averaging about 32; septa straight and usually slightly and unevenly thickened in dissepimentarium. Yardarm carinae numerous and strong on some septa of many corallites. Long septa twisted in tabularium, extending to axis of some corallites. Concentric pattern of dissepiment traces well defined.

Longitudinal thin sections.—Tabularium width usually less than one-half the corallite diameter. Dissepiments mostly small, with some elongate and flat toward periphery. Tabularium comprising large flat tabellae and nearly straight complete tabulae; slight overall arching of tabular elements common. Carinal traces well defined in depth.

Fine structure.—Trabeculae ill defined.

Comparison with related forms.—This subspecies differs from typical *fisherae* by having a narrower tabularium with more of the nearly straight, complete tabulae. Septal thickening is more characteristic of subsp. *antelopensis* than of subsp. *cockalorumensis*.

Occurrence.—Middle Devonian coral zone F. Antelope Range, north end, locality M1347, unit 4 of the Nevada Formation. Fish Creek Range, Cockalorum Wash area, Coral Ridge locality M1364; Cockalorum Wash Formation. Bare Mountain, Nye County, Nev., locality M1359. Simpson Park Range, north end at Coal Canyon, Horse Creek Valley quadrangle, Nevada; 0.75 mile south of mouth of Coal Canyon, cobbles in conglomerate at base of volcanic sequence.

Study material consists of nine partial coralla.

Hexagonaria meeki n. sp.

Plate 14, figures 1–4

Type material.—Holotype, USNM 166458. Fish Creek Range; Cockalorum Wash area, locality M1352.

Diagnosis.—*Hexagonaria* with thin wall and very thin septa having yardarm carinae, many elongate dissepiments, and a narrow tabularium for the genus. Long septa withdrawn from axis.

Transverse thin sections.—Septal count averaging about 28. Septa unusually thin for the genus, slightly wavy and withdrawn from axis. Most corallites having yardarm carinae; some septa with zigzag carinae passing into yardarm carinae along a septum. Minor septa nearly as long as major septa. Concentric pattern of dissepiment traces well developed only on inner part of band; outer dissepiments highly irregular, larger and sublonsdaleioid in some corallites near periphery. In places septa discontinuous peripherally, not reaching the wall.

Longitudinal thin sections.—Tabularium ranging from one-fourth to one-third the corallite diameter; tabularium comprising many complete or nearly complete tabulae and large flat tabellae; degree of tabellar sag great for the genus, almost no arching. Dissepiments large for the genus, many being very elongate, in three to six columns on each side. Carinal traces well shown in depth. Waviness of septa evident in longitudinal section.

Fine structure.—No trabecular features shown.

External features.—The holotype is a large globular head 28 cm in diameter, corallites of which have a relatively small central pit and a broad, nearly flat calice platform.

Comparison with related forms.—*Hexagonaria meeki* has the yardarm carinae of *H. fisherae* and its subspecies, but differs decidedly in the thinness and waviness of its septa, the narrowness of its tabularium, and the peripheral discontinuity of its septa, together with the development of irregular sublonsdaleioid features.

Occurrence.—Middle Devonian coral zone F. Fish Creek Range; Cockalorum Wash area, Coral Ridge locality M1352. Cockalorum Wash Formation. Study material consists of five coralla.

Hexagonaria sp. c

Plate 13, figures 8, 9

Figured material.—USNM 166461. Fish Creek Range; Cockalorum Wash area, locality M1353.

Diagnosis.—*Hexagonaria* with very wide tabularium and abbreviated, noncarinate septa; minor septa well developed. Dissepiments all axially inclined in several columns.

Transverse thin sections.—Septal count about 36. Septa smooth, straight, slightly thickened; major septa one-fourth to one-third of corallite radius, minor septa subequal to major septa. Dissepiment trace pattern fairly uniform, concentric-anguloconcentric. Wall somewhat thickened.

Longitudinal thin sections.—Tabularium width exceeding one-half of corallite diameter, in some three-fourths the diameter. Tabulae straight and complete or nearly complete with marginal tabellae. Slight axial sag more common than arching. Dissepiments mostly elongate in three to six columns; all axially inclined.

Comparison with related forms.—*Hexagonaria* sp. c differs from sp. n by having fully developed minor septa, whereas these are partly aborted in sp. n. *Hexagonaria* sp. r differs in having much longer, wavy septa.

Occurrence.—Middle Devonian coral zone F. Fish Creek Range; Cockalorum Wash area, Coral Ridge locality M1353. Cockalorum Wash Formation. Study material is one corallum.

Hexagonaria sp. f

Plate 13, figures 4, 5

Figured material.—USNM 166463. Fish Creek Range; Cockalorum Wash area, locality M1353.

Diagnosis.—*Hexagonaria* with broad corallites having long, thin, straight, and wavy septa, some of which meet axially. Scattered corallites showing patches of septa with zigzag but not yardarm carinae. Peripheral dissepiments elongate and flat.

Transverse thin sections.—Septal count about 46. Minor septa exceeding one-half the length of major septa. Stereoplasmic thickenings absent. Zigzag carinae numerous in parts of a few corallites only. Wall thin. Dissepiment traces concentric and close-spaced in inner part of band, less uniform in peripheral part.

Longitudinal thin sections.—Tabularium about one-third corallite diameter. Dissepimentarium with six to nine columns of dissepiments on each side, of which the peripheral ones are in part very elongate and flat or peripherally inclined. Tabularium quite nonuniform and comprising combinations of wide, flat tabellae.

Comparison with related forms—*Hexagonaria* sp. f. lacks the yardarm carinae of *H.* sp. w.

Occurrence.—Middle Devonian coral zone F. Fish Creek Range; Cockalorum Wash area, Coral Ridge locality M1353. Cockalorum Wash Formation. Study material is one corallum.

Hexagonaria? sp. h

Plate 14, figures 13, 14

Figured material.—USNM 166464. Hot Creek Range, Nev.; Morey Peak area, locality M1358.

Diagnosis.—*Hexagonaria*-like coral with long, thickened, noncarinate septa, thickened wall, a wide tabularium, and nearly flat outer dissepiments.

Transverse thin section.—Septal count 32. Wall and septa stereoplasmically thickened; septa straight, tapering smoothly in wedge fashion from wall to tabularium where the major septa are abruptly thinned and most continue to axis. Pattern of dissepiment traces concentric and fairly uniform. Minor septa about one-half the length of major septa.

Longitudinal thin section.—Tabularium about one-half the corallite diameter; wide tabulae partly complete and slightly arched. Dissepiments in two to four columns on each side, outermost nearly flat or inclined axially at very low angles.

Fine structure.—Trabecular structure well shown in longtitudinal section; trabeculae inclined peripherally.

Remarks.—This genus has the thickened wall and septa of *Xystriphyllum*, but differs from that genus by having a wide tabularium and flat peripheral dissepiments.

Occurrence.—Middle Devonian. Hot Creek Range, Nev.; Morey Peak area, locality M1358. Study material is one corallum.

Hexagonaria sp. n

Plate 14, figures 8–12

Figured material.—USNM 166460. Hot Creek Range, Nye County, Nev.; Warm Springs area, locality M1354.

This distinctive cerioid coral from the Warm Springs area, Hot Creek Range, Nev., forms large heads 30 cm or more in diameter, the calices of which are wide and deep and lack a peripheral platform. Corallites have a very wide tabularium and a narrow dissepimentarium. Major septa are short, stereoplasmically thickened peripherally; minor septa are commonly aborted, with resulting complexity of chevron dissepiment traces. The wall is unevenly thickened stereoplasmically.

In longitudinal thin section, this coral reveals a narrow dissepimentarium having two to five columns of steeply inclined, partly elongate dissepiments on each side. The very wide tabularium comprises partly complete, nearly straight tabulae with very wide flat tabellae, which are neither arched nor sagging.

Hexagonaria sp. r from the Roberts Mountains has a similarly wide dissepimentarium and steeply inclined dissepiments, but has longer septa and lacks the tendency to abort minor septa.

Occurrence.—Middle Devonian coral zone F. Hot Creek Range, Warm Springs area, locality M1354. Study material consists of three coralla.

Hexagonaria sp. r

Plate 14, figures 6, 7

Figured material.—USNM 166462. Roberts Mountains; Red Canyon locality M1339.

Diagnosis.—*Hexagonaria* having wide corallites, a very wide tabularium, and wavy, noncarinate, moderately long septa withdrawn from the axis.

Transverse thin section.—Septal count from 42 to 50. Major septa slightly, unevenly thickened, extending about two-thirds the distance to axis. Minor septa more than one-half the length of major septa. Pattern of dissepiment traces fairly evenly concentric. Wall thickened stereoplasmically.

Longitudinal thin section.—Tabularium width exceeds one-half the corallite diameter and in places is three-fourths the diameter. Tabulae close-spaced, mostly complete, straight to undulant with slight axial sag. Dissepiments mostly small, some elongate, nearly all axially inclined.

External features.—Large globular heads of this form with wide corallites lacking a peripheral platform. Calice wide, deep, steep sided, and with a flat bottom.

Comparison with related forms.—This coral differs from *Hexagonaria* sp. c by having a higher septal count, longer and wavy septa, as well as more closely spaced tabulae more of which are complete. *Hexagonaria* sp. n

differs by having minor septa commonly aborted and has more widely spaced tabulae.

Occurrence.—Middle Devonian coral zone F or G. Roberts Mountains; Red Canyon, locality M1339. Nevada Formation. Study material is one corallum.

Hexagonaria sp. w

Plate 13, figures 1–3

Figured material.—USNM 166459. Hot Creek Range; Warm Springs area, Nye County, Nev., locality M1354.

This distinctive form with wide corallites has thin carinate septa, the longest reaching the axis. The septal count ranges from 40 to 44; septa are straight to wavy, the carinae partly of zigzag type, but predominantly of yardarm type. The tabularium is less than one-third the corallite diameter, the dissepimentarium wide, with partly small and partly quite elongate, flat dissepiments.

Hexagonaria sp. w. has the thin yardarm carinate septa of *H. meeki* n. sp., but differs by its larger septal count, longer septa, wider dissepimentarium and more regular arrangement of dissepiment traces and septa near the periphery.

Occurrence.—Middle Devonian coral zone F. Hot Creek Range; Warm Springs area, locality M1354. Study material is one corallum.

Genus Taimyrophyllum Chernychev 1941

1941. *Taimyrophyllum* Chernychev, p. 12; pl. 1, figs. 1–3; pl. 2, figs. 1–3; pl. 5, fig. 5.
1958. *Taimyrophyllum* Chernychev. Bulvanker, pls. 76, 77.
1961. *Aphroidophyllum* Lenz, p. 505; pl. 3, figs. 1, 2.
1964. *Taimyrophyllum* Chernychev. Pedder, p. 436, pl. 62, figs. 12, 13; pls. 63–66.

Type species.—*Taimyrophyllum speciosum* Chernychev 1941; by author designation. Devonian, Tareia River, Taimyr, U.S.S.R.

Diagnosis.—Astraeoid, thamnastraeoid to somewhat aphroid rugose corals forming hemispherical or flattened colonies 13 cm and more in greatest diameter. Calices with median pit surrounded by a platform in some corallites almost flat, reflexed slightly, or protruding as part of a prominent crateriform rim surrounding calice pit. Septa on distal surfaces forming prominent calicular ridges with entirely radial symmetry. Longest septa reaching the axis, where they are twisted. Dissepiment traces concentric to anguloconcentric within the inner part of the dissepimentarium, where they are usually somewhat crowded; pattern of traces becoming irregular and more open peripherally. Tabularium of medium width, the close-spaced tabulae having axial sag. Some large flat-lying dissepiments in the peripheral band of irregular elongate configuration, giving rise to aphroid features as seen in transverse section. Septa smooth, lacking zigzag carinae, and in some corallites having uniform, radially extended stereoplasmic thickenings.

Remarks.—Characters which serve to distinguish *Taimyrophyllum* from otherwise similar *Billingsastraea* are prominent aphroid features of *Taimyrophyllum*, together with absence of zigzag carinae, lack of tabular arching, and tendency of septa to become radially thickened. *Billingsastraea*, as here interpreted, usually has arched, rather than depressed, tabulae and only rarely exhibits radially extended thickening of septa. Some forms of *Billingsastraea* have numerous zigzag carinae that continue in depth longitudinally.

Taimyrophyllum nolani n. sp.

Plate 9, figures 1–6; plate 10, figures 1–7

Type material.—Holotype, USNM 166451; paratypes, USNM 166452, 166453. Lone Mountain localities M1349, M1344; Roberts Mountains, Pyramid Hill, locality M1350.

Diagnosis.—*Taimyrophyllum* having septa thickened in tabularium, with crateriform calice rims; axial ends of septa considerably twisted. Chevron dissepiment traces relatively few.

Transverse thin sections.—Septal count 38 in corallite of 17-mm diameter. In some corallites minor septa unrecognizable, in others these septa either much shorter or not extending as far into the twisted axial complex. Septa straight to slightly wavy and fairly smooth in dissepimentarium, becoming twisted in axial complex and having minor lateral bumps; septa commonly thickened from inner part of dissepimentarium into tabularium; thickenings with fairly even tapered radial distribution. Zigzag carinae absent. Aphroid lacunae of highly irregular shape and distribution, being little developed in some corallites. No trace of a wall.

Longitudinal thin sections.—Approximately three to eight of the inner and smaller dissepiments very steeply inclined or vertical, with abrupt change outward to the flat-lying larger dissepiments bordering the corallite. Close-spaced, rather delicate tabulae mostly complete, unevenly wavy, and with overall sag, almost never straight and always without distal arching like those of *Billingsastraea*. Some coralla with roughly horizontal layers of stereoplasm connecting corallites. Large flat-lying dissepiments 2–5 mm long, these producing the big aphroid lacunae visible in transverse section.

Fine structure.—Thickened septa revealing weakly defined transverse trabecular strands normal to margins. Similar strands observed in fanlike groupings within the horizontal stereoplasmic layers between corallites.

External features.—Discoidal flattened colonies of this species with prominent crateriform calice rims superficially resemble *Pachyphyllum* but have quite different internal structure.

Comparison with related forms.—The type species *T. speciosum* Chernychev from Taimyr, northern Siberia, differs from *nolani* by lacking crateriform margins, by lacking the septal thickening, and by having more numerous chevron dissepiment traces. *T. carinatum* Bulvanker from the Kuznetz Basin, Russia, has larger corallites with a greater septal count and better differentiated minor septa. *T. triadorum* Pedder (1964) from the Hume Formation of western Canada has unthickened septa and a much greater number of chevron dissepiment traces and lacks the crateriform calice rims; *T. vescibalteatum* of the Nahanni Formation, also of western Canada, has more numerous, smaller aphroid lacunae than the new species and more of the chevron dissepiment traces. *T. howelli* (Lenz, 1961) of the Hume Formation is perhaps the most closely related species, but differs in its unthickened septa and its very large number of aphroid lacunae.

Occurrence.—Middle Devonian coral zone F. Lone Mountain localities M1344, M1349. Roberts Mountains; Pyramid Hill locality M1350. Unit 4 of the Nevada Formation. Study material comprises 14 nearly complete and partial coralla.

No family assignment

Genus Lyrielasma Hill 1939

1939. *Lyrielasma* Hill, p. 243.
1949. *Lyrielasma* Hill. Stumm, p. 34; pl. 16, figs. 3–5.
1967. *Lyrielasma* Hill. Pedder, p. 1–29; pls. 1–2.

Type species. — *Cyathophyllum subcaespitosum* Chapman, 1925; by author designation. Devonian, Australia.

Diagnosis.—The diagnosis given by Pedder (1967, p. 3) in a recent revision of this genus is as follows:

Solitary(?) to fasciculate corallum with subcylindrical corallites; budding where observed, peripheral and nonparicidal. Peripheral stereozone prominent and in part composed of lamellar sclerenchyme; internal lamellar stereozones may also be present. Septa well developed, either radially or pinnately arranged, strongly carinate in early stages, later becoming less carinate or even smooth. Trabeculae parallel and more or less horizontal. Dissepiments elongate, steeply inclined and rarely lonsdaleioid; rare or absent in early stage; normally several deep in adult stages. Tabularium axially depressed, composed of predominantly closely spaced and incomplete tabulae.

Embolophyllum Pedder 1967 differs mainly by having a narrower septal stereozone.

Lyrielasma antelopensis n. sp.

Plate 7, figures 9–11

Type material.—Holotype, USNM 166445. Antelope Range, locality M1347.

Diagnosis.—Colonial *Lyrielasma* with well-developed septal stereozone, short minor septa, some nearly complete straight tabulae, and a deep calice with narrow rim.

Transverse thin sections.—Septal count about 56 in a corallite of 21-mm diameter. Longest major septa approaching the axis; minor septa ranging from stubby to one-third the length of major septa. Septa somewhat wavy, thinned in tabularium, thickened moderately toward periphery. Some major septa with parallel side branches in dissepimentarium. Dissepiment trace pattern tending to become complex peripherally, with chevrons and herringbone features. Septal stereozone about 1 mm wide. Septal grooves rather weakly defined in epitheca.

Longitudinal thin sections.—Dissepiments elongate, steeply inclined in six to 10 columns on each side; tabularium one-third to one-fourth of corallite diameter, comprising complete, fairly straight tabulae and wide, flat tabellae. No amplexoid septal extensions.

Fine structure.—Trabecular structure in septal stereozone horizontal to peripherally inclined at low angles.

External features.—Subcylindrical mature corallites of this loosely phaceloid species with subdued and rounded rugae and longitudinal (septal) grooves. No lateral connective processes observed. Calice about 15 mm deep, somewhat constricted at the bottom, with elongate tapering lip.

Comparison with related forms.—*Lyrielasma subcaespitosum*, the type species, has longer minor septa; *L. chapmani* Pedder has longer minor septa, a wider stereozone, and narrower mature tabularium lacking the complete straight tabulae.

Occurrence.—Middle Devonian coral zone F. Antelope Range, north end, locality M1347. Unit 4 of the Nevada Formation. Study material consists of three partial coralla.

LOCALITY REGISTER

Lone Mountain, Eureka County, Nev.:

M54. Bartine Ranch quadrangle, about 1,200 ft due south of highest peak (VABM 7936) of Lone Mountain. Coral-bearing upper dolomitic beds of unit 4 of the Nevada Formation.

M1340. Bartine Ranch quadrangle, about 0.5 mile south of highest peak (VABM 7936) of Lone Mountain. Loose float blocks from coral-bearing upper dolomitic beds in unit 4 of the Nevada Formation.

M1341. Bartine Ranch quadrangle. South side of Lone Mountain, 3,000 ft southeast of highest peak (VABM 7936), altitude 7,300 ft; 400 ft west of east boundary of quadrangle. Unit 4 of the Nevada Formation with silicified brachiopods and corals.

M1344. Bartine Ranch quadrangle. South side of Lone Mountain, 2,500 ft south-southeast of highest peak (VABM 7936), altitude 7,440 ft; across ravine 900 ft west of M1341. Unit 4 of the Nevada Formation with silicified corals.

M1360. Bartine Ranch quadrangle. Northwest slope of Lone Mountain on crest of spur 0.8 mile N. 34° W. of highest peak (VABM 7936), altitude 6,800 ft, near Mineral Monument 6828. Unit 4 of the Nevada Formation with silicified corals.

M1361. Bartine Ranch quadrangle. South slope of Lone Mountain, 900 ft due south of highest peak (VABM 7936), altitude 7,600 ft. Upper part of unit 4 of the Nevada Formation with silicified corals.

M1363. Bartine Ranch quadrangle. Northwest end of Lone Mountain, 2,000 ft S. 72° W. of Lone Mountain zinc mine, near top main ridge, altitude 6,600 ft. Upper part of unit 4 of the Nevada Formation with silicified colonial corals.

M1349. Whistler Mountain quadrangle, west edge. Southeast side Lone Mountain at Reef Point which is on spur 1,500 ft southeast of summit 7360. North side of spur near top, altitude 6,880 ft. Unit 4 of the Nevada Formation with silicified colonial corals.

M1362. Whistler Mountain quadrangle, west edge. Southeast end of Lone Mountain, west slope, about 800 ft southwest of Flag Point (7360) which is 4,800 ft southeast of top Lone Mountain (VABM 7936). Upper beds of unit 4 of the Nevada Formation with silicified fossils.

Roberts Mountains, Nev.:

M1345. Roberts Creek Mountain quadrangle, southeast corner. Pyramid Hill, north end. Northeast of Roberts Creek Ranch house, NE¼ sec. 19, T. 22 N., R. 51 E., on top spur 1,700 ft north-northwest of summit 7504 (Pyramid Hill), altitude 7,000 ft. Unit 4 of the Nevada Formation.

M1348. Roberts Creek Mountain quadrangle, southeast corner. Northwest side of Pyramid Hill (7504), NE¼ sec. 19, T. 22 N., R. 51 E. 800 ft northwest of summit 7504, altitude 7,000 ft. Unit 4 of the Nevada Formation with corals.

M1350. Roberts Creek Mountain quadrangle, southeast corner. Pyramid Hill (7504), southwest slope, altitude 6,750 ft; 3,500 ft northeast of Roberts Creek Ranch house, 1,700 ft south-southwest of summit 7504. Float corals from unit 4 of the Nevada Formation.

M1365. Roberts Creek Mountain quadrangle. East side Bobcat Peak (9063), northwest of Roberts Creek Ranch; 1.1 miles N. 78° E. of summit 9063 in saddle just southwest of summit 8466. Unit 4 of the Nevada Formation with corals.

M1342. Roberts Creek Mountain quadrangle. East side Bobcat Peak (9063), 1,800 ft S. 80° W. of summit 8466, near top of east-west spur, altitude 8440 ft. Unit 4 of the Nevada Formation with corals.

M1339. Roberts Creek Mountain quadrangle. East side of Red Canyon, 1.4 miles S. 18° E. of hill 6897, altitude 6,840 ft just east of creek bed. Nevada Formation with corals.

Sulphur Spring Range, Nev.:

M1346. Garden Valley quadrangle. East side of range, about 0.8 mile northwest of Romano Ranch house in sec. 11, T. 23 N., R. 52 E., east side of butte 6523 (Terrace Butte), altitude about 6,200 ft.

Antelope Range, Eureka County, Nev.:

M30. Bellevue Peak quadrangle, southwest corner. Antelope Range, north end, SE¼ sec. 16, T. 16 N., R. 51 E., about 0.7 mile north-northwest of Antelope summit (7829) on west side summit 7602, altitude about 7,500 ft. Unit 4 of the Nevada Formation.

M1347. Cockalorum Wash quadrangle, northwest corner. Antelope Range, north end. Sec. 21, T. 16 N., R. 51 E. Antelope summit (7829) just below top on west side. Unit 4 of the Nevada Formation with abundant corals.

Fish Creek Range:

M1351. Cockalorum Wash quadrangle. Reef Hill 1.5 miles south of Cockalorum Wash, 3,500 ft south-southwest of Nyeka Peak (7352) at north edge of NE¼ sec. 5, T. 14 N., R. 52 E., altitude 6,840 ft. Low hill with silicified coral deposit.

M1352. Cockalorum Wash quadrangle. Coral Ridge, 1 mile N. 70° E. of Willow Creek Ranch house, in NE¼ sec. 19, T. 14 N., R. 52 E.; altitude 6,850 ft, at west base of hills 1,700 ft north of Willow Creek and 500 ft east of Indian Creek. Middle Devonian coral beds with *Hexagonaria*.

M1353. Cockalorum Wash quadrangle. Coral Ridge; top of ridge 1,800 ft east of BM 6928 on north section line NE¼ sec. 19, T. 14 N., R. 52 E., altitude 7,000 ft. Middle Devonian beds with corals and brachiopods.

M1355. Cockalorum Wash quadrangle. Coral Ridge; hills north of Willow Creek in SE¼ sec. 18, T. 14 N., R. 52 E.; 1.4 miles N. 59° E. of Willow Creek Ranch house on ridge top, altitude 6,960 ft, 800 ft west of section line. Coral-bearing limestone of Middle Devonian age.

M1356. Cockalorum Wash quadrangle. Coral Ridge; hills north of Willow Creek, 1.1 miles N. 60° E. of Willow Creek Ranch house on west side of hills on north boundary sec. 19, T. 14 N., R. 52 E., altitude 6,950 ft. Middle Devonian limestone with corals.

M1364. Cockalorum Wash quadrangle. Coral Ridge; 1.2 miles N. 68° E. of Willow Creek Ranch house, east side of ridge 2,300 ft north of Willow Creek, altitude 6,920 ft in NE¼ sec. 19, T. 14 N., R. 52 E. Middle Devonian silicified corals in light-gray limestone.

Hot Creek Range, Nye County, Nev.:

M1338. Morey Peak 3 quadrangle. North of Morey Peak, 5,500 feet east of west boundary, 3,500 ft north of south boundary T. 10 N., R. 51 E. Middle Devonian beds with corals.

M1354. Warm Springs area. Locality just southwest of Warm Springs. Dark-gray limestone with abundant silicified Middle Devonian fossils.

M1358. Morey Peak area. Two miles north of Morey mine, 4.2 miles N. 87° W. of Moores Station on east side of range, altitude 7,400 ft. Middle Devonian limestone with corals.

Bare Mountain, Nye County, Nev.:

M1359. Bare Mountain, southeast of Beatty. Tarantula Canyon, about 0.7 mile west of mouth of canyon on south side; northeast end of Bare Mountain. Devonian fossils in dark-gray carbonaceous limestone.

Diamond Mountains, White Pine County, Nev.:

M6. Pinto Summit quadrangle. Southwest side of Sentinel Mountain at head of southeast branch of Oxyoke Canyon in SW¼ sec. 15, T. 18 N., R. 54 E. North of saddle, altitude about 7,900 ft. Tan-colored fine silty dolomite at base of Bay State Dolomite Member with corals and abundant large silicified *Stringocephalus*.

M53. Pinto Summit quadrangle. East side of southeast branch of Oxyoke Canyon. General collections from vicinity of locality M6 in basal tan silty dolomite of Bay State Dolomite Member and including uppermost beds of Woodpecker Limestone Member.

M204. Pinto Summit quadrangle. West of south end Alhambra Hills and southwest of Fair Play mine in

NE¼ sec. 36, T. 18 N., R. 54 E. About 500 ft south-southwest of shaft at altitude 6,289 ft. Dark-gray limestone of Woodpecker Limestone Member with corals and large *Atrypa*.

M1337. Pinto Summit quadrangle. Alhambra Hills, south end; SE¼SW¼ sec. 30, T. 18 N., R. 55 E. East side Alhambra Hills 0.25 mile southeast of Fair Play mine, altitude 6,100 ft. At top of Woodpecker limestone member and base of Bay State Dolomite Member. Dark-gray dolomitic limestone beds with corals, *Rensselandia* and *Stringocephalus*.

S8. Pinto Summit quadrangle. Alhambra Hills, south end. Measured section (Aug. 9, 1951) on east slope of hills about on north section line in NW¼ sec. 31, T. 18 N., R. 55 E., altitude 6,300 ft. Dark-gray limestone with corals and brachiopods in upper part of Woodpecker Limestone Member.

Confusion Range, Utah:

M1343. Fish Spring quadrangle. Measured section (by R. K. Hose, 1955) in T. 21 S., R. 16 W., 5.25 miles south of Highway 6, 13 miles northwest of Ibex. About 175 ft below top Simonson dolomite in Hose's unit 30. Corals.

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PLATES 1–14

[Contact photographs of the plates in this report are available, at cost, from the U.S. Geological Survey Photographic Library, Federal Center, Denver, Colorado 80225]

PLATE 1

FIGURES 1–3. *Cystiphylloides* sp. a (p. 24).
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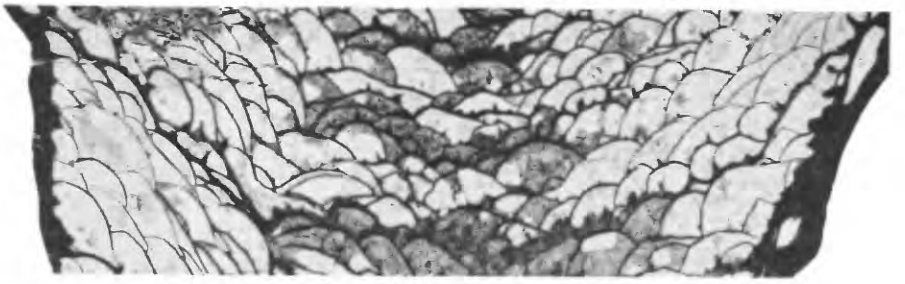

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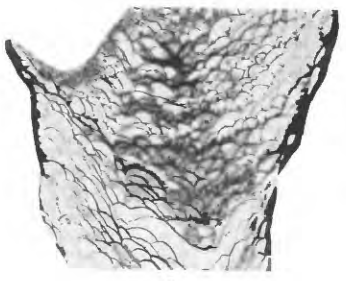

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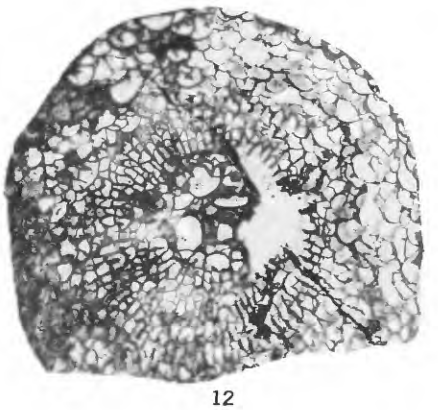

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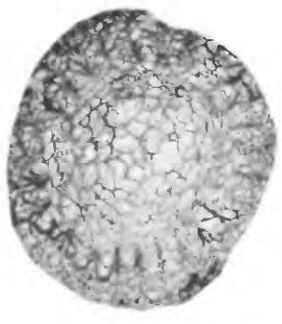

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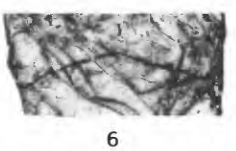

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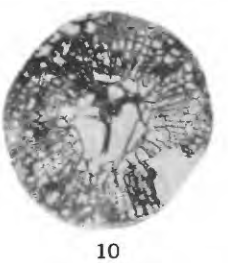

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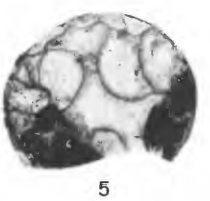

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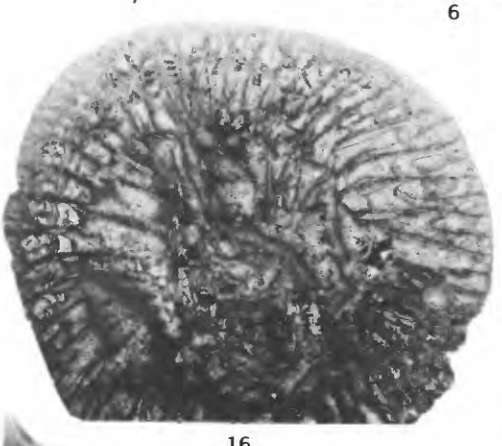

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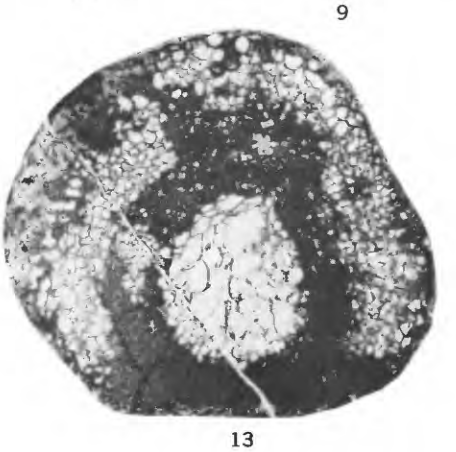

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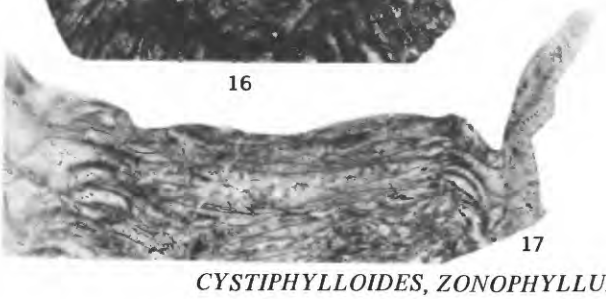

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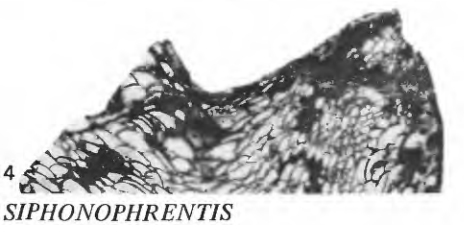

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CYSTIPHYLLOIDES, ZONOPHYLLUM, MESOPHYLLUM, AND *SIPHONOPHRENTIS*

PLATE 2

FIGURES 1, 2. *Acanthophyllum robertsensis* n. sp. (p. 30).
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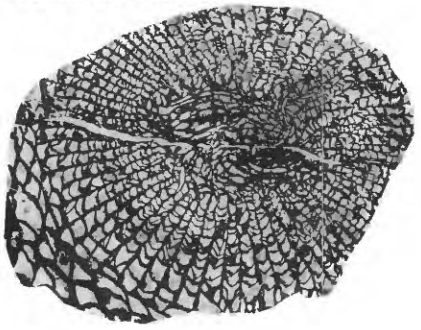
Transverse and longitudinal thin sections (× 2), USNM 166428.
Middle Devonian, upper part of Simonson Dolomite; Confusion Range, Utah, locality M1343.



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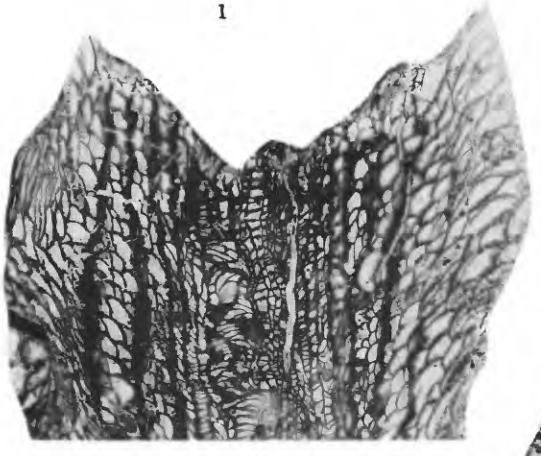

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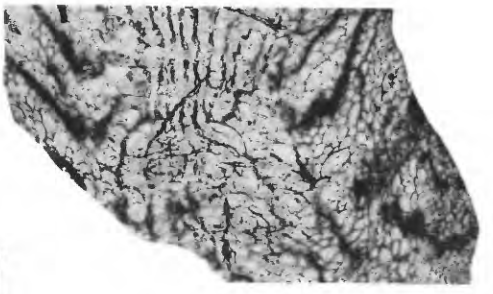

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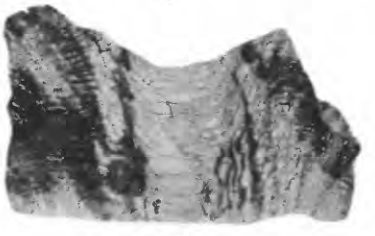

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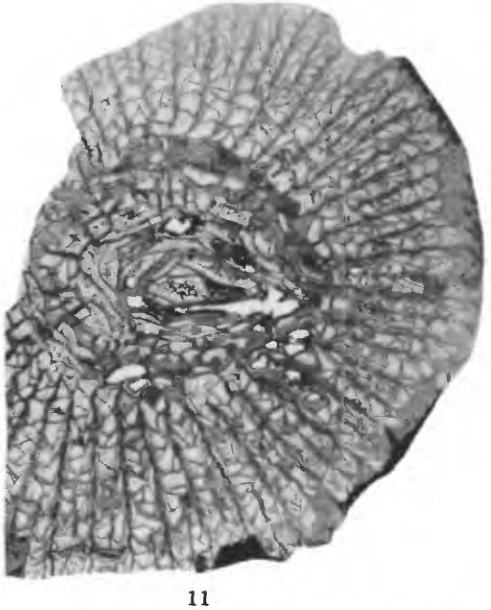

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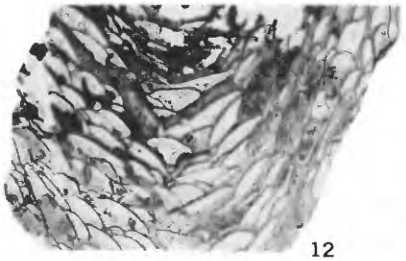

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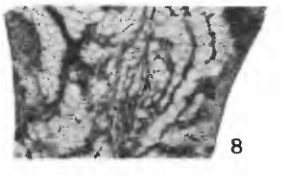


8

ACANTHOPHYLLUM AND *DIGONOPHYLLUM*

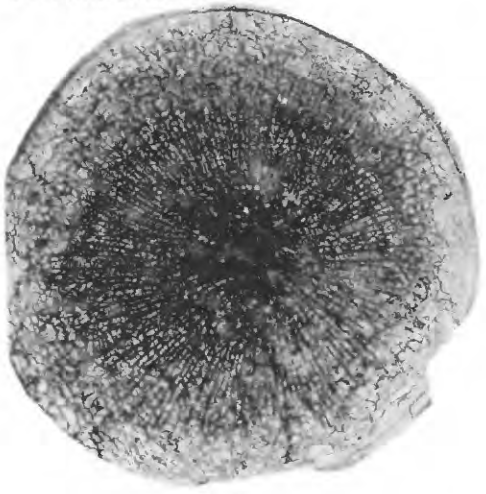
PLATE 3

FIGURES 1–5. *Digonophyllum (Mochlophyllum) alhambraensis* n. sp. (p. 27).
Thin sections as follows:
Transverse (× 0.9), longitudinal (× 1), transverse (× 3.5), transverse (× 3.5), longitudinal (× 2); holotype USNM 166429.
Middle Devonian coral zone G. Alhambra Hills, locality M1337; topmost beds of the Wodpecker Limestone Member.

6, 7. *Digonophyllum (Mochlophyllum) alhambraensis* subsp. *robertsensis* n. subsp. (p. 27).
Transverse and longitudinal thin sections (× 1½); USNM 166430.
Middle Devonian coral zone F or G. Roberts Mountains, Red Canyon, locality M1339.

8, 9. *Mesophyllum (Lekanophyllum)* cf. *M. (L.)* sp. 1 (p. 29).
Transverse and longitudinal thin sections (× 1½), USNM 166466.
Middle Devonian coral zone F. Hot Creek Range, Morey Peak area, locality M1338.

10, 11. *Digonophyllum occidentalis* n. sp. (p. 26).
Transverse and longitudinal thin sections of holotype (× 1½), USNM 166431.
Middle Devonian coral zone F. Roberts Mountains, Bobcat Peak, locality M1342.



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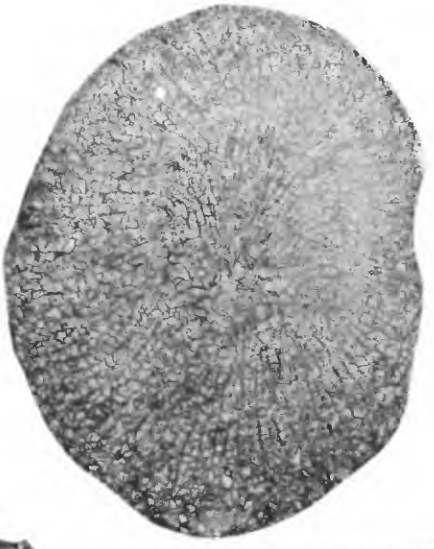

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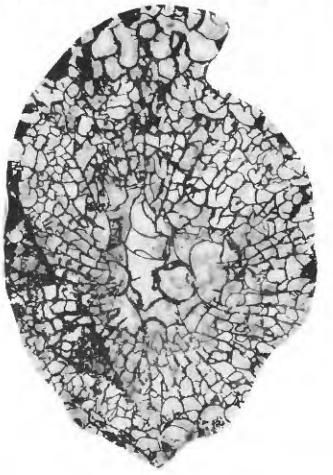

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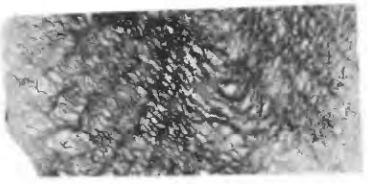

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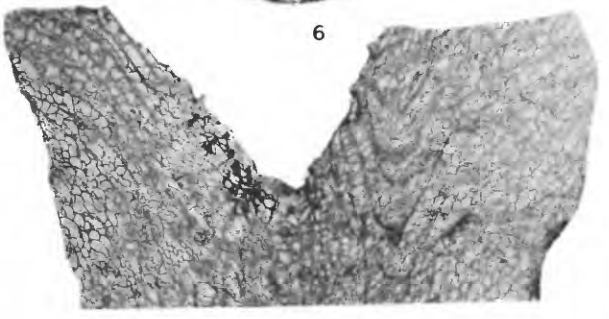

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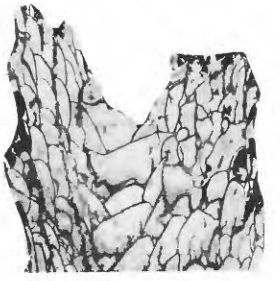

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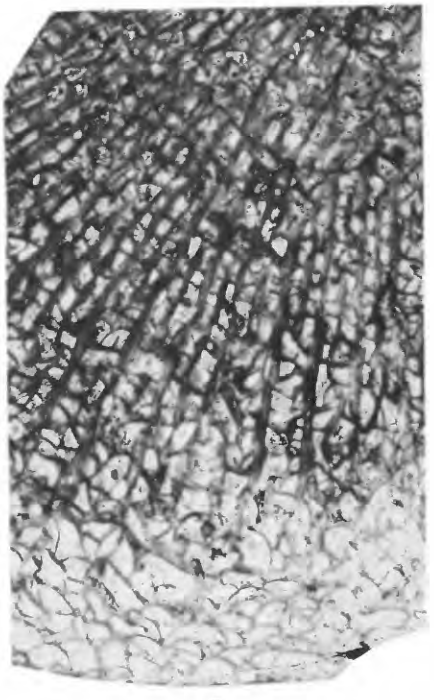

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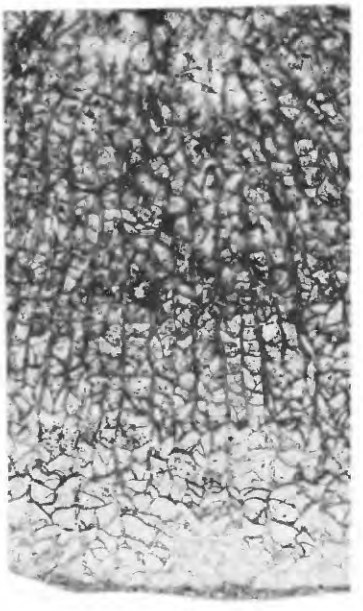

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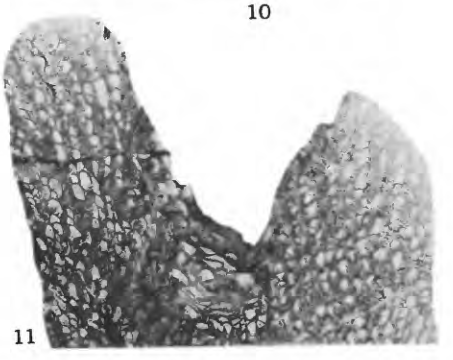

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DIGONOPHYLLUM AND *MESOPHYLLUM*

PLATE 4

FIGURES 1–4. *Cyathophyllum (Moravophyllum)* sp. 1 (p. 34).
1, 2. Transverse and longitudinal thin sections (× 2), USNM 166432a.
3, 4. Transverse and longitudinal thin sections (× 2), USNM 166432b.
Middle Devonian coral zone F; Lone Mountain, locality M1344.

5, 6. *Keriophyllum*? cf. *K.*? *kobehense* (Stumm).
5. Oblique calice view (× 2), USNM 166467a.
6. Calice view (× 2), USNM 166467b.
Middle Devonian coral zone F. Lone Mountain, locality M1341.

7. *Keriophyllum*? *kobehense* (Stumm) (p. 36).
Transverse thin section (× 1½) of holotype USNM 96213a.
Middle Devonian, probably unit 4 of the Nevada Formation and coral zone F. Lone Mountain; collected by C. D. Walcott.

8. *Acanthophyllum* sp.
Longitudinal thin section (× 2), USNM 166468.
Same horizon and locality as figs. 1–4.

9–11. *Acanthophyllum* sp. p (p. 31).
9. Transverse thin section (× 1½), USNM 166433a.
Middle Devonian coral zone F. Roberts Mountains; Pyramid Hill, locality M1345.
10, 11. Transverse (× 2) and longitudinal thin sections (× 1½), USNM 166433b.
Middle Devonian coral zone F. Roberts Mountains; Pyramid Hill, locality M1348.

12, 13. *Paracanthus*? sp. f (p. 32).
Transverse and longitudinal thin sections (× 2), USNM 166436.
Middle Devonian coral zone F. Lone Mountain, locality M1344.

14–19. *Paracanthus nevadensis* n. gen., n. sp. (p. 32).
14, 15. Transverse and longitudinal thin sections (× 1½) of holotype, USNM 166434.
16, 17. Transverse and longitudinal thin sections (× 1½) of paratype, USNM 166435a.
18. Transverse thin section (× 1½) of paratype, USNM 166435b.
19. Transverse thin section (× 1½) of paratype, USNM 166435c.
Middle Devonian coral zone F or G. Roberts Mountains; Red Canyon, locality M1339.


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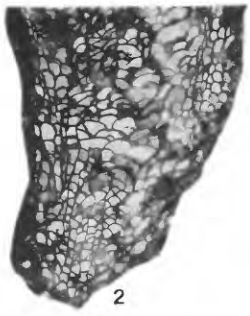
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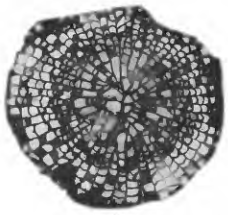
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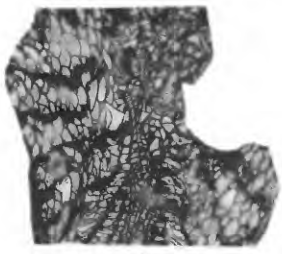
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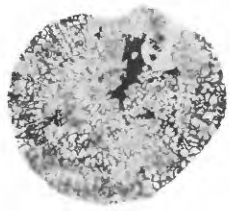
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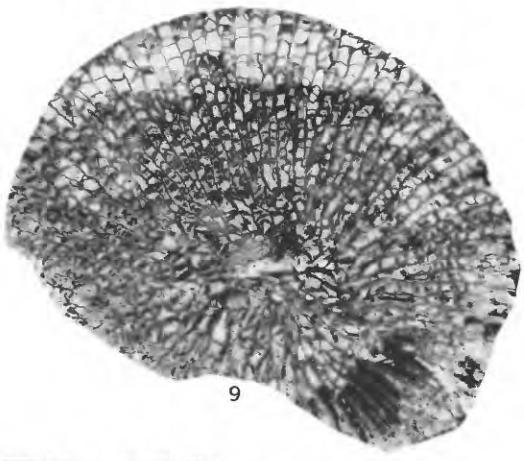
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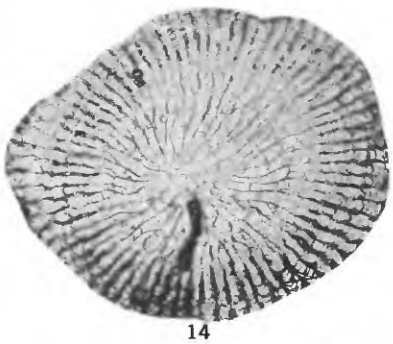
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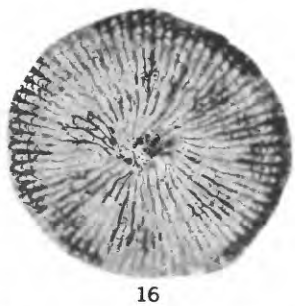
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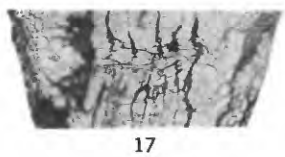
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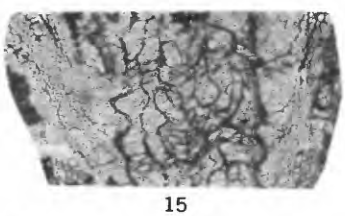
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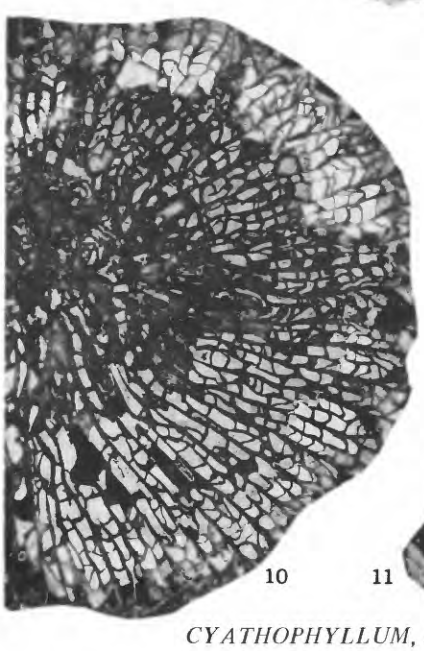
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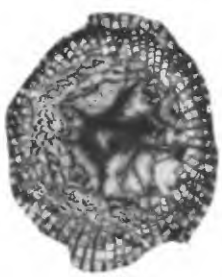
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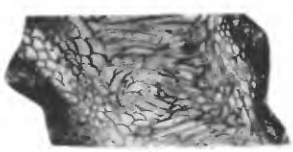
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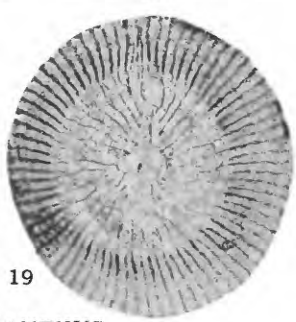
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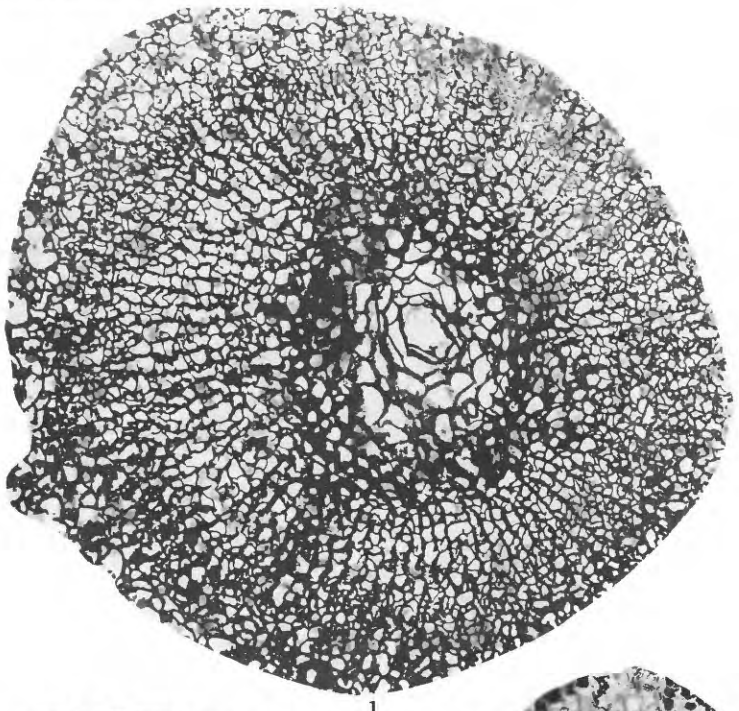
CYATHOPHYLLUM, KERIOPHYLLUM?, ACANTHOPHYLLUM, AND *PARACANTHUS*

PLATE 5

FIGURES 1–4. *Keriophyllum mclareni* n. sp. (p. 35).
1, 2. Transverse (× 3) and longitudinal (× 2) thin sections of holotype, USNM 166437.
3. Transverse thin section (× 2) of paratype, USNM 166438a.
4. Transverse thin section (× 2) of paratype, USNM 166438b.
Middle Devonian coral zone F. Lone Mountain, locality M1344.

5. *Cyathophyllum (Moravophyllum)* sp.
Transverse thin section (× 2), USNM 166439.
Same horizon and locality as figs. 1–4.

6–10. *Cyathophyllum (Moravophyllum) alhambraensis* n. sp. (p. 33).
6–8. Transverse and longitudinal thin sections (× 2) of holotype, USNM 166440.
Middle Devonian coral zone G. Alhambra Hills, locality M1337.
9, 10. Transverse and longitudinal thin sections of paratype (× 1½), USNM 166441.
Middle Devonian coral zone G. Sulphur Spring Range, locality M1346.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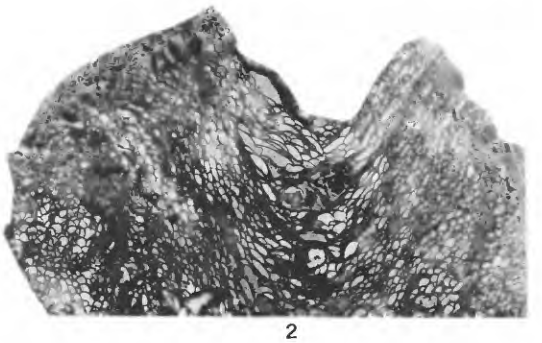
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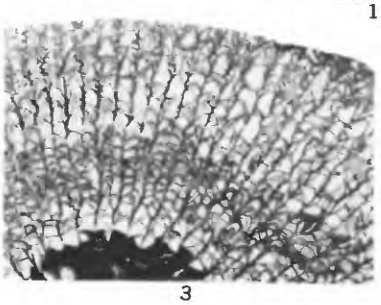
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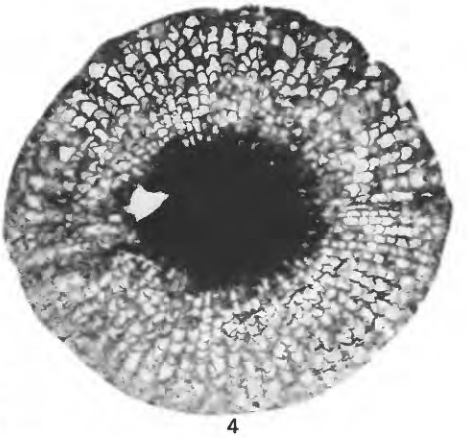
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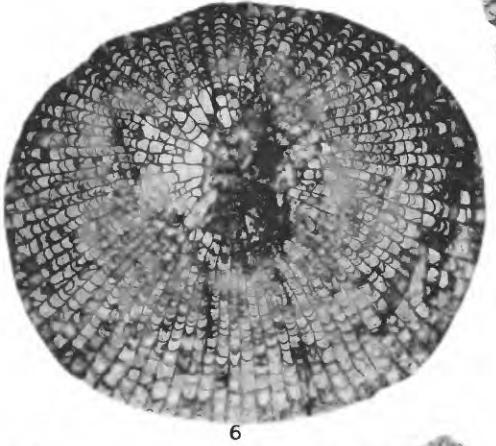
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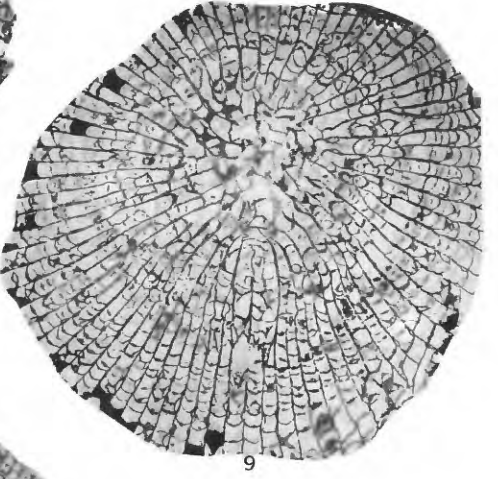
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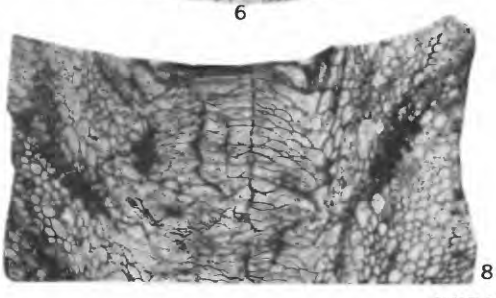
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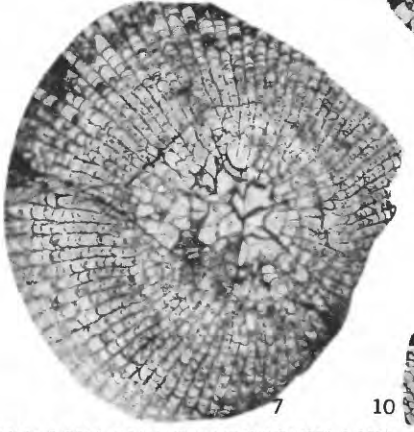
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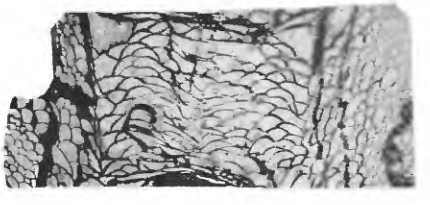
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KERIOPHYLLUM AND *CYATHOPHYLLUM*

PLATE 6

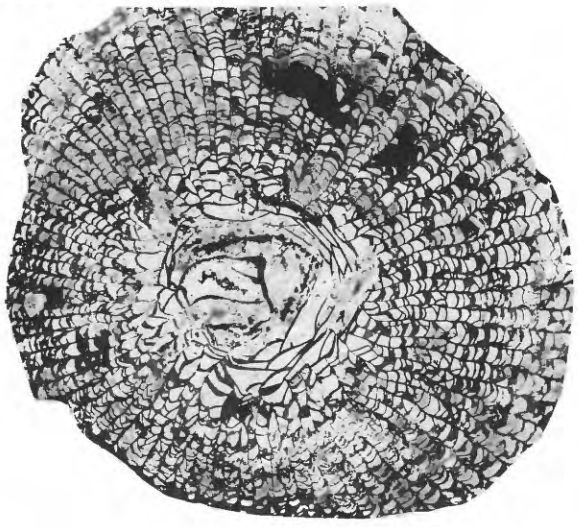
FIGURES 1. *Cyathophyllum (Moravophyllum)*? sp.
Transverse thin section (× 1½), USNM 166469.
Middle Devonian. Cockalorum Wash area, locality M1356.

2, 3. *Paracanthus* cf. *P. nevadensis* n. sp.
Transverse and longitudinal thin sections (× 2), USNM 166470.
Middle Devonian. Cockalorum Wash area, locality M1353.

4, 5. *Paracanthus nevadensis* n. sp.
Transverse and longitudinal thin sections (× 2), USNM 166471.
Same horizon and locality as figs. 2, 3.

6, 7. *Paracanthus* cf. *P. nevadensis* n. sp.
Transverse and longitudinal thin sections (× 2), USNM 166472.
Middle Devonian. Cockalorum Wash area, locality M1355.

8–12. *Tabulophyllum antelopensis* n. sp. (p. 38).
8, 9. Transverse and longitudinal thin sections (× 2), holotype, USNM 166442.
10, 11. Longitudinal thin sections (× 2), paratype, USNM 166444.
12. Transverse thin section (× 2), paratype, USNM 166443.
Middle Devonian coral zone F. Northern Antelope Range, locality M1347.



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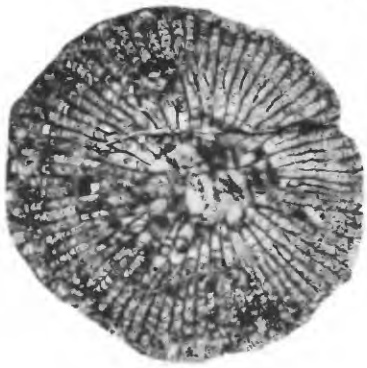

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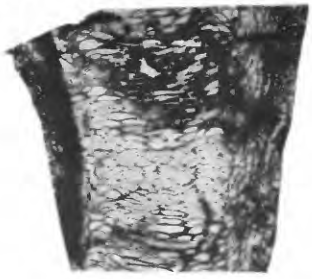

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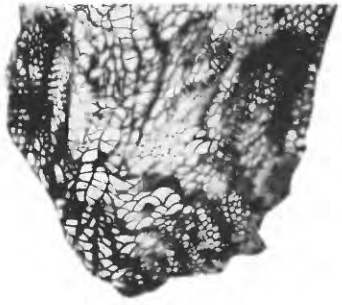

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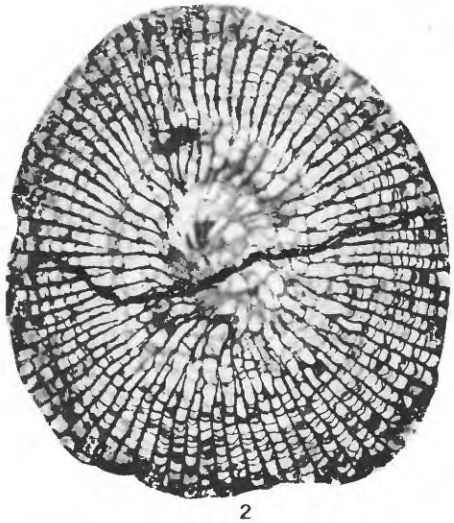

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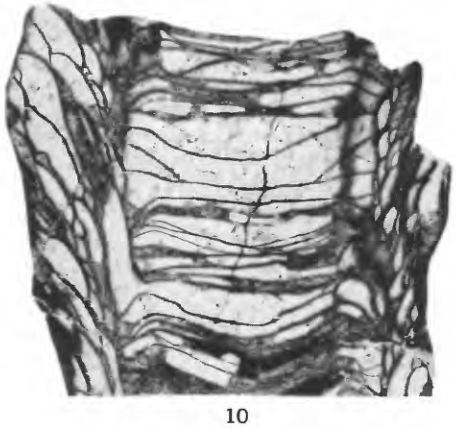

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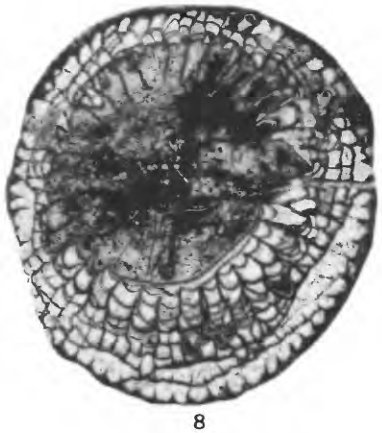

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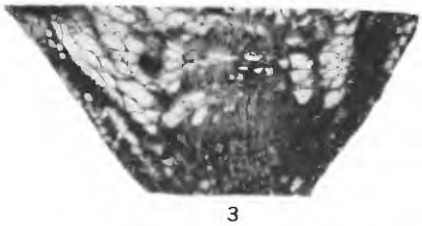

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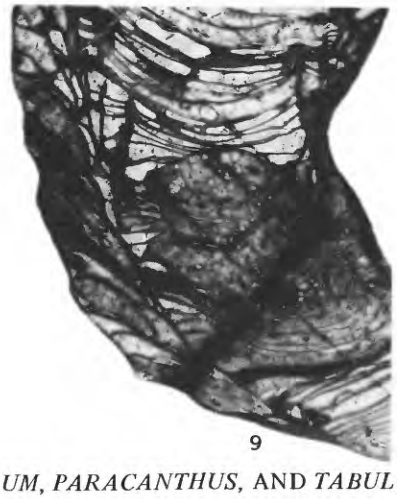

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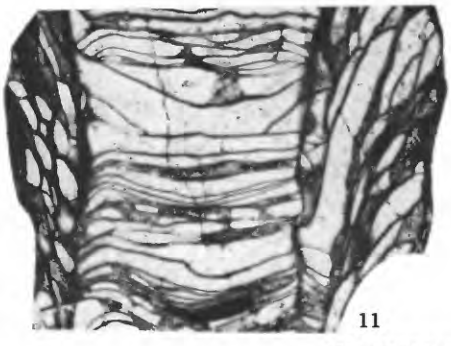

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CYATHOPHYLLUM, PARACANTHUS, AND *TABULOPHYLLUM*

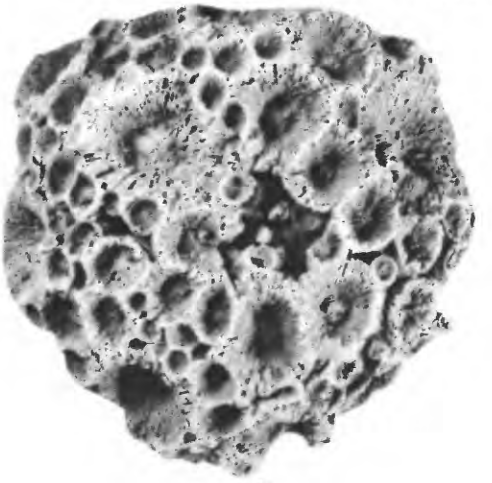
PLATE 7

FIGURES 1–8. *Cyathophyllum (Orthocyathus) flexum* (Stumm) (p. 34).

1. Calice view of holotype (× 1), USNM 96219a.
2. Lateral view of paratype with offsets (× 1½), USNM 96219d.
3. Lateral view of paratype (× 1½), USNM 96219c.
4. Longitudinal section (× 1½). Copy of Stumm (1938, pl. 59, fig. 6c) figure.
   Middle Devonian coral zone F. Lone Mountain; collected by C. D. Walcott.
5, 6. Calice view (× 1) and transverse thin section (× 1½), USNM 166473.
   Middle Devonian coral zone F. Lone Mountain, locality M1363; Nevada Formation unit 4.
7, 8. Transverse and longitudinal thin sections (× 2), USNM 166474.
   Middle Devonian coral zone F. Lone Mountain, locality M54; Nevada Formation unit 4.

9–11. *Lyrielasma antelopensis* n. sp. (p. 45).

Transverse and longitudinal thin sections (× 2) of holotype, USNM 166445.
Middle Devonian coral zone F. Northern Antelope Range, locality M1347.



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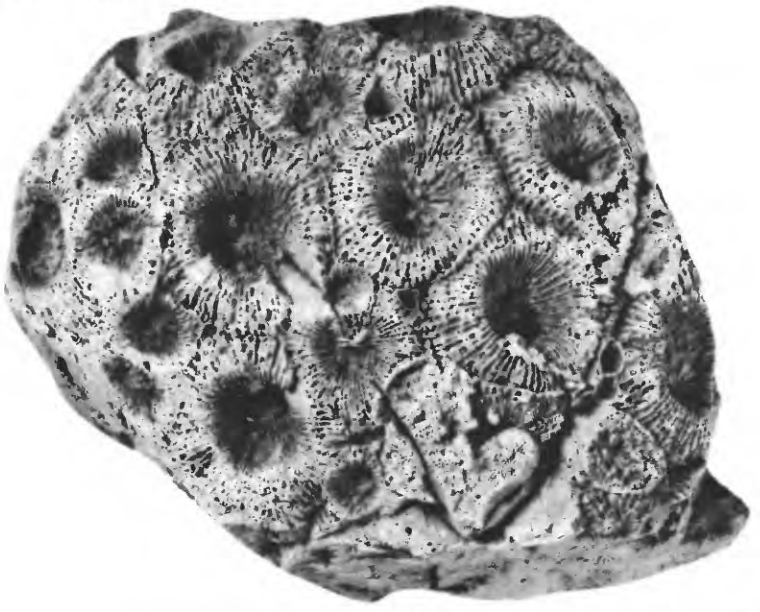

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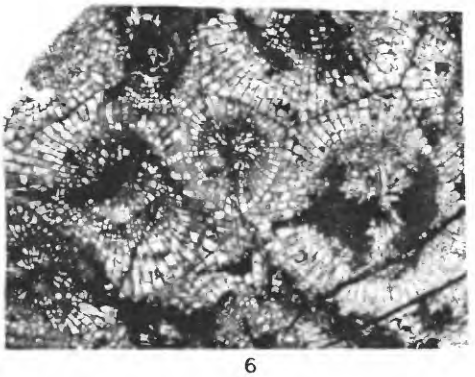

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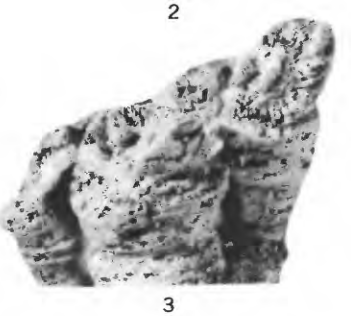

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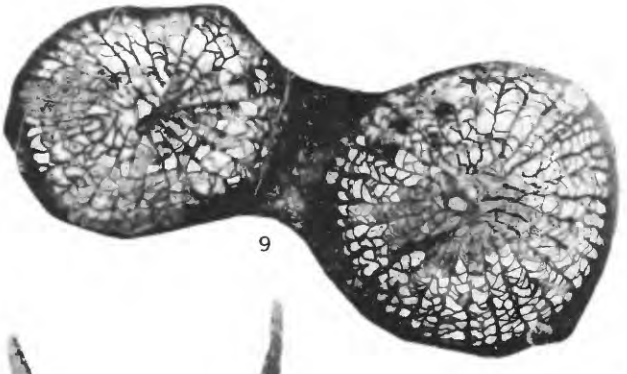

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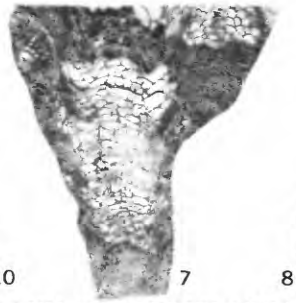

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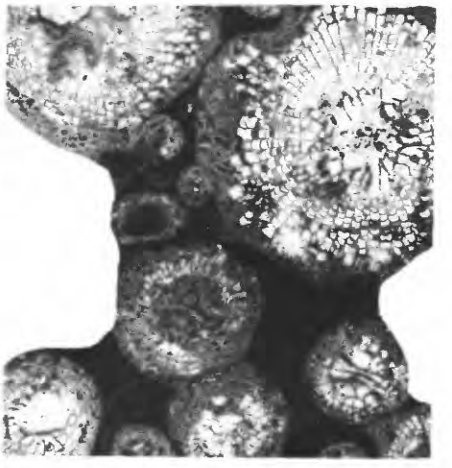


8

CYATHOPHYLLUM AND *LYRIELASMA*

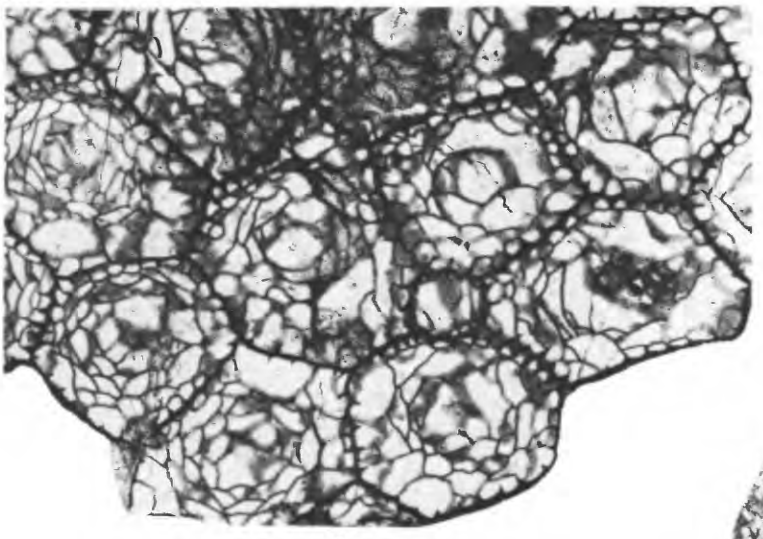
PLATE 8

FIGURES 1–3. *Utaratuia eurekaensis* n. sp. (p. 37).
Transverse (× 4) and longitudinal thin sections (× 2, × 4) of holotype, USNM 166446.
Middle Devonian coral zone F; Lone Mountain, locality M1344.

4, 5. *Australophyllum prismatophylloides* (Stumm) (p. 39).
Transverse thin sections (× 2) of holotype, USNM 96217.
Middle Devonian; Lone Mountain. Collected by C. D. Walcott.

6–15. *Sociophyllum eurekaensis* n. sp. (p. 36).
6, 7. Transverse thin sections (× 2) of paratype, USNM 166449.
Middle Devonian coral zone F; Lone Mountain, locality M1344.
8–15. Transverse and longitudinal thin sections (× 2) of holotype, USNM 166447.
Middle Devonian coral zone F; Roberts Mountains, Pyramid Hill, locality M1348.

16–18. *Sociophyllum eurekaensis* subsp. b. (p. 37).
Longitudinal thin sections (× 2), USNM 166448.
Middle Devonian coral zone F; Roberts Mountains, Bobcat Peak, locality M1342.



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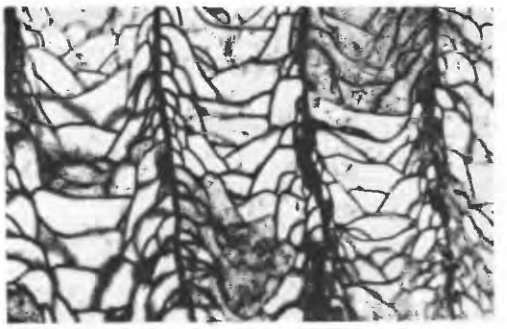

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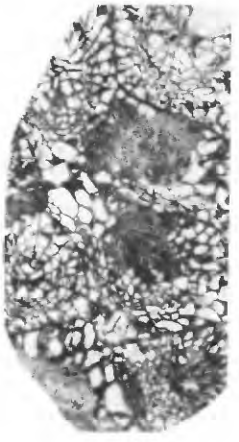

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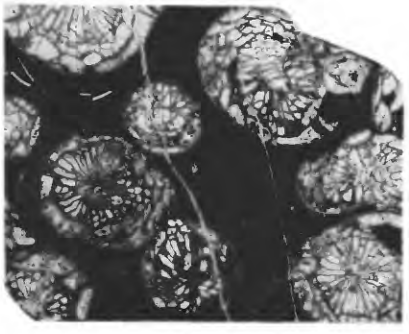

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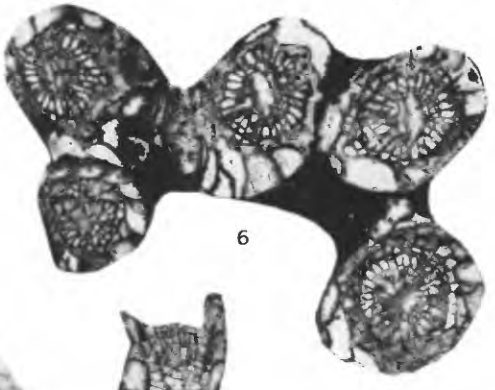

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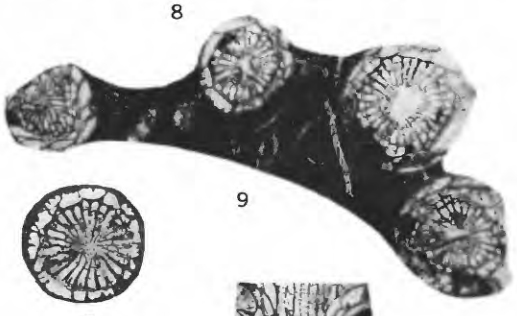

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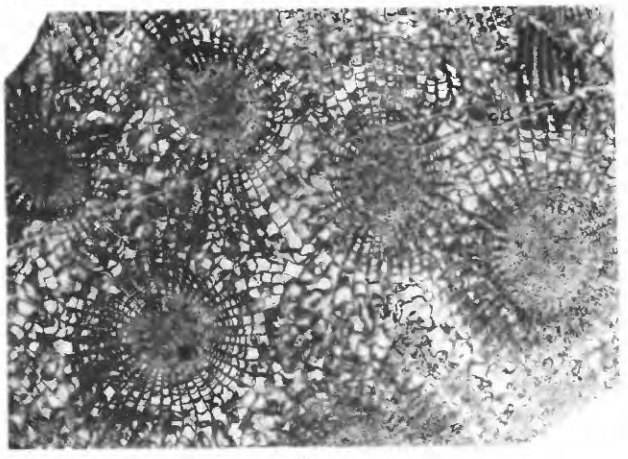
UTARATUIA, AUSTRALOPHYLLUM, AND *SOCIOPHYLLUM*

PLATE 9

FIGURES 1–6. *Taimyrophyllum nolani* n. sp. (p. 44).

1. Calice view of paratype (× 1), USNM 166452.
Middle Devonian coral zone F; Lone Mountain, locality M1349.
2. Calice view of paratype (× 1½), USNM 166453.
Middle Devonian coral zone F; Lone Mountain locality M1344.
3–5. Transverse thin section (× 2), longitudinal thin section (× 2), enlargement of part of figure 3 (× 4), holotype, USNM 166451.
Middle Devonian coral zone F; Lone Mountain, locality M1349.
6. Transverse thin section (× 8), paratype, USNM 166475.
Middle Devonian coral zone F; Roberts Mountains, Pyramid Hill, locality M1350.



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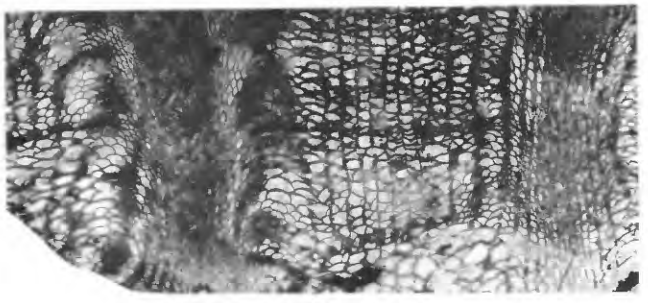

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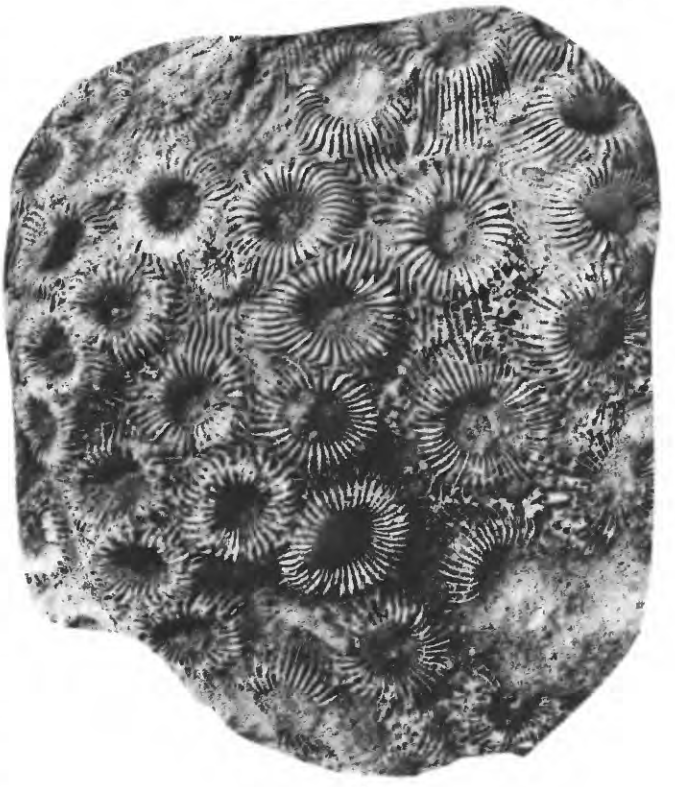

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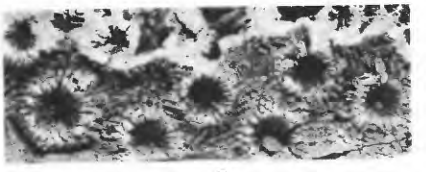

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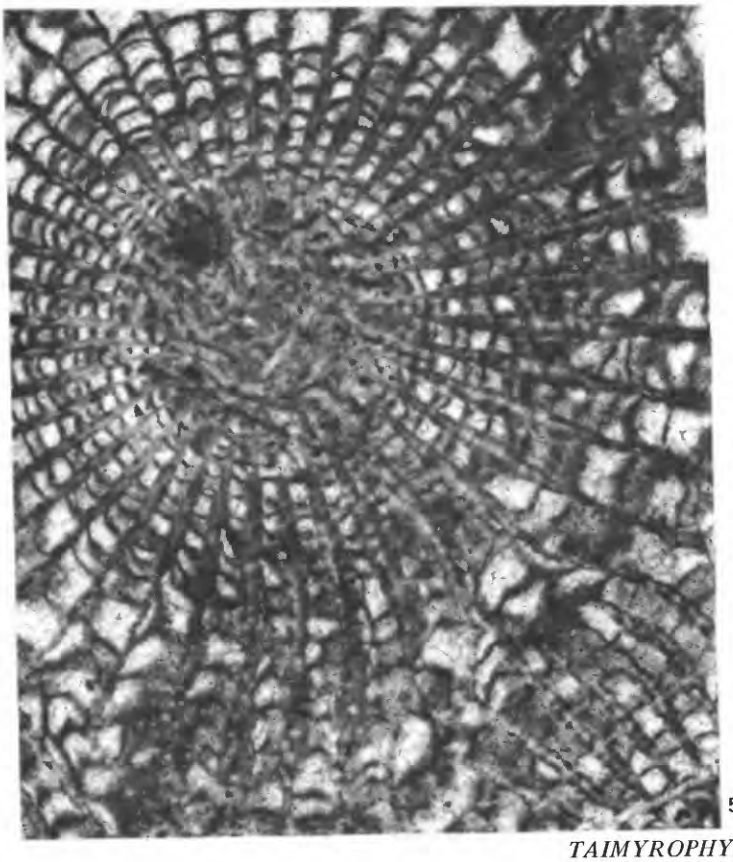

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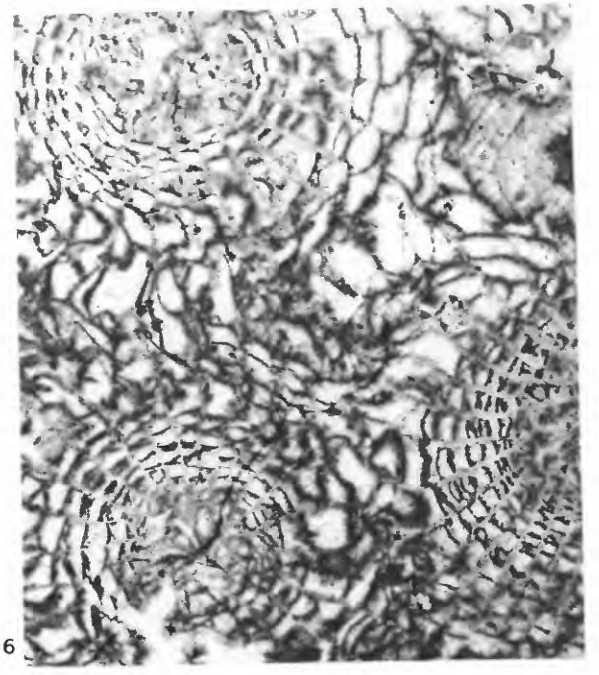

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TAIMYROPHYLLUM

PLATE 10

FIGURES 1–7. *Taimyrophyllum nolani* n. sp. (p. 44).

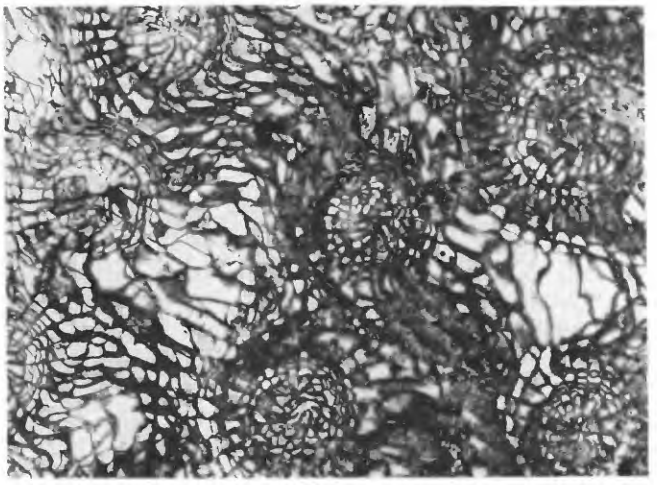
1, 2. Transverse and longitudinal thin sections (× 4), paratype, USNM 166476.
Middle Devonian coral zone F; Lone Mountain, locality M1344.

3. Transverse thin section (×8), paratype, USNM 166477.
Same horizon and locality as figs. 1, 2.

4, 5. Longitudinal thin sections (× 8), paratype, USNM 166475.
Middle Devonian coral zone F; Roberts Mountains, Pyramid Hill, locality M1350.

6. Longitudinal thin section (× 8), holotype, USNM 166451.
Middle Devonian coral zone F; Lone Mountain, locality M1349.

7. Transverse thin section (× 2), paratype, USNM 166475.
Same horizon and locality as figs. 4, 5.



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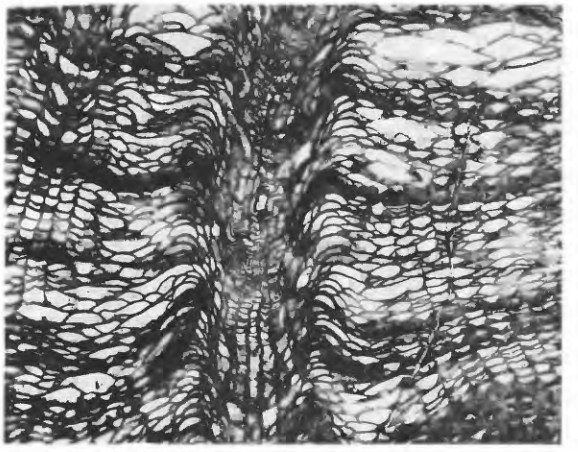

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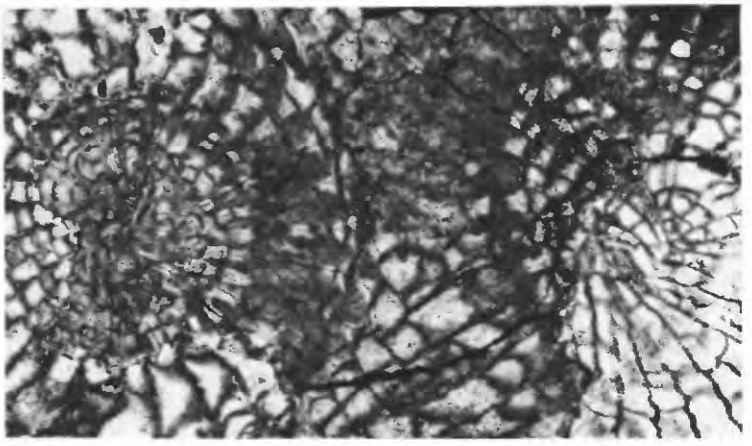

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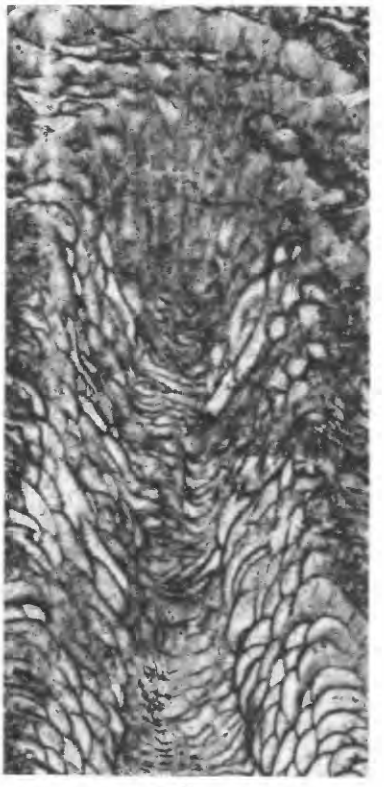

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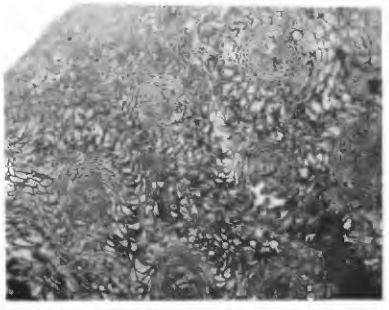

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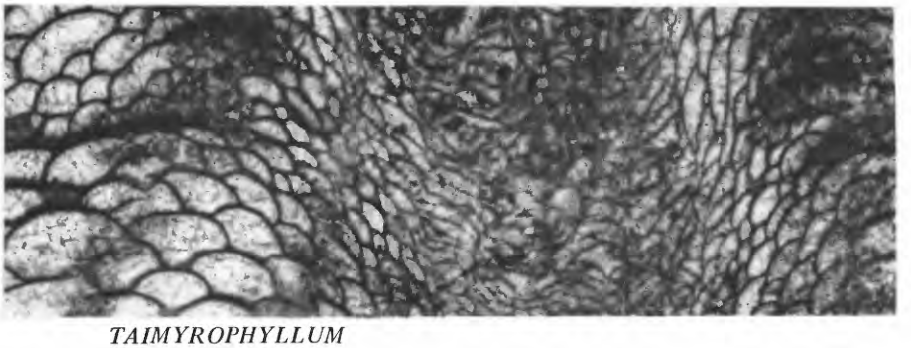


6

TAIMYROPHYLLUM

PLATE 11

FIGURES 1–3. *Hexagonaria fisherae* (Merriam) (p. 40).

1, 2. Transverse thin sections (× 6), USNM 96218a.

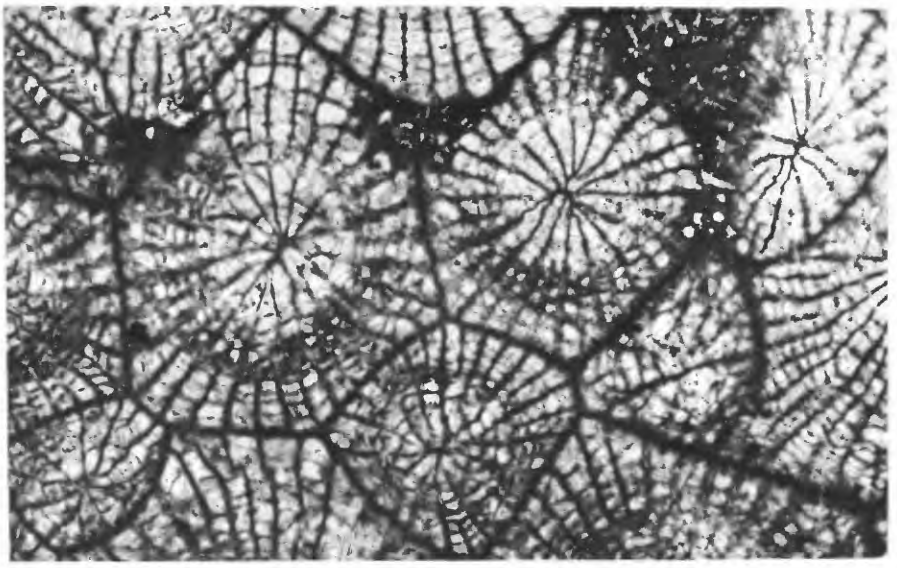
3. Longitudinal thin section (× 6), USNM 96218b. From specimen figured by Stumm (1938, pl. 59) as *Prismatophyllum profundum* (Hall).

Middle Devonian coral zone F; Lone Mountain. Collected by C. D. Walcott.

4–6. *Hexagonaria fisherae* subsp. *cockalorumensis* n. subsp. (p. 41).

Transverse and longitudinal thin sections (× 4), holotype, USNM 166454.

Middle Devonian coral zone F. Cockalorum Wash Formation; Cockalorum Wash area, locality M1351.



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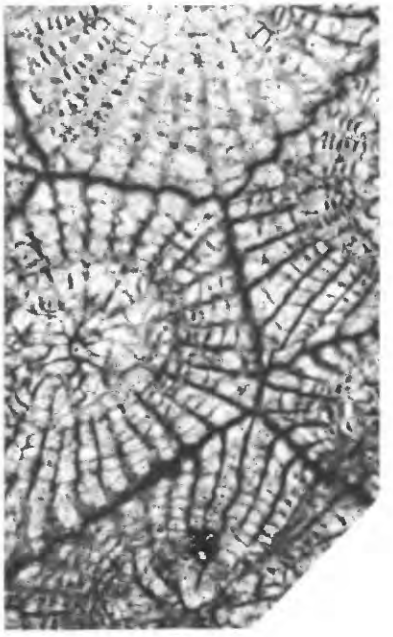

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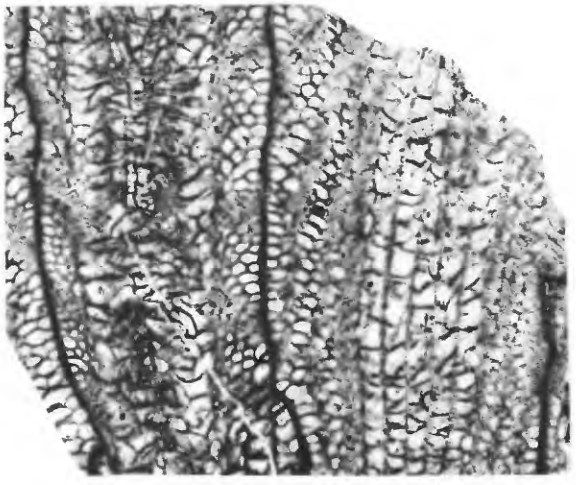

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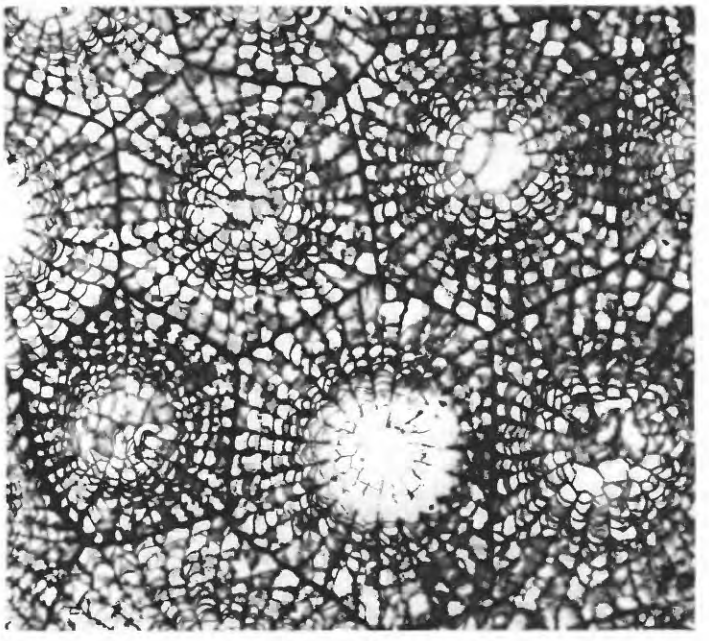

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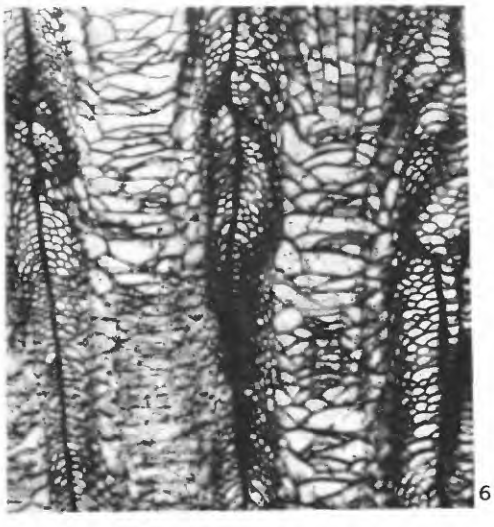

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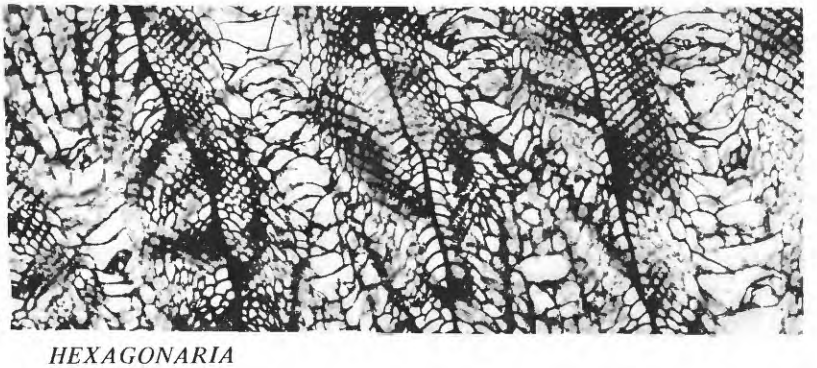

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HEXAGONARIA

PLATE 12

FIGURES 1–7. *Hexagonaria fisherae* subsp. *cockalorumensis* n. subsp. (p. 41).

1. Oblique view of entire corallum (× ⅓), paratype, USNM 166455.
2. Calice view (× 1½), paratype, USNM 166478.

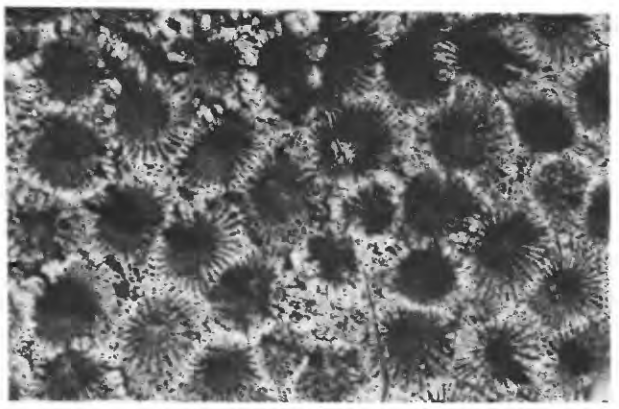
Middle Devonian coral zone F. Cockalorum Wash Formation; Cockalorum Wash area, locality M1351.

3, 4. Transverse and longitudinal thin sections (× 3), USNM 166479.

Middle Devonian coral zone F. Cockalorum Wash Formation; Cockalorum Wash area, locality M1352.

5–7. Transverse and longitudinal thin sections (× 8) of holotype, USNM 166454.

Same horizon and locality as figs. 1, 2.



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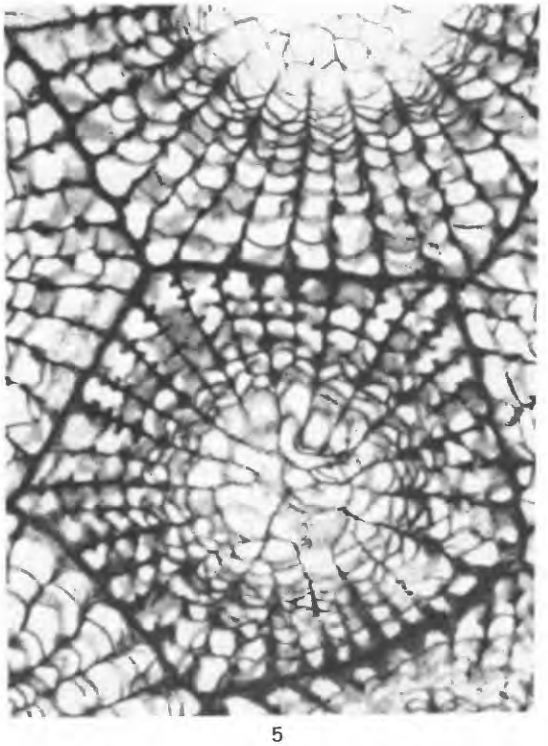

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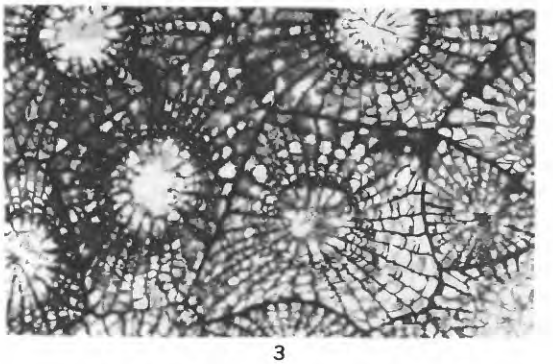

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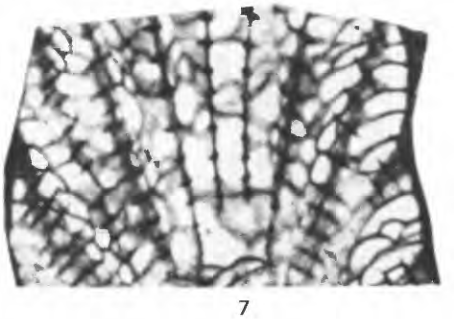

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HEXAGONARIA

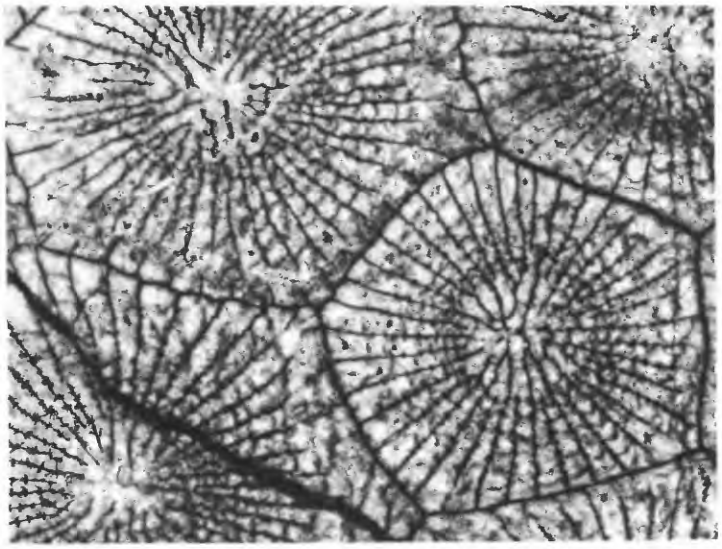
PLATE 13

FIGURES 1–3. *Hexagonaria* sp. w (p. 44).
Transverse (× 4, × 8) and longitudinal (× 2) thin sections, USNM 166459.
Middle Devonian coral zone F; Hot Creek Range, Warm Springs, locality M1354.

4, 5. *Hexagonaria* sp. f (p. 42).
Transverse and longitudinal thin sections (× 2), USNM 166463.
Middle Devonian coral zone F; Cockalorum Wash Formation, Cockalorum Wash area, locality M1353.

6, 7. *Hexagonaria fisherae* subsp. *antelopensis* n. subsp. (p. 41).
Transverse and longitudinal thin sections (× 2) of holotype, USNM 166456.
Middle Devonian coral zone F; Antelope Range, locality M1347.

8, 9. *Hexagonaria* sp. c (p. 42).
Transverse and longitudinal thin sections (× 4), USNM 166461.
Same horizon and locality as figs. 4, 5.



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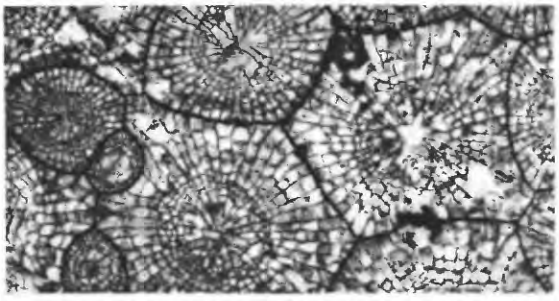

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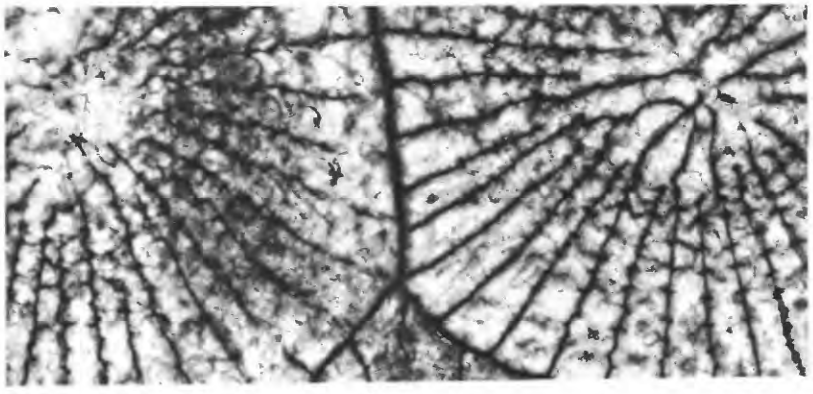

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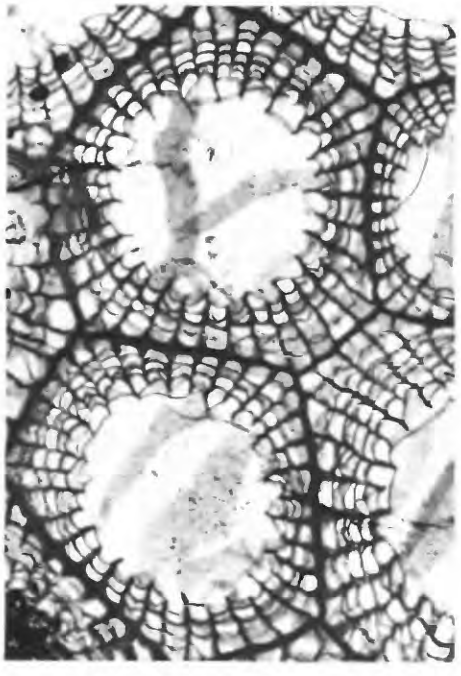

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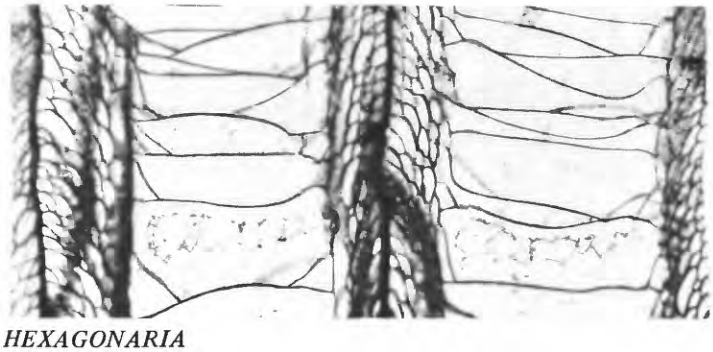

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HEXAGONARIA

PLATE 14

FIGURES 1–4. *Hexagonaria meeki* n. sp. (p. 42).
Transverse and longitudinal thin sections (× 1½), holotype, USNM 166458.
Middle Devonian coral zone F. Cockalorum Wash Formation; Cockalorum Wash area, locality M1352.

5. *Hexagonaria* sp. cf. *H. meeki* n. sp.
Transverse thin section (× 3), USNM 166480.
Middle Devonian; Roberts Mountains, Bobcat Peak, locality M1365.

6, 7. *Hexagonaria* sp. r (p. 43).
Transverse and longitudinal thin sections (× 1½), USNM 166462.
Middle Devonian coral zone F or G. Roberts Mountains; Red Canyon, locality M1339.

8–12. *Hexagonaria* sp. n (p. 43).
Transverse and longitudinal thin sections (× 1½), USNM 166460.
Middle Devonian coral zone F. Hot Creek Range, Warm Springs, locality M1354.

13, 14. *Hexagonaria*? sp. h (p. 43).
Transverse and longitudinal thin sections (× 4), USNM 166464.
Middle Devonian. Hot Creek Range; Morey Peak area, locality M1358.

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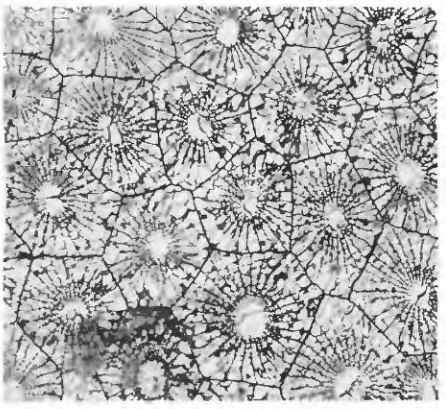

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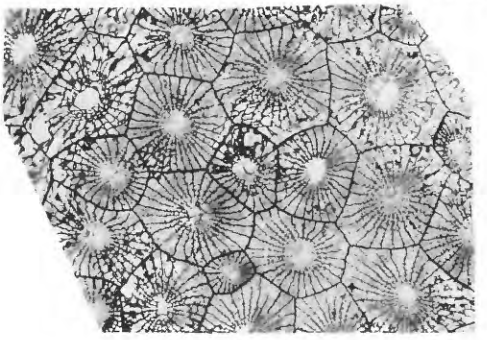

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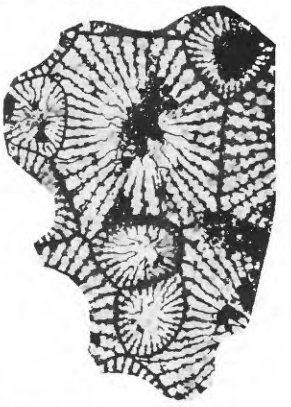

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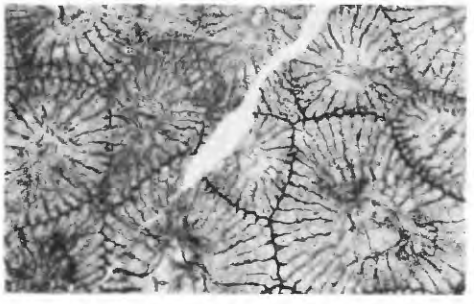

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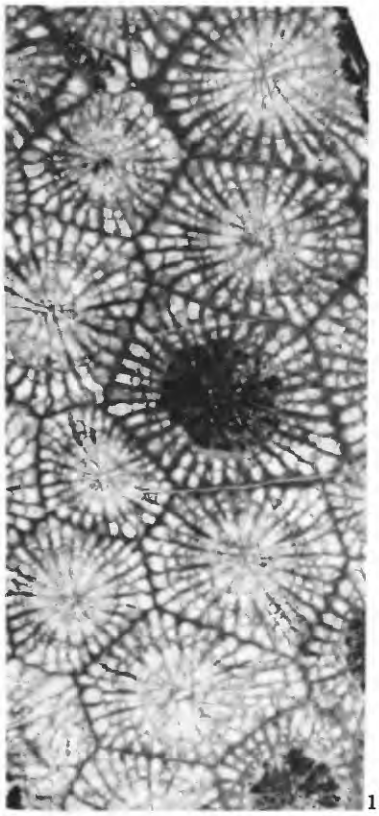

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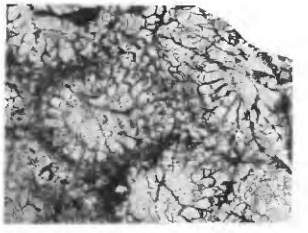

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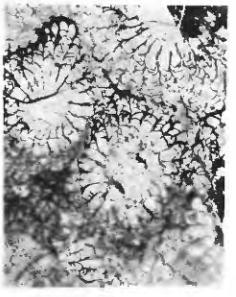

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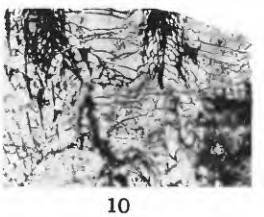

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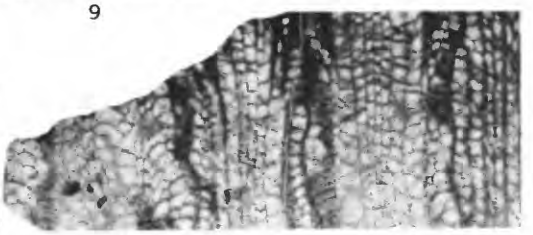

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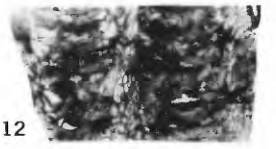

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HEXAGONARIA