SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 119, NUMBER 3
(End of Volume)

Charles D. and Mary Vaux Walcott Research Fund

MISSISSIPPIAN FAUNA IN NORTHWESTERN SONORA MEXICO

(With Nine Plates)

By
W. H. Easton
John E. Sanders
J. Brookes Knight
Arthur K. Miller

(Publication 4313)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
AUGUST 8, 1958

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FOREWORD

This is the third of a series of descriptive papers on the paleontology of the rocks exposed in the vicinity of Caborca, Sonora. The faunas of the Cambrian and Permian sediments have already been published.[1] This description of the Mississippian fossils is the last extensive paper in the series. Pre-Cambrian algae and a few Devonian species are the only other fossils collected by the expeditions of 1943 and 1944.

The work in Sonora was undertaken to establish a Paleozoic sequence in that region. Some excitement resulted from the early report of Cambrian in an area that had hitherto been thought to contain mostly Mesozoic rocks. The work of A. R. V. Arellano of the Instituto Geológico de México and G. A. Cooper of the Smithsonian Institution resulted in the discovery of Lower Cambrian and Devonian as well as confirmation of the presence of Middle Cambrian, Mississippian, and Permian.

The Mississippian rocks occur in a limited area, actually consisting of two small hills about half a mile apart. The easternmost of the hills produced a fair fauna but only a few fossils were found in the western hill. These were sufficient for dating, however. Stratigraphically the Sonora Mississippian offers nothing unusal and can be correlated satisfactorily with Mississippian strata of the Great Basin Province of the United States.

In connection with correlation of the fauna of the eastern hill it is of interest to note here that the Mexican fossils were examined by Arthur L. Bowsher, United States Geological Survey. Mr. Bowsher has studied intensively the fossils and stratigraphy of the Mississippian of southern New Mexico where a fine fossiliferous sequence has been described by him and Dr. Lowell R. Laudon of the University of Wisconsin.[2] It is Mr. Bowsher's opinion that the fauna of the eastern

[1] Cambrian stratigraphy and paleontology near Caborca, northwestern Sonora, Mexico. Smithsonian Misc. Coll., vol. 119, No. 1, 1952: Introduction and stratigraphy, by G. A. Cooper and A. R. V. Arellano, pp. 1-23, pls. 1-5, figs. 1-7; *Girvanella,* by J. H. Johnson, pp. 24-26, pl. 6; Pleospongia, by V. J. Okulitch, pp. 27-35, pls. 7-10; Brachiopoda, by G. A. Cooper, pp. 36-48, pls. 11-13; The original collection of Cambrian trilobites from Sonora, by A. Stoyanow, pp. 49-59, pl. 14; Trilobites, by C. Lochman, pp. 60-101, pls. 15-31, figs. 8, 9.

Permian fauna at El Antimonio, western Sonora, Mexico. Smithsonian Misc. Coll., vol. 119, No. 2, 1953: Stratigraphy and faunal zones, by G. A. Cooper, pp. 1-13, pl. 1, figs. 1-3; A giant Permian fusuline from Sonora, by C. O. Dunbar, pp. 14-19, pls. 2, 3; Corals, by H. Duncan, p. 20, pl. 23; Sponges, Brachiopoda, Pelecypoda, and Scaphopoda, by G. A. Cooper, pp. 21-80, pls. 4-24A,B,C, 25D; Cephalopoda, by A. K. Miller, pp. 81-82, pl. 24D; Gastropoda, by J. B. Knight, pp. 83-90, pls. 24E, 25A,B,C.

[2] Laudon, L. R., and Bowsher, A. L., Mississippian formations of southwestern New Mexico. Bull. Geol. Soc. Amer., vol. 60, pp. 1-88, 1949.

hill near Bisani, the fossils of which are described herein, are most like those of the Andrecito formation. In New Mexico this formation occupies a position intermediate between the Kinderhookian Caballero formation and the Osagian Lake Valley formation. Easton and Sanders in their comments below emphasize the intermediate character of the Mexican fauna.

Preparation by Cooper of the Mississippian fossils from Sonora offered considerable difficulty. These all proved to be silicified but the specimens on being freed from the limestone by acid were unusually fragile. Many were lost in the process because they were seamed with small cracks and fell apart in the acid. Some were sufficiently large that they could be pieced together and thus saved. The preparation of the specimens thus proved a laborious and time-consuming task. In spite of the difficulties a fair number of species was obtained.

The middle portion of the eastern hill from which most of the fossils were taken contains much silica. In some of the silicious masses fossils were buried that could not be recovered. It is, therefore, interesting to note that a specimen of the large brachiopod *Syringothyris* was seen on the outcrop but could not be freed.

I take this opportunity to thank my colleagues for describing the interesting fossils recorded here. Dr. W. H. Easton kindly studied the corals and became so interested in them and their relationships to the Mississippian corals of western United States that he visited the Caborca region with a party of students from the University of Southern California. This separate expedition yielded additional material. Thanks are extended to Dr. John E. Sanders of Yale University for his work on the Mississippian brachiopods of the Caborca area. Dr. Sanders has been studying the little-known sequences of Mississippian in eastern Tennessee and was thus able to bring his knowledge of this region to his study of these western Mexican fossils. Although Dr. J. Brookes Knight was unable to make good specific identifications of many of the snails, he was able to indicate the generic representation of the Gastropoda in a geographic area in which they are poorly known. Thanks go to him for his work on this poorly preserved part of the fauna. Indebtedness must be acknowledged to Dr. A. K. Miller, University of Iowa, for describing the one specimen of cephalopod collected. This is a poor specimen at best, but it is an interesting and important genus of the Mississippian.

G. Arthur Cooper
Head Curator, Department of Geology
United States National Museum

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Charles D. and Mary Vaux Walcott Research Fund

MISSISSIPPIAN FAUNA IN NORTHWESTERN SONORA, MEXICO

MISSISSIPPIAN CORALS FROM NORTHWESTERN SONORA, MEXICO

By W. H. Easton
University of Southern California

(Plates 1, 2, 9C; text figures 1-3)

INTRODUCTION

The first material upon which this study is based was collected in 1943 and 1944 by G. A. Cooper and A. R. V. Arellano during the course of geologic investigations carried on by them in the vicinity of Caborca in northwest Sonora, Mexico. During the years between first preparation of the report (1948) and now (March 1956) the writer has had many opportunities to study and collect from strata of similar age and physical character at numerous localities in California, Nevada, Arizona, and Utah. Accordingly, these recent investigations also permit a close correlation of the coralline strata from Sonora with deposits in the Great Basin of the western United States, as well as with strata in Missouri (this latter resource being necessary in the earlier draft of the paper). In view of the significant similarity of these Mexican corals with those from the western United States, the writer eventually was encouraged to visit the Mexican locality himself in order to study the stratigraphy first hand and to acquire duplicate collections for the University of Southern California. This collecting trip was made in December 1955.

ACKNOWLEDGMENTS

The writer takes pleasure in acknowledging his indebtedness to Dr. G. A. Cooper of the United States National Museum for making available the specimens collected by Cooper and Arellano. He is indebted also to the following students from the University of Southern

California for assistance in the field and for the use of equipment on this collecting trip: R. Hammer, D. Ingebrigtsen, J. LoBue, R. Pesci, and R. Sherman. Financial assistance in this project was made available by the University of Southern California. The physical features and paleogeographic significance of the section will be presented in a publication of the International Geological Congress (XX) which was held at Mexico City in September 1956.

GEOLOGY

The alluvial plain near Bisani laps up against various isolated hills, the positions of which are shown in text figure 1. The hill from which most of the silicified fossils were collected is located 1.4 miles (2.2 kilometers) road distance[3] on a bearing N. 71° W. from the northeast fence corner of Bisani. Bisani is 13.3 miles (21.3 kilometers) west of the southwest corner of the town of Caborca. This hill is about 300 feet in diameter, is almost circular, and rises 65 feet above the playa lake on its west side. In addition to the above silicified fossils four more corals and a few brachiopods were collected from the north end of the small hill 0.5 mile west of the above-mentioned hill, or 2 miles west of Bisani.

The stratigraphic section on the main hill contains only 164 feet (53 meters) of strata, as shown in text figure 2. The fossiliferous portion of the outcrop consists mainly of a very cherty interval (unit 2 of the stratigraphic column) bounded by two lighter intervals.

A description of the measured section of Mississippian strata 1½ miles west-northwest of Bisani, Mexico, is given below. The top bed shown is on the eastern face of the hill, this being the apparent order of succession.

The writer entertains the greatest doubts that the apparent order of superposition as seen in the outcrops is the actual order of stratigraphic succession. For various reasons the solution of this elementary problem is confounded. The action of occasional strong currents and the presence, presumably, of shallow water, are testified to by broken and waterworn corals, disassociated brachiopod valves, and occasional streaks of coarse fossil debris such as criquina, in otherwise fine-grained sediments. Nevertheless, clear-cut instances of truncated crossbedding or graded bedding such as would indicate order of super-

[3] Incidentally, rural roads in this region, as is generally true in the arid parts of western North America, exist more from faith and less from ballast than do roads in moister climes, hence, great variation may exist from time to time in the interpretation of parts of the road system shown herein (see plate 9, C).

position were not seen by the writer, nor does he know of anyone who has visited the outcrop who was able on these grounds to verify the structural attitude. Bottom markings or other details at bedding planes seem to have been obliterated by the extensive shearing and gliding coincident with the deformation of these strata. As a matter of fact, all trace of bedding in several places has been destroyed by brecciation and by alteration through either recrystallization or dolomitization.

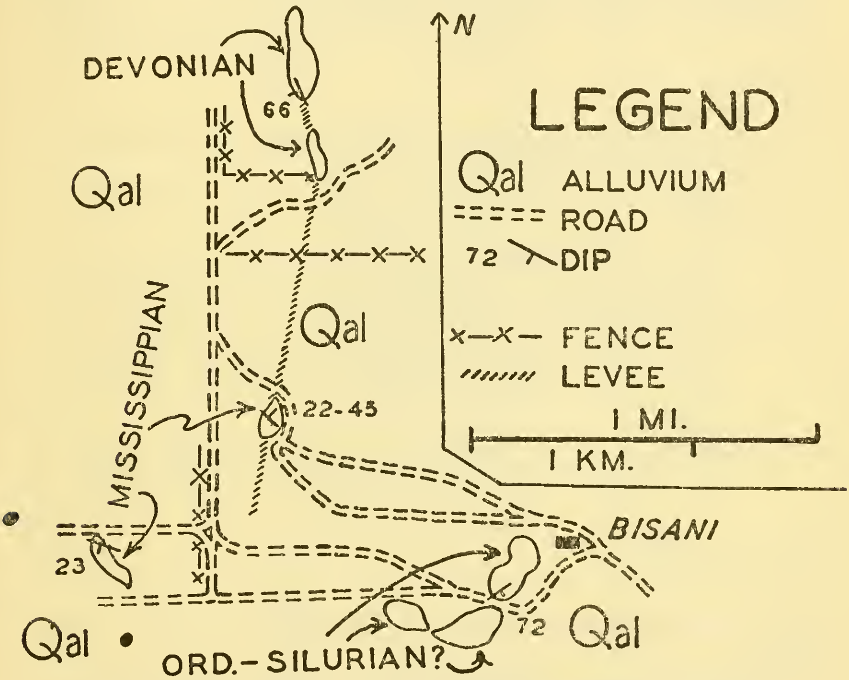

Fig. 1.—Sketch map of the geology near Bisani, Sonora, Mexico.

Older and younger strata crop out in the vicinity but not in continuity with these beds, so lithologic correlation is not possible. Moreover, the faunas of the beds are not distinct enough either to enable evaluation of evolutionary changes or to enable correlation with the inadequately known faunas of the western United States. As a result, discussions of the order of stratigraphic succession mostly concern the significance of orientation of corals present in various beds.

Almost all the simple zaphrenthid corals lie prostrate in parallelism with the bedding. Some, like *Caninophyllum,* also were abraded enough in locally strong currents to cause removal of most of the theca and thereby to expose the dissepiments. One remarkable specimen of *Caninophyllum* on the east side of the main hill, however, not only was oriented with its long axis normal to the planes of stratification but its calyx is encrusted with a spherical growth of *Syringopora* so as to make it abnormally topheavy. Although this aggregation may indicate that currents overturned a coral in a normal sedimentary sequence so that the *Syringopora* now points down, the concavity of laminations in the bedding over the upwardly directed apex of the *Caninophyllum* seem to indicate downward depression of soft sediment during growth. Moreover, it is difficult to imagine this elongate

	Feet
Top not exposed.	
1. Limestone, gray, medium-grained to fine-grained, 5 percent brownish weathering chert nodules	40
2. Limestone, as in bed 3, but chert amounts to about 75 percent of unit	19
3. Limestone, dark gray, mostly fine-grained, bedding up to 1 foot, 30-50 percent reddish-brown weathering, chert in nodules and beds, cliffy western face of hill, increasingly fossiliferous up-section...	74
4. Limestone, dark gray, weathering light brown, fine-grained with medium-grained streaks, bedding to 2 feet, 5 percent dark gray nodular chert weathering reddish-brown, bluff-maker, unfossiliferous	20
5. Criquina, gray, coarse-grained	5
6. Limestone, dark gray, weathering light brown, fine-grained, bedding up to 6 inches, 35 percent dark gray bedded chert, unfossilferous.	6
Total	164
Base not exposed.	

fossil remaining balanced on end amid evidence of strong current action.

Numerous colonies of *Lithostrotionella* and *Syringopora* on the large hill are now oriented upside down. It is easy to verify direction of growth on the outcrop by determining normally upwardly convex dissepiments or tabulae in the former case and by noting normally upwardly diverging new corallites in the latter case. The writer did not observe a single colony of either genus right side up among about 20 large colonies for which he determined orientation. Some other colonies, however, seemed equivocal, or necessary features could not be seen. In general, colonies seem to be resting on their convex, calical surfaces, which were directed up in life.

Evidence on orientation of fossils in the western Mississippian hill is meager. Of 11 disassociated single valves of *Perditocardinia* for which orientation could be determined, 7 lay with their concave or

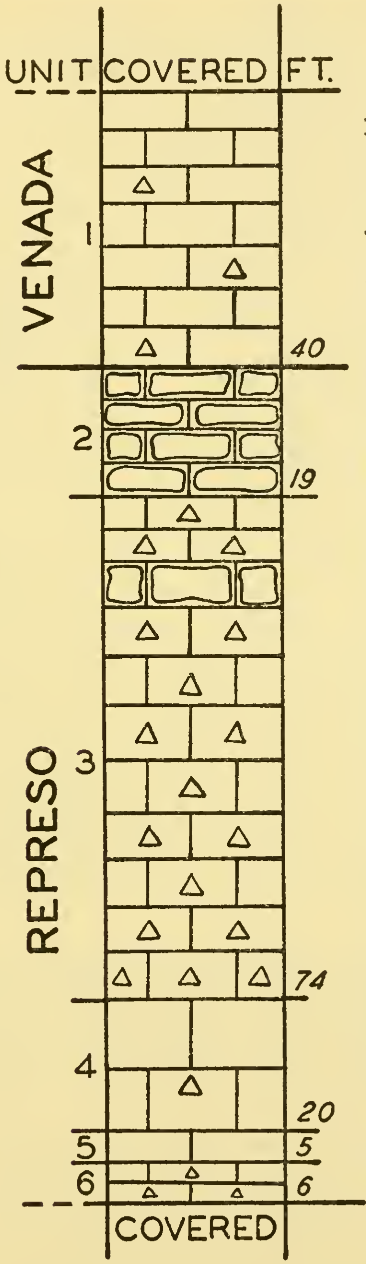

Fig. 2.—Stratigraphic section of Mississippian strata near Bisani, shown in apparent order of superposition.

inner surfaces up and with their convex surfaces down, whereas only 4 single valves were observed to retain the normal orientation of concavo-convex objects in a current-swept environment (that is, with their concave surfaces down).

In view of the evidence presented in the three foregoing paragraphs, the writer concluded that strata in both of these hills are structurally overturned and that apparent dips of 22° to 46° eastward should be interpreted as indicating the western limb of a westerly-overturned anticline. This opinion is not shared by some or possibly even by any other geologists who have studied the field evidence, although about a score of geologists examined the area in late August on excursion A-8 of the XX International Geological Congress. During a discussion of this subject by several paleontologists at section 7 of the Congress in Mexico City in early September 1956, it developed that Dr. C. O. Dunbar definitely established on the excursion that one colony of *Lithostrotionella* is right side up. This evidence, it should be remembered, is in conflict with that revealed by the score or more of colonies studied by the writer, and indicates that both orientations exist. Along these lines, Dr. G. A. Cooper reports (correspondence, January 10, 1956) that elsewhere he has "seen coral heads several feet across overturned with the bottom staring one in the face. This is a common condition in Michigan where there are no structural complications and is simply evidence that the corals lived in rough water then as they do now." The writer had an opportunity to observe the same phenomenon of mixed evidence of coral colonies in Early Permian strata in Nevada, just a few weeks before the above discussions in Mexico. In none of these other instances, however, is the physical evidence so strongly one-sided as it is in the case of the Mississippian strata near Bisani.

Fossils collected by Cooper and Arellano from various beds in the main hill are referred to herein as "undifferentiated" collections. Dr. Cooper informed the writer in conversation that most of the collections came from the cherty strata near the summit of the hill and that he did not collect from strata on the east slope. Those undifferentiated collections, therefore, mostly came from unit 2 of the measured section. Collections made by the writer's party were differentiated as to units 1, 2, and 3 as shown in text figure 2. The presence of the same species of *Perditocardinia* (near *P. dubia*) and of *Caninophyllum sonorense* in unit 1 and in the hills ½ mile west of the main Mississippian hill would indicate that these represent the same stratigraphic unit. Corals and brachiopods from units 2 and 3 were not found by the writer at the western one of the two Mississippian hills.

By correlating the writer's findings with statements by Cooper (in Weller et al., 1948, pp. 136, 137) and by Cooper and Arellano (1946, p. 610) it seems apparent that the so-called Venada beds with *Perditocardinia* are unit 1 of text figure 2 and the so-called Represo beds with the Kinderhook-Osage fauna are units 2 and 3 and presumably units 4-6 of text figure 2. These names (Venada and Represo) were proposed by Arellano (in Weller et al., 1948, pp. 136, 137) without description or designation of a type locality.

The known range of *Perditocardinia* indicates a late Meramec age for the Venada beds, which would place them in normal position above the Represo beds, which is the way they appear in the outcrop. In this case the various lines of evidence for structural overturning are all invalid in this area. On the other hand, if the physical evidence is valid, then *Perditocardinia* has an earlier range in the Cordilleran region than it has in the midcontinent United States. In view of the conflict of evidence, the writer has adopted the objective viewpoint and has presented the measured section, graphical stratigraphic section (text fig. 2), and index map (text fig. 1) as if the beds are all in normal stratigraphic position. As a matter of opinion, however, the writer thinks that evidence is equally strong that both of the hills are structurally inverted. It is quite probable that this problem will be solved as soon as the meager fauna of the Venada beds is definitely identified to the north in more complete stratigraphic sequences such as are available in Nevada and California.

The corals are nearly all siliceous replacements, although interiors of some of the larger specimens may contain considerable amounts of calcite. Silicification is best nearest the surface, but is generally evident even in the centers of blocks. Replacement is generally complete and homogeneous so that very few specimens are coarsely beekitized. Extensive, partial local silicification of the matrix, where incipient chert nodules are located, has almost obscured morphologic features in some specimens. Fine stringers of quartz or of calcite commonly transect the fossils, causing them in the latter case to fall apart when prepared in an acid bath.

RELATIONSHIPS OF THE FAUNA

Material received by the writer included 188 individual corals or colonies, plus a considerable number of fragments of syringoporoid corals. Of these, 173 specimens are identified. In addition, the collecting party from the University of Southern California obtained 137 additional specimens which were identified plus a few which were not. A list of the 18 species in the coralline fauna from the main locality follows:

Caninia corniculum (Miller) emend. Easton, 1944
Caninia species
Caninophyllum sonorense Easton, new species
Cyathaxonia cordillerensis Easton, new species
Cystelasma invaginatum Easton, new species
Koninckophyllum species
Lithostrotionella confluens Easton, new species
Neozaphrentis tenella (Miller), 1891
Pleurodictyum subramosum Easton, new species
Rotiphyllum occidentale Easton, new species
Rotiphyllum vesiculosum Easton, new species
Syringopora tubifera Easton, new species
Syringopora, new species A
Syringopora, new species B
Triplophyllites (*Homalophyllites*) *circularis* Easton, new species
Triplophyllites (*Homalophyllites*) species
Trochophyllum (*Barrandeophyllum*) species
Trochophyllum (*Trochophyllum*) species

It is apparent from the faunal list that most of the elements are new species. Moreover, five corals identified only as "sp." certainly represent new species, but the material does not justify making types of the specimens. Only two species are assigned to previously known corals. In spite of the apparent scarcity of useful coral species, it is possible to make a reasonable correlation of the Mexican corals with some corals in the standard Mississippian section of the midwestern United States.

Consider first the two previously described species.

Caninia corniculum (Miller) emend. Easton is abundant in the Chouteau limestone of Missouri and Illinois but also occurs in the Pierson limestone and St. Joe limestone (both of Osage age in Missouri), and at other localities of uncertain stratigraphic position, although within the limits of the beds cited (Easton, 1944, p. 50).

Neozaphrentis tenella (Miller) is common and abundant in the Pierson formation of earliest Osage age. It also is known from the Chouteau limestone at the Kinderhook-Osage boundary in Missouri.

Consider next the new species:

Rotiphyllum occidentale is related to *Rotiphyllum hians* in lower and upper parts of the Chouteau limestone (unrestricted) of Missouri. *R. occidentale* occurs commonly in the Great Basin of the

United States in association with *Spirifer centronatus*[4] of Kinderhook-Osage range.

Rotiphyllum vesiculosum is at present a stratigraphically insignificant relative of *R. occidentale.*

Triplophyllites (*Homalophyllites*) *circularis* is closely related to *T.* (*H.*) *pinnatus* (Easton), 1944. The latter species occurs in the upper part of the Chouteau limestone (unrestricted) of Missouri (Easton, 1944, p. 44), which may indicate a possible Osage age for the new species. Other species range in age from upper Kinderhookian into the Osage, and some occur even in upper Meramec strata. The younger species, however, are flattened on the convex side, so this species very probably indicates Kinderhook age.

Lithostrotionella confluens belongs to a genus whose stratigraphic range in North America has not been accurately determined. Until fairly recently, *Lithostrotionella* (*Lithostrotion* of authors) has been considered an index of upper Meramec strata, namely, St. Louis and St. Genevieve limestones. It is now known to occur well down in the Osage series. There is no practical similarity between *L. confluens* and *Lithostrotion microstylum* White, from the Chouteau limestone, which is the only related Kinderhookian coral.

Cyathaxonia cordillerensis is very closely related to *C. tantilla* from the Chouteau limestone and from various other formations near the Kinderhook-Osage boundary in the Mississippi River Valley.

Caninophyllum sonorense is related to *C. incrassatum* from the Redwall limestone and *C. sedaliense* from near the Kinderhook-Osage boundary in Missouri. Similar corals occur abundantly in the Monte Cristo formation and correlative strata in the Great Basin, but the systematics of these western cyathophyllid corals has not been worked out yet.

Cystelasma invaginatum is an odd form not very closely related to other known species. It seemingly is more primitive than species from the Salem limestone of Indiana.

Pleurodictyum subramosum is simply another species in a genus of long range and uncertain stratigraphic value.

Syringopora tubifera has the same faults as the next preceding species, in addition to which a revision of the syringoporoid corals is long overdue. It is not of great stratigraphic importance at present.

Consider next the corals identified as "species":

Caninia species is not well enough preserved to make it very useful.

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[4] Called *Cyrtospirifer? latior* (Swallow) by Sanders.

It has no known close relatives in North American Mississippian faunas.

Trochophyllum (*Trochophyllum*) species is rather closely related to the only other known species *Trochophyllum* (*T.*) *declinis* (Miller), from the Keokuk beds of Indiana.

Trochophyllum (*Barrandeophyllum*) species belongs to a subgenus not previously reported from North America, to the writer's knowledge. The genotype of *Barrandeophyllum* occurs in the lower Middle Devonian of Bohemia and other species are known from Russian strata equivalent to some of the lower Iowan beds in North America.

Triplophyllites (*Homalophyllites*) species, *Syringopora,* new species A, and *Syringopora,* new species B are not diagnostic of subdivisions within their late Paleozoic coralline genera.

Koninckophyllum species is not very close to the lower Mississippian *K. glabrum* from Missouri and so is of uncertain significance at present, other than to indicate a general relationship with Tournaisian-Viséan corals in the European succession.

AGE OF THE FAUNA

Among the various corals known, the following indicate an age transgressing the Kinderhookian-Osagian boundary, in other words, roughly the age of the Chouteau limestone (unrestricted) and the Pierson formation of Missouri: *Caninia corniculum, Rotiphyllum occidentale, Triplophyllites* (*Homalophyllites*) *circularis, Trochophyllum* (*Barrandeophyllum*) species, *Cyathaxonia cordillerense,* and *Neozaphrentis tenella. Trochophyllum* (*Trochophyllum*) species and possibly *Lithostrotionella confluens* and *Cystelasma invaginatum* indicate an age younger than Chouteau. *Caninophyllum sonorense* might indicate either Lower or Middle Mississippian age. Where the writer has observed corals of this sort most commonly in the Great Basin, they are generally pre-Meramec, as in the Dawn Limestone member of the Monte Cristo limestone. A much larger form occurs in the Yellowpine member of supposed Meramec age in southern Nevada.

The type Mississippian sections are not yet known well enough to permit accurate correlation of the Sonoran beds with them on the basis of corals. For instance, when Easton published a review of the Chouteau corals (1944) the precise stratigraphic positions from which each of the types came was not determinable in most cases. Accordingly, much of the fauna was assigned to the Chouteau limestone, unrestricted, and was considered to span the Kinderhook-Osage boundary. Subsequently efforts have been started to re-collect the strata and to establish the ranges of the species on the basis of new collections referred to current stratigraphic usage. The first results of this important work (Beveridge and Clark, 1952, pp. 72, 76; Spreng, 1952, p. 84) indicate to those authors that the Chouteau should be raised to group rank and that its components, the Compton, Sedalia, and Northview formations, all should be referred to the Kinderhook series. They place the Kinderhook-Osage boundary at the base of the Pierson limestone. As published by Spreng (1952, p. 84) the lower Pierson fauna contains the Osage forms *Caninia corniculum, Neozaphrentis tenella, Cyathaxonia tantilla, Triplophyllites* (*Homalophyllites*) species, and *Caninophyllum* (*Vesiculophyllum*) *sedaliense,* which indicate relationships with the Sonora fauna. Moreover, the Fern Glen is considered by Beveridge and Clarke (1952, p. 76) to be correlative with the Pierson, and therefore the presence of *Cyathaxonia* in the Fern Glen lends additional weight to assigning the Sonoran strata a basal Osage age, at least in part. A revised Kinderhook range chart of species has not been published, so it is not possible now to make an evaluation of how much, if any, of the coralline population is also of Kinderhook age. In any case, the evidence indicates that the Sonoran corals are about at the Kinderhook-Osage boundary and are most probably basal Osage.

The Dawn limestone member of the Monte Cristo limestone carries some of the same species as does the Mississippian section near Bisani. *Lithostrotionella confluens, Triplophyllites* (*Homalophyllites*) *circularis, Rotiphyllum occidentale,* and brachiopods such as *Spirifer centronatus, Schizophoria, Rhipidomella,* and *Spirifer* cf. *S. logani* are noteworthy in both formations. The writer has encountered the foregoing association of species in Mississippian strata over much of the Great Basin of the western United States, but so far the fanua has only been cited infrequently, and then only in part (Hazzard, 1954a, p. 883; 1954b, p. 28). The best place to collect this fauna, insofar as the writer knows, is on the east side of the northern Nopah Range in southeastern California. There, in Hazzard's measured section G-G' (Hazzard, 1937, pp. 274, 275, 332, 333; 1954a, p. 883) the Dawn limestone member is 350 feet thick. It is in normal stratigraphic succession above the Sultan limestone (Devonian) and beneath the Anchor limestone member of the Monte Cristo formation (Mississippian). The fauna is almost equally well represented in the Providence Mountains of California (Hazzard, 1954b, p. 28) where the Dawn and Anchor limestone members are not readily separable. Unpublished information available to the writer indicates that the fauna also occurs in Nevada in the Joana limestone member of the White Pine shale (where *Rotiphyllum, Caninophyllum,* and *Lithostrotionella* are common), the Bristol Pass limestone, and the Rogers Spring limestone; in Utah in the Midridge limestone; and in Arizona in the Redwall limestone. Owing to uncertainties about the precise ranges of the species in the Cordilleran region, the foregoing formations may not be all of the same precise age. The Redwall limestone, for instance, is almost certainly a bit younger in part than are the other formations (Easton and Gutschick, 1953, p. 9). The approximate relationship of these various formations has been shown elsewhere (Eastern Nevada Geological Association, 1953, pp. 146, 147).

GEOGRAPHIC RELATIONSHIP OF THE FAUNA

The collection at hand contains elements of all three Carboniferous facies faunas recognized by Hill (1948, pp. 121, 142, 143)—the *Cyathaxonia,* compound, and caniniid-clisiophyllid faunas.

Noticeably absent from the collection are *Cleistopora* and *Palaeacis.* Some species of these genera are characteristic of equivalent strata in the Mississippi Valley, in western Europe, and in Australia. Also lacking but characteristic of and common in the equivalent beds of the Mississippi Valley are any species of *Clinophyllum,* calceolid *Homalophyllites,* and *Microcyathus.* The presence of abundant *Triplophyllites* (*Homalophyllites*), of rather common *Rotiphyllum,* and of rare *Neozaphrentis* and *Cyathaxonia* signify a distant connection with the Mississippi Valley seas. The species of *Trochophyllum* signify relationships not only with Russian and Chinese seas but also with English seas all of the same general age.

The presence of Osage *Lithostrotionella,* and of *Caninophyllum, Rotiphyllum,* and *Homalophyllites* links the Sonoran deposits with other deposits in and bordering the Cordilleran geosyncline in California, Nevada, Utah, and Arizona.

In summation, the Mexican coral fauna is an isolated population consisting of (1) some ubiquitous genera, (2) a few elements characteristic of strata in the Mississippi Valley transgressing the Kinderhook-Osage boundary, (3) some elements occurring as far east as western Europe, (4) some elements from the western United States, and (5) some elements occurring as far west as central Russia, eastern China, and Australia.

SYSTEMATICS

Phylum COELENTERATA

Class Anthozoa

Order Tetracoralla

Family CYATHAXONIDAE

Genus CYATHAXONIA Michelin, 1847

CYATHAXONIA CORDILLERENSIS Easton, new species

Plate 1, figures 14, 17, 18

Diagnosis.—*Cyathaxonia* measuring about 10 mm. in length by 3 mm. in calical diameter, with 32 spinose septa in adult stages.

Externals.—Small, curved, ceratoid corals. Theca with septal grooves and encircling striae. Apical angle 25°. The cardinal septum is on the convex side of the coral.

Calyces.—One specimen (a paratype, pl. 1, fig. 17; diameter 2.5 mm. by 3 mm.) has 33 subequal septa in an evenly concave calyx. One order of septa is slightly shorter than the other. The columella is long, circular in cross section, and tapers to a point. Other details obscured with matrix.

The holotype (pl. 1, figs. 14, 18; diameter 3.5 mm. by 4 mm.), probably in late maturity, has 36 long septa arranged in pairs; one septum of each pair here and there seems to be clearly contingent upon the cardinal side of the next septum. The counter position is marked by axial fusion of three septa. Alar septa are indistinguishable from the other major septa, but the loculus on the counter side of each septum is very slightly wider than the neighboring loculi. There are four groups of septa in each quadrant. At the position of the very short cardinal septum is a large space which has every appearance of a fossula but may be the result of faulty preservation. The columella is thickest where joined by the septa, but at its terminus is free, smooth, and oval in cross section. Tabulae and septal spines not observed.

Four paratypes in the U.S.C. collection are about 10 mm. long and are about 3.0 mm. in diameter at the calyx. One of these has seven septa in each quadrant, plus the cardinal, counter, and two alars. Three have 32 septa and one has 28 septa. The calyx is 2.0 mm. deep and the boss stands 0.7 mm. above the calical floor. No cardinal fossula is present. Septa are spinose.

One incomplete paratype in the U.S.C. collection is now 17 mm.

long and was probably over 20 mm. long when complete. It is 3.5 mm. in diameter at the calyx and has 32 spinose septa. Spines are arranged in rows which are inclined apically at about 15° to the axis.

Comparison.—*C. cordillerensis* differs from *C. tantilla* (Miller), which it most closely resembles, in having 32 septa in mature stages instead of having 28 or fewer septa. The species are similar in size, diameter, apical angle, and epithecal features.

C. arcuata Weller, as reviewed by Conkin and Conkin (1954, p. 215), is twice as large as *C. cordillerensis,* and has more septa (34 to 36) as an adult. Inasmuch as Conkin and Conkin report the absence of spines in *C. arcuata,* it is notably different from *Cyathaxonia tantilla* and *C. cordillerensis,* and should be placed in some other genus, possibly new.

Occurrence.—Unit 2, 1 specimen. Unit 3, 4 specimens. Undifferentiated units, 2 specimens.

Material.—Holotype, U.S.N.M. 127950; figured paratype, 127951; 4 paratypes, U.S.C. 4060; 1 paratype, U.S.C. 4061.

Family LACCOPHYLLIDAE

1928. Laccophyllidae Grabau, Pal. Sinica, ser. B., vol. 2, fasc. 2, p. 82.
1938. Laccophyllidae Prantl, Ann. Mag. Nat. Hist., ser. 11, vol. 2, No. 7, p. 20.

Remarks.—Prantl's work is the best to date on the family and should be consulted for details. Numerous taxonomic problems concerning laccophyllids cannot be solved until further study of genotypes is made.

Gorsky (1932, p. 87) considered *Laccophyllum, Alleynia,* and *Barrandeophyllum* "seemingly identical." Butler (1935, p. 118) considered *Alleynia, Laccophyllum,* and *Syringaxon* to be possibly synonymous. Butler's view was followed by Lang, Smith, and Thomas (1940, p. 129) who state without reservation that the generic names are synonymous. Prantl (1938, p. 21) considered *Alleynia* and *Syringaxon* to be synonymous but he reserved opinion on *Laccpohyllum.* Even if all the above names are synonyms and *Syringaxon* is the prior genus, there is still some doubt as to the position of *Metriophyllum,* which may be a senior synonym of *Syringaxon.* Lastly, *Ptychocyathus* has priority over all other names, but an appeal has been made to the International Commission of Zoological Nomenclature to suppress Ludwig's genera. So far as is known to the writer, the Commission has not yet acted. In summary, then, there is strong reason to believe that the family name should be based upon either *Syringaxon, Metriophyllum,* or *Ptychocyathus.* The *Laccophyllidae* as used here may eventually prove to contain the Lindstroemiidae Pocta, 1902, and the Metriophyllidae Hill, 1939. In any case, there is nothing to be gained by changing the family name now with so many uncertainties apparent.

Systematically, the writer considers the family provisionally to contain three homoeomorphic groups. The first of these is typified by *Laccophyllum,* the second by *Trochophyllum,* and the third by *Laccophyllum cyathaxoniaeformis* Gorsky.

Genus **TROCHOPHYLLUM** Milne-Edwards and Haime, 1850

1850. *Trochophyllum* Milne-Edwards and Haime, a Monograph of the British Fossil Corals, Pt. I, p. lxvii. Palaeont. Soc.
1851. *Trochophyllum* Milne-Edwards and Haime, Mus. Hist. Nat., Arch., vol. 5, pp. 166, 356.
1935. *Crassiphyllum* Grove, Amer. Midl. Nat., vol. 16, No. 3, p. 368.
1940. *Trochophyllum* Lang, Smith, and Thomas, Index of Paleozoic coral genera, p. 135. British Mus. (Nat. Hist.).
1944. *Permia* Hudson, Journ. Paleont., vol. 18, No. 4, p. 359 [in part].
1948. *Trochophyllum* Stumm, Journ. Paleont., vol. 22, No. 1, p. 71.

Diagnosis.—Small, ceratoid, curved or geniculate, simple corals. Epitheca smooth, striate, pseudocostate, or with septal grooves. Calyx inverted, moderately deep, Septa in one or two orders, most meeting at or forming an axial tube. Tabulae may be in two orders, those in the axial tube constituting "inner tabulae," and those in loculi constituting "outer tabulae."

Genotype.—*Trochophyllum verneuli* Milne-Edwards and Haime, 1850, p. lxvii, by original designation.

Occurrence.—The genotype was collected by de Verneuil from the hills 7 miles south of Louisville, Ky. These beds have been well-known collecting grounds for fossils from the New Providence shale in the Keokuk portion of the Mississippian period.

Remarks.—The writer considers it advisable to apply and extend Hudson's broad interpretation of *Permia* (to the same corals but under the name *Trochophyllum*) for several reasons, namely (1) the convergence of structure in several lines of development does indicate that *Trochophyllum* can be used as a composite genus; (2) at the present time only a few species are known and these are not adequate for evolutionary purposes; (3) stratigraphic usefulness is enhanced by having fewer narrowly restricted genera to consider.

Even so, the significant variations known to occur warrant some subdivision of *Trochophyllum;* therefore, the writer proposes a new arrangement of these groups under the genus *Trochophyllum.*

Much confusion exists regarding tabulae and dissepiments in

Permia and related subgenera. The tendency in the literature has been to refer to the skeletal elements in loculi as dissepiments. Apparently by so doing, Grabau, Grove, and Hudson have avoided any inference that the aforementioned structures extend across the entire calyx as would typical tabulae. On the other hand, it should be pointed out that the "dissepiments" referred to by these writers resemble the dissepiments of other corals less than they resemble tabulae of other corals. For example, typical dissepiments are convex axially and are arranged in series sloping from the epitheca proximally and axially, whereas the "dissepiments" mentioned above slope from the axial region proximally and peripherally. There seems to be no disagreement about horizontal skeletal elements within the central tube—these are termed tabulae. In order to clarify the terminology, the writer proposes that the horizontal skeletal elements within the tube be referred to as "inner tabulae" and the elements sloping down to the epitheca from the axial region be termed "outer tabulae."

Stuckenberg (1895) does not refer to tabulae or dissepiments in his generic and specific descriptions of *Permia* and *P. iwanowi,* but his figure 6d on plate 3 shows some transverse structures in loculi near the lower right edge of that specimen that might be transverse skeletal structures.

The central tube seems generally to be formed of the fused inner ends of the septa with addition of stereoplasm. As such it may be technically termed a stereotheca, but unless details of microscopic structure are discernible, this feature cannot be recognized; therefore, the writer uses the looser terminology "axial tube."

Subgenus **TROCHOPHYLLUM** Milne-Edwards and Haime, 1850

[Synonymy the same as for the genus.]

Diagnosis.—Trochophyllum with a nontabulate axial tube, only one (major) order of septa, the weakly or strongly developed cardinal fossula on the convex side when corals are curved, outer tabulae present in the loculi, septal grooves usually absent, and stereoplasm deposited on the axial tube.

Type.—Same as for the genus.

Occurrence.—The occurrence is the same as for the genotype.

Remarks.—Included here are *Trochophyllum* (*Trochophyllum*) *declinis* (Miller), *Trochophyllum* (*T.*) species described in this paper, *Trochophyllum* (*T.*) *choniukounense* (Grabau) [=*Barrandeophyllum choniukounense* Grabau], *Trochophyllum* (*T.*) *compressum* (Grabau) [=*Barrandeophyllum compressum* Grabau], and probably

Trochophyllum (*T.*) *disjunctum* (Grabau) [=*Barrandeophyllum disjunctum* Grabau].

TROCHOPHYLLUM (TROCHOPHYLLUM) species

Plate 1, figures 13, 21

Externals.—Medium size, curved geniculate, ceratoid, measuring 20 mm. in length. The theca is smooth except for rugae. A long oblique scar of attachment is present at the apex. Apical angle is 35°.

Calyx.—The calyx (diameters 9.5 mm. by 8.5 mm.) is shallow with the distal ends of the septa sloping down toward the calyx floor. There are 25 major septa of about equal length for one very short one and two or three on either side of it which become progressively longer. This deep depression on the convex side of the coral is assumed to be the cardinal fossula. This interpretation is borne out by the character of the sixth septa on either side of the short cardinal septum, which are contratingent against the seventh septa. Septa of the cardinal quadrants are radially arranged, whereas those of both counter quadrants are flexed counterclockwise. Minor septa are not present.

The axial tube is a thin subcircular cylinder which rises 2 mm. or more above the floor of the calyx. The outer surface of the axial tube bears here and there the traces of septa or of tabulae, but there is no surficial indication that it is composed of fused skeletal elements. Internally, the axial tube is nontabulate; indeed, its interior walls are quite smooth down a distance of perhaps 10 mm. where the bending of the coral carries the tube out of sight.

Tabulae are present in the cardinal quadrants; they are very steeply inclined and may be confused with septa because they also are directed counterclockwise. Tabulae are also indicated by horizontal traces on the inside of the theca.

Dissepiments were not observed but rejuvenation resembles broad dissepimental structure where a new inner theca has been deposited and older portions of the calyx sealed off.

Occurrence.—Undifferentiated, 1 specimen.

Material.—U.S.N.M. 127949.

Subgenus BARRANDEOPHYLLUM (Pocta) Easton, new combination

1902. *Barrandeophyllum* Pocta, *in* Barrande, Syst. Silur. du Centre de la Boheme, vol. 8, t. 2, p. 190.

Diagnosis.—*Trochophyllum* with inner tabulae in the axial tube which may expand rapidly, two orders of septa, outer tabulae present in the loculi, septal grooves present, and little or no stereoplasmic thickening of the axial tube.

Type.—*Barrandeophyllum perplexum* Pocta, 1902.

Occurrence.—Lower Middle Devonian of Bohemia.

Remarks.—Included here are *Trochophyllum* (*Barrandeophyllum*) *perplexum* (Pocta), *Trochophyllum* (*B.*) species described in this paper, and *Trochophyllum* (*B.*) *turbinatum* (Gorsky) [=*Laccophyllum turbinatum* Gorsky].

TROCHOPHYLLUM (BARRANDEOPHYLLUM) species

Plate 1, figures 19, 23

Externals.—Small, curved, ceratoid, measuring 8 mm. in length. Theca without interseptal ridges but with encircling rugae. Apical angle 25°. Apex marked by oblique scar of attachment.

Calyx.—The calyx (diameter 3.5 mm.) is moderately deep and vertically walled. The 16 major septa are radially arranged and terminate at the axial tube. These septa are equally spaced, except for four which almost meet the tips of four others at the axial tube; this distribution appears to be fortuitous, rather than being related to the basic plan of septal insertion. Short minor septa alternate with the major septa.

The axial tube consists of a tabulate tube lying halfway to the axis from the theca. Most of the major septa terminate at right angles against it and there is no external indication that it is formed of the bent inner ends of the septa. The axial tube is subcircular in cross section, actually being subtley pentagonal in the specimen at hand. The density of packing of tabulae within the axial tube is not known. Outer tabulae are quite closely spaced between the axial tube and the theca, being steeply arched distally to where they meet the axial tube.

Occurrence.—Undifferentiated, 1 specimen.

Material.—U.S.N.M. 127952.

Remarks.—There being but one specimen, it was not sectioned. Further details may be furnished by study of additional material collected in the future, but at present there would be nothing gained by giving this specimen a new name.

As far as is known to the writer, this is the first time that *Barrandeophyllum* has been reported from the Mississippian of North America. Although the specimen has no value in detailed correlations, it affords a bit of evidence as to the geographic distribution of Mississippian faunas.

Subgenus PERMIA Stuckenberg, 1895

1895. *Permia* Stuckenberg, Mém. Com. Géol., vol. 10, No. 3, pp. 26, 186.
1928. *Permia* Grabau, Pal. Sinica, ser. B, vol. 2, fasc. 2, p. 95.

1940. *Permia* Lang, Smith, and Thomas, Index of Palaeozoic coral genera, p. 97. British Mus. (Nat. Hist.).
1944. *Permia* Hudson, Journ. Paleont., vol. 18, No. 4, p. 359.

Diagnosis.—*Trochophyllum* with a nontabulate axial tube, two orders of septa, the cardinal fossula weakly or strongly developed and lying on the convex side of the coral when the coral is curved, outer tabulae in the loculi, septal grooves usually present, and the axial tube thickened with stereoplasm.

Original diagnosis.—"Solitary corals having slightly curved cups in the shape of a small horn, of fairly large size.[5] Columella occupying a space in the central part of the cup, of fairly large size, tubelike and hollow. Septa in two generations. The cardinal septum is shorter than the other septa of the first order and is inserted in a fossula. Other septa of that order reach the columella and they alternate with shorter septa of the second order." (Free translation of the Russian text.)

Genotype.—*Permia iwanowi* Stuckenberg, 1895, pp. 27, 187, pl. 3, figs. 6a-6g. The holotype and paratypes of *P. iwanowi* were designated by Hudson (1944, p. 359). For an English translation of Stuckenberg's description of the genotype, with corrections from the published figures, see Hudson (1944, pp. 359, 360).

Occurrence.—The genotype is from the Lower Carboniferous of the west slope of the Urals, on the Gubacha River round about the village of Gubacha (otherwise known as Ivanoff) in the Perm district.

Remarks.—Hudson (1944) referred the first new species to *Permia* since Stuckenberg's work. Included here are *Trochophyllum* (*Permia*) *iwanowi*, *Trochophyllum* (*P.*) *caverna* Hudson, and *Trochophyllum* (*P.*) *carbonaria* Hudson.

Subgenus not named

1932. *Laccophyllum* Gorsky, Trans. Geol. Prosp. Serv., U.S.S.R., fasc. 51, p. 6 [in part].

Diagnosis.—*Trochophyllum* with inner tabulae in the axial tube, septa of one order, outer tabulae present in the loculi, and the axial tube thickened by stereoplasm.

Remarks.—If *Trochophyllum turbinatum* (Gorsky) [=*Laccophyllum turbinatum* Gorsky] has just one order of septa, then it would belong in this subgenus. As it stands, Gorsky (1932, p. 68) says two

[5] The German text (p. 186) has an extra sentence at this point not contained in the Russian text; namely, "The calyx is circular."

septa "bifurcate at the periphery," but one cannot be sure if this signifies that two major septa or a major and a minor septum are involved in each case.

Family METRIOPHYLLIDAE

Genus **ROTIPHYLLUM** Hudson, 1942

Remarks.—For a diagnosis see Hudson, 1942, or Easton, 1944. The material under study shows well-developed alar pseudofossulae, hence the generic diagnosis should be changed from "alar fossulae indistinguishable from other loculi" (Hudson, 1942, p. 257) to alar fossulae either indistinguishable or present as pseudofossulae with each alar septum contratingent against the adjacent counter septum and occupying an extra wide loculus axially.

ROTIPHYLLUM OCCIDENTALE Easton, new species

Plate 1, figures 1-3

Description.—A mature specimen (the holotype, pl. 1, figs. 2, 3; diameters 6 mm. by 7 mm.) has 26 major septa alternating with an equal number of short minor septa. The columella is thin and tall. The cardinal septum extends across the fossula below the calyx floor, but retreats distally.

Another mature specimen (width of calyx 6 mm.) has 24 major septa plus alternating minor septa. The columella is narrowly elliptical. Traces of tabulae can be seen along the fractured edge of the specimen.

In a specimen in early maturity or late youth (pl. 1, fig. 1; diameter 4.5 mm. by 5 mm.) there are 24 major septa but no minor septa. The cardinal fossula is as in later stages, the counter septum extends farther distally than in later stages, and alar pseudofossulae can be distinguished as large, long loculi. The columella is narrowly elliptical.

Another specimen in late youth (diameters 4 mm. by 4 mm.) has 20 major septa, 4 of which have just been inserted. The columella is narrowly elliptical.

A paratype (U.S.C. 4066) in late maturity is 14 mm. long and has calical diameters of 8.8 mm. by 9.1 mm. The apical angle is 35°. Septal grooves are faint. The cardinal fossula is on the convex side of the corallite and is keyhole-shaped (axially swollen). The calyx slopes toward the counter side and apically at 35° and is 4 mm. deep. The short cardinal septum is bordered by 6 majors plus the alar septum in each quadrant, and the long counter septum is also bordered by 7 majors, the total being 30 major septa. Rudimentary to short minor septa alternate with the majors. Alar pseudofossulae are distinct. The columella at the axial end of the counter septum extends slightly into the cardinal fossula and stands up 2 mm. from the floor of the calyx.

Another paratype (U.S.C. 4063) is attached along its cardinal side to a brachiopod shell for a distance of about 10 mm.

The most advanced stage seen (U.S.C. 4066) has 35 major septa at a calical width of 10.3 mm.

Comparison.—*Rotiphyllum occidentale* differs from *R. hians* Easton, 1944, in having slightly more septa at comparable stages, a thinner columella above the calical floor, and a deeper and less flaring calyx. The two species resemble each other rather closely, however.

Occurrence.—Unit 3, 22 specimens; unit 2, 1 specimen; unit 1, 2 specimens; undifferentiated, 6 specimens.

Material.—Holotype, U.S.N.M. 127946; paratypes, U.S.N.M. 127947, U.S.C. 4066, and 4063; topotypes, U.S.N.M. 137146, and U.S.C. 4062 and 4064.

Remarks.—In summation, there is no evidence that minor septa are inserted until after all the major septa are present. The evenly expanding calyx, therefore, continues to maintain the apical angle (about 45°) by insertion of minor septa in late maturity. The stage of old age may be said to commence when the calyx ceases to expand and the spaces between major and minor septa become equal. The columella changes its cross section from narrowly elliptical in early stages to thin and bladelike in late stages.

ROTIPHYLLUM VESICULOSUM Easton, new species

Plate 1, figure 25

Description.—*Rotiphyllum* resembling *R. occidentale* but having dissepiments.

The holotype, U.S.C. 4067, is a fragment 20 mm. long with a circular calyx 11 mm. in diameter. The prominent cardinal fossula is on the convex side of the coral and is slightly swollen axially. The cardinal septum is very short in the calyx but extends across the floor of the cardinal fossula and runs up the side of the columella as a prominent ridge. The calyx contains 31 major septa, of which 8 (including the alar septa) are in each cardinal quadrant. The counter septum is not clearly distinguishable. The columella is prominent, being 1 mm. thick and 3 mm. wide and standing 3 mm. above the calical floor. Dissepiments are lacking in a narrow zone on the counter side, but occur in as many as five ranks on the cardinal side. Most are concentric, but several lonsdaleoid dissepiments clearly span two or three septa. Minor septa are sparse and only occur in the outer region of the thickest dissepimentarium. Tabulae are not discernible.

The paratype, U.S.C. 4068, is 9 mm. in diameter at the calyx and has 31 rather radially arranged major septa. The cardinal septum is as in the holotype, but the counter septum is attached to the prominent columella in typical lophophyllid fashion. One rank of concentric dissepiments occurs in the right cardinal quadrant. Minor septa occur between all majors and traverse the dissepiment. Tabulae arch up steeply and then are depressed around the columella so that they make a horseshoe-shaped mound around the axial region.

Comparison.—*R. vesiculosum* resembles *R. occidentale* Easton in all features except that the former species possesses dissepiments. In this same respect it differs from all other *Rotiphyllum.*

Occurrence.—Unit 3, 2 specimens.

Material.—Holotype, U.S.C. 4067; paratype, U.S.C. 4068.

Remarks.—The presence of tabulae would ordinarily be sufficient to separate this species from *Rotiphyllum,* yet the two specimens at hand seem clearly to be merely extreme variations of *R. occidentale* with which they occur. If a population is discovered in which the specimens are consistently dissepimented, then a new genus should be made for them. At present this procedure is unwarranted, particularly in view of the known tendency of zaphrenthid corals to develop a trend toward dissepiments.

Family HAPSIPHYLLIDAE

Genus TRIPLOPHYLLITES Easton, 1944

Subgenus HOMALOPHYLLITES Easton, 1944, emended 1951

HOMALOPHYLLITES REVERSUS species group, Easton, 1951

TRIPLOPHYLLITES (HOMALOPHYLLITES) CIRCULARIS Easton, new species

Plate 1, figures 4, 7-9

Externals.—Small to medium-sized, curved, ceratoid, measuring up to 22 mm. in length but averaging 10 mm. to 15 mm. Apical angle 25° to 30°. Theca with rugae and striae but rarely with septal grooves. Two paratypes, U.S.N.M. 127945e, have girdlelike epithecal indentations or constrictions.

Calyces.—Calyx of holotype (diameters 7 mm. by 7 mm.) in late maturity has 31 major septa, all but 5 of which terminate around an axially enlarged cardinal fossula, forming a solid fossular wall. The cardinal septum is even shorter than either of the adjacent short major septa in the fossula. Minor septa extend one-fourth of the radius and alternate with the major septa, except at the alar and cardinal positions. Minor septa are absent adjacent to the last-formed septum in each counter quadrant. These latter septa resemble minor septa but are longer and are fused with the next adjacent counter septa. Alar pseudofossulae are poorly differentiated, the loculi being no wider than other loculi, but the last-formed counter septa extend less far distally than other majors and hence lie in depressions. The two short septa in the cardinal fossula bordering the cardinal septum are short major septa instead of minor septa. Minor septa are not present on either side of these last-formed major septa in the cardinal quadrants. The cardinal and counter quadrants contain 15 and 16 major septa and 10 and 13 minor septa respectively.

In a paratype, U.S.N.M. 127945a (diameters 6.5 mm. by 6.5 mm.) in late maturity there are 30 major septa distributed essentially as in the holotype. Minor septa are distributed in identical fashion as in the holotype. This specimen is slightly more mature than the holotype and thereby affords an opportunity to determine the order of septal insertion in a late stage. There are 5 major septa in the cardinal fossula; 2 are very short and are present near the periphery of the calyx; 2 are long down in the fossula and eventually would have become longer to add their substance to the fossular wall (as in the holotype).

In a paratype, U.S.N.M. 127945d (diameters 4 mm. by 4 mm.) in middle maturity, there are 24 major septa of which 11 are in the cardinal quadrants. Alar septa do not quite reach the fossular wall and are a little depressed beneath the floor of the calyx; this rudimentary fossula, combined with the usual development of alar pseudofossulae makes a distinctive break in symmetry at the alar positions. The cardinal fossula is slightly swollen axially. Minor septa are very short.

In a paratype, U.S.N.M. 127945c (diameters 3 mm. by 3 mm.) in early maturity, there are 22 major septa, of which 11 are in the cardinal quadrants. Only 19 have been inserted at the level of the calyx floor, however, and the specimen therefore represents a stage somewhat earlier than in U.S.N.M. 127945d. The cardinal fossula is as before; alar position is less well marked than before; the counter septum is bordered by extra wide loculi.

In a paratype, U.S.N.M. 127945b (diameters 2 mm. by 2 mm.)

there are 18 major septa with rudimentary minor septa present at a few places. The cardinal septum is long and extends completely across the large cardinal fossula. Each of the major septa adjacent to the cardinal septum resembles the minor septa. There are 9 major septa on the cardinal side and 9 on the counter side.

Tabulae observed among U.S.N.M. 127945f are steeply convex distally. They are not commonly discernible in calyces and are generally incomplete or at least not present at the same level in all loculi.

Early stages.—The earliest stage observed (diameter about 0.8 mm.), in U.S.N.M. 127945d, has 8 septa. The cardinal quadrants contain 3 and the counter quadrants contain 5 septa. Minor septa are not present.

Comparison.—*T.* (*H.*) *circularis* differs from *T.* (*H.*) *calceolus* (White and Whitfield) in being circular in cross section instead of being flattened on the convex side, and in having longer minor septa. It differs from *T.* (*H.*) *subcrassus* Easton and Gutschick, 1953, in having a thinner theca and fewer septa.

Occurrence.—Unit 3, 26 specimens; unit 2, 8 specimens; unit 1, 2 specimens; undifferentiated, 93 specimens.

Material.—Holotype, U.S.N.M. 127944; figured paratypes, U.S.-N.M. 127945a, b; unfigured paratypes, U.S.N.M. 127945c-g; topotypes, U.S.N.M. 127945, U.S.C. 4069 and 4070.

Remarks.—*T.* (*H.*) *calceolus* becomes increasingly flattened distally. *T.* (*H.*) *circularis,* on the other hand, is evenly circular in cross sections throughout. If there is any phylogenetic significance to the progressive flattening of *T.* (*H.*) *calceolus,* then it would seem that it evolved from an unflattened ancestor. Inasmuch as the two species named above are quite similar in other respects, it is not impossible that *T.* (*H.*) *calceolus* evolved from *T.* (*H.*) *circularis.*

The only other variable character is the length of the minor septa, which are longer in *T.* (*H.*) *circularis* than in the other species. Amplexoid retreat of the major septa is a significant feature of many corals, but it is not known whether a phylogenetic interpretation can be applied to shortening of minor septa. If the two orders of septa behave similarly, then there is substantiating evidence for the possible ancestry of *T.* (*H.*) *calceolus* in *T.* (*H.*) *circularis.*

Further indication of the close relationship between *T.* (*H.*) *circularis and T.* (*H.*) *calceolus* is seen in the presence of epithecal constrictions, which are rare in the former but common in the latter species.

TRIPLOPHYLLITES (HOMALOPHYLLITES) species

Plate 2, figure 7

?1951. *Triplophyllites* (*Homalophyllites*) sp. EASTON, Journ. Paleont., vol. 25, No. 3, p. 399, pl. 61, figs. 8a-8c. Escabrosa limestone, Arizona.

Externals.—Simple, curved, ceratoid coral with the cardinal fossula on the convex side. The cardinal septum is very short and lies in a slightly axially swollen cardinal fossula. In a calyx 16 mm. by 14. mm, 35 radially arranged major septa traverse two-thirds of the radius as vertical plates and then extend across the tabulae as low ridges twisted loosely counterclockwise at the axis. Minor septa are absent or are represented by septal ridges. Tabulae axially depressed. No dissepiments.

Occurrence.—Unit 3, 1 specimen.

Material.—U.S.C. 4170.

Remarks.—This specimen seems to be a little more mature or at least has more and longer septa than does the specimen from Arizona cited above.

TRIPLOPHYLLITES species

Among the few fragments seen, one measuring 8 mm. in diameter has about 30 septa which extend about three-fourths of the radius and are free axially. At a diameter of 13 mm. there are about 45 to 50 major septa, minor septa are lacking, and there is a prominent key-hole-shaped inner wall in conjunction with the cardinal fossula.

Occurrence.—North end of low hill 2 miles west of Bisani, Mexico. This is about 0.5 mile west of the major locality at the lime kilns; 3 specimens.

Material.—U.S.C. 4231.

Remarks.—This sort of coral is common in late Paleozoic rocks.

Genus NEOZAPHRENTIS Grove, 1935

NEOZAPHRENTIS TENELLA (Miller), 1891, emend. Easton, 1944

Plate 2, figure 5

1944. *Neozaphrentis tenella* EASTON, Illinois Geol. Surv., Rep. Inv. 97, p. 45, pl. 4, figs. 1-3; pl. 16, figs. 26-30 (contains prior synonymy).

Externals.—Curved, ceratoid, simple corals with an apical angle of 20°-30° and a circular cross section. Theca with growth lines and occasional concentric ridges and depressions, but septal grooves are not discernible. Specimens range up to 25 mm. in length. The cardinal fossula is on the concave side of the corallite.

In early neanic stage a calyx 3.3 mm. in diameter contains a short cardinal septum in a V-shaped cardinal fossula; the right cardinal quadrant contains two pinnate majors; the right and left counter quadrants each contain four majors; the counter septum extends slightly into the cardinal fossula; the left cardinal quadrant contains three pinnate majors. Alar pseudofossulae narrow. Trace of a distally convex tabula is visible, but dissepiments and minor septa are absent.

In midephebic stage a calyx at 6.5 mm. width contains a very short cardinal septum and four and five strikingly pinnate majors in the right and left cardinal quadrants, respectively. Each counter quadrant contains seven radially arranged majors. The slightly axially swollen counter septum extends a little past the axis and into the parallel-sided cardinal fossula. Alar pseudofossulae distinct, but dissepiments and minor septa are absent.

In late ephebic stage at a width of 9.0 mm. the cardinal septum extends about one-third of the length of the V-shaped cardinal fossula. Each cardinal quadrant contains five radially arranged major septa and each counter quadrant contains six major septa. The axially swollen counter septum stands higher than the other majors in the calyx and extends to the axis where it occupies an open space formed by the union of the narrow alar pseudofossulae with the cardinal fossula. Minor septa occur as ridges in most loculi. Tabulae slope steeply away from the axial region, particularly steeply into the cardinal fossula. Dissepiments absent.

Occurrence.—Unit 3, 7 specimens.

Material.—Figured hypotype, U.S.C. 4165; unfigured hypotypes U.S.C. 4166 and 4167; other material, U.S.C. 4168.

Remarks.—*Neozaphrentis tenella* is characterized by the long counter septum and by rudimentary or absent dissepiments. *N. tenella* passes through a stage in which the septa of the cardinal quadrants are notably pinnate.

Mature *N. tenella* from the midwest usually contain from 25 to 27 major speta, although as many as 34 major septa have been observed. The material at hand is only known to have up to 24 major septa. This difference is too slight to warrant separation from the well-known midwestern species.

Family CANINIIDAE

Genus CANINIA Michelin in Gervais, 1840

CANINIA CORNICULUM (Miller) emend. Easton

Plate 1, figures 5, 6

1944. *Caninia corniculum* (Miller), emend. EASTON, Illinois Geol. Surv., Rep. Inv. 97, p. 49; pl. 12, figs. 1-3; pl. 16, figs. 40-42. (This reference contains prior synonymy.)

Externals.—The specimens at hand illustrate very well the variable nature of this species. Corals range from short, widely flaring examples with an apical angle of 40° through the normal or at least more frequent examples with apical angles of 10° to 15°, and finally into specimens which are subcylindrical. Thecas only rarely show traces of septal grooves, most exteriors being striate, rugose, and contorted all together.

Calyces.—Calyces are moderately deep, with tabulate floors usually horizontal, but also inclined at greater or less angles. Septa are frequently rather sinuous, continue to be inserted during calical growth, and may or may not meet the theca. When dissepiments are observed, two kinds occur—in early maturity broad isolated patches consisting of one large vesicle may be seen; in late maturity the patches become more general and finally overlap to form a lonsdaleoid dissepimentarium three or four vesicles deep in late stages.

In late maturity (diameters 12 mm. by 11.5 mm.) one specimen, U.S.N.M. 127948, has 33 long major septa extending two-thirds of the radius. The cardinal septum is short and in a very deep fossula where the tabulae are steeply invaginated. The counter septum is longer than the other majors. Minor septa short or rudimentary to absent and not present on the surfaces of the innermost dissepiments, although weakly developed on the outer dissepiments and the theca. Dissepiments present in one to three ranks. This specimen is trochoid and 1.5 cm. long (incomplete).

At a slightly later stage, U.S.N.M. 127956a, there are about the same number of septa, but the dissepimentarium has five or six rows of vessicles and minor septa are present on the surface of the innermost row. This specimen is subcylindrical and 4 cm. long (incomplete).

In early maturity a specimen, U.S.N.M. 127956c (diameters 5 mm. by 8.5 mm.) has 25 major septa, 5 of which meet axially. This specimen is elongate in one diameter because of modifications for attachment; a rather carinate ridge extends along this side. A dissepiment is present at one place and minor septa are present on the theca at that place.

The most advanced stage observed, U.S.N.M. 127956e (diameters 13 mm. by 14 mm.) has 36 major septa. Minor septa and dissepiments are both less well developed than in earlier stages.

Two cylindrical examples, U.S.N.M. 127956f, g (about 10 mm. in diameter) have 22 major septa, with a few minors and no dissepiments observed.

The broken apex of one specimen shows six or eight septa meeting at the axis.

Tabulae.—Tabulae in U.S.N.M. 127956b are about 1 mm. apart or there may be six in 5 mm. They are flat axially and strongly recurved peripherally, being invaginated one inside the next.

Occurrence.—Unit 3, 3 specimens; unit 2, 3 specimens; unit 1, 1 specimen; undifferentiated, 27 specimens.

Material.—Hypotypes, U.S.N.M. 127948 and 127956a-g; other material U.S.N.M. 127956, U.S.C. 4071, 4078, 4079.

Remarks.—*Caninia corniculum* is highly variable, but can be recognized as occurring in two intergrading phases. One of these is the flaring type which will show minor septa and dissepiments in rows in late stages. The other is the cylindrical phase (Easton, 1944, p. 50) which is characterized by amplexoid retreat of the major septa and with few minor septa and sparse dissepiments. Although not always discernible, the slightly sinuous major septa and geniculate habit of growth aid in determinations. If dissepiments and minor septa are not observed, the species converges upon *Amplexus* of authors and cannot be certainly identified without sections. That it is referable to *Caninia* is borne out not only in the morphology of mature calyces, but also in the axial meeting of septa in young stages.

It is not known what significances should be attached to the two extremes of variation. Individuals may be different enough to be termed separate species, but when a suite is available there is no apparent line of demarcation between variations.

CANINIA species

Plate 1, figure 10

Externals.—Slightly contorted ceratoid coral with an apical angle of 35°. The epitheca is nearly smooth, there being only faint encircling irregularities.

Calyx depth not known. At a diameter of 2 cm. there are about 40 septa of equal length, extending two-thirds of the radius. Calyx floor smooth and flat. Dissepiments occupying about one-half the radius. The outer row or two of dissepiments are lonsdaleoid; the inner rows are concentric.

A rough longitudinal section is observable where etching has destroyed a side of the coral. Tabulae are horizontal or very slightly sagging axially, but are strongly recurved near their peripheries. Dissepiments very steeply inclined.

Occurrence.—Unit 2, 3 specimens; unit 3, 1 specimen; undifferentiated, 2 specimens.

Material.—U.S.N.M. 127953, 127961; U.S.C. 4163, 4164.

Genus CANINOPHYLLUM Lewis, 1929

Remarks.—*Vesiculophyllum* Easton, 1944, was erected for caninioid corals which differ from *Caninophyllum* chiefly in having the dissepimentarium well developed only in late stages. As presently interpreted by the writer, this would be of subgeneric rank; therefore, *Vesiculophyllum* is now considered by the writer to be a subgenus of *Caninophyllum.*

CANINOPHYLLUM SONORENSE Easton, new species

Plate 2, figures 1-4

Description.—These are large solitary corals, curved ceratoid to nearly cylindrical, commonly about 10 cm. long and 3 cm. in diameter at the calyx. Calyces are deep, with four bundles of septa, corresponding to the four quadrants, descending steeply to almost touch pinnately at the axis. Specimens are commonly decorticated, but the theca, where observed, is thin and is only fairly ridged longitudinally.

In transverse section at maturity, diameters 25 mm. by 25 mm., the holotype (pl. 2, fig. 3) has 47 long major septa which are grouped into four distinct pinnate bundles. The right and left cardinal quadrants contain eight and nine major septa, respectively, and the cardinal septum is longer and thinner than the adjacent majors. Septa of the cardinal quadrants are more dilated than are septa of the counter quadrants. The counter side has about three ranks of concentric dissepiments between major and minor septa, and has a narrow peripheral zone of lonsdaleoid dissepiments. Minor septa extend across the dissepimentarium. Major septa are not dilated in the dissepimentarium.

In early maturity, diameters 15 mm. by 15 mm., the holotype (pl. 2, fig. 2) has 36 almost equally dilated septa, of which the cardinal is short. The cardinal quadrants contain six or seven major septa. Only one or two very short minor septa are discernible, and dissepiments are absent.

In a paratype about 30 mm. in diameter the long cardinal septum in the base of the narrow cardinal fossula retreats upward as the fossula progressively invades the dissepimentarium. Cardinal quadrants contain 9 and 10 long major septa which are grouped pinnately against the cardinal fossula and the alar septa. The counter quadrants, including the counter septum, contain 26 major septa which are grouped in pinnate bundles which almost reach the axis. The dissepimentarium extends one-half to two-thirds of the radius in some places. Minor septa barely reach the inner edge of the dissepimentarium.

Another paratype at a diameter of about 25 mm. has about 50 major septa in pinnate groups. It has lonsdaleoid dissepiments in the margin of a dissepimentarium which extends about half of the radius.

In longitudinal section the tabulae occur irregularly about 10 in 2 cm., are commonly incomplete, and may be slightly concave, or slightly convex. Dissepiments are quite elongate and nearly vertical, being about 4 or more times as long as wide.

In transverse section dissepiments usually appear concentric but a few angulo-concentric instances are present. Lonsdaleoid dissepiments are uncommon but are present.

Comparison.—This species differs from *C. incrassatum* Easton and Gutschick, 1953, in having only rudimentary minor septa even into late maturity and in having concentric dissepiments instead of herringbone dissepiments. The dissepimentarium of *C. sonorense* is generally narrower than than of *C. incrassatum.*

C. sonorense differs from *Caninophyllum sedaliense* (White), 1880, in having a much narrower dissepimentarium, longer and more quadripartite groups of major septa, and shorter minor septa.

Occurrence.—Unit 1, 35 specimens. North end of small hill 2 miles west of Bisani, Mexico, 1 specimen.

Material.—Holotype, U.S.C. 4225; paratypes, U.S.C. 4179, 4224, 4226, 4229; topotypes, U.S.C. 4171, 4172, 4222, 4227, 4228, and U.S.N.M. 127959.

Family CLISIOPHYLLIDAE

Genus KONINCKOPHYLLUM Thomson and Nicholson, 1876

KONINCKOPHYLLUM species

Plate 2, figure 6

Externals.—Simple, curved, ceratoid corals with an apical angle of about 30°. Cardinal fossula on the convex side of the corallite. Theca with concentric striae and irregularly placed constrictions, and faint septal grooves. The figured specimen is 22 mm. long and is circular in cross section.

A calyx at a diameter of 13.0 mm. is 6 mm. deep but has a very large, broad, conical boss in the axial region which stands 3 mm. above the calical floor. Calical walls are essentially vertical. The cardinal septum is a ridge in the slightly swollen cardinal fossula. Each cardinal quadrant contains 10 major septa and the counter quadrants together with the indistinguishable counter septum contain a total of 23 major septa. Dissepimentarium narrow (1 or 2 mm. wide) and traversed by the cardinal fossula and by the thin minor septa which stop at the axial or inner end of the dissepimentarium. Dissepiments seemingly concentric. Axial structure seemingly consists of tentlike tabulae and minor septa fused to an axial rod, and all reinforced by extensive stereoplasm. Locally septa may merely lie upon upper surfaces of tabulae. Lamellae and tabellae absent.

Silicification has obscured details on the one cut surface prepared.

Occurrence.—Unit 1, 2 specimens.

Material.—U.S.C. 4169.

Remarks.—Lower Carboniferous strata elsewhere often abound in clisiophyllid corals, but the writer has not discovered in the United States a species closely resembling this one from Sonora. It has longer, tapering majors, more tentlike tabulae, and narrower dissepimentarium than has typical *Koninckophyllum. Koninckophyllum glabrum* (Keyes) from the Chouteau limestone of Missouri, lacks the long major septa and very conical tabulae. The two specimens at hand may even be juveniles.

Family LITHOSTROTIONTIDAE

Genus **LITHOSTROTIONELLA** Yabe and Hayasaka, 1915

1915. *Lithostrotionella* Yabe and Hayasaka, Journ. Geol. Soc. Tokyo, vol. 22, p. 94.

Lithostrotion of authors [especially in North American literature].

LITHOSTROTIONELLA CONFLUENS Easton, new species

Plate 1, figure 12; plate 2, figures 8, 9

Externals.—Coralla irregularly spherical, the largest specimen at hand measuring over 14 cm. in greatest diameter, but still incomplete. Corallites in a small corallum with well-preserved externals vary from polygonal cross sections in the center of the corallum to circular cross section where several individuals extend above the general surface level. Epitheca coarsely wrinkled. Corallites contorted where they are in border positions in the colony.

Corallites nearly cylindrical except near the calyces, where they flare broadly. Calyces shallow peripherally and bounded by a thin theca separating adjacent polygonal individuals. Axial portions of corallites moderately deep, with a thin bladelike columellar plate extending above the deepest part of the calical floor but not reaching the level of the peripheral floor. Calyces about 1 cm. in diameter on the average. Septal traces on the calyx floor become increasingly prominent axially.

Transverse sections.—A mature calyx of the holotype (diameters 9 mm. by 15 mm.) has 24 major septa alternating with minor septa. Within the tabularium the major septa are slightly thickened and tend to fuse with the axial complex. One major septum is longer than the others and may fuse with another major opposite it to form a continuous median septum, but in any case the long septum is much thickened by stereoplasm to form the narrowly elliptical axial plate.

The dissepimentarium is broad, occupying one-fourth to one-third of the diameter of the calyx. Its outer portion is typically lonsdaleoid, some of the larger vesicles occupying the space between three or four septa. The inner portion of the dissepimentarium consists of nearly concentric dissepiments spaced somewhat more closely than in the outer region. The major portion of the dissepimentarium is thickened with stereoplasm to approach the character of an inner wall. Where lonsdaleoid dissepiments are absent and the rows can be counted, there are from 8 to 12 rows of dissepiments, with an average of about 10. Although as many as 24 major septa may be present, the calyces most often have about 20 major septa. Major and minor septa are equally thin and somewhat sinuous in the dissepimentarium, neither order touching the epitheca except locally. Only the very tips of the minor septa extend into the tabularium from the dissepimentarium.

Tabellae occur in the axial region. Some loculi lack tabellae and others may have up to eight rows. Some tabellae are straight, some concave axially, and others convex axially, but they are roughly concentric.

If tabulae are present, they cannot be distinguished from the dissepiments and tabellae.

Longitudinal section.—A section of the holotype shows a band of axially convex elongate dissepiments sloping proximally at an angle of about 45° near the epitheca but becoming smaller and vertical axially. In a transverse line there are usually about seven rows of dissepiments. Each corallite has its own epitheca, separated from the adjacent epitheca by a dark line.

In the tabularium is the solid area of the axial plate, from which large tabellae slope proximally at a very low angle and then slope steeply at their outer edges. Some tabellae even have a sag in them before turning down abruptly and another sag where their extreme outer edges curved distally a short distance. The outer sag corresponds in position to the very rare, short, distally concave tabulae.

Comparison.—This species is characterized externally by the broadly flaring distal portions of the calyces and the depressed calyx floor in the axial region. Internally it is characterized by the similar major and minor septa in the dissepimentarium, the irregular pattern of the lonsdaleoid dissepiments, the slightly thickened axial portions of the major septa, the tendency of major septa to touch the column, and the stereoplasmic thickening of structures to resemble an inner wall.

Lithostrotionella confluens differs from *L. castelnaui* Hayasaka, which it resembles somewhat, in having stronger minor septa, longer major septa, a thicker columellar plate, and less steeply dipping tabellae than has the latter species.

Occurrence.—Unit 3, 4 specimens in collection, numerous left on outcrop; unit 1, 1 specimen; undifferentiated, 9 specimens.

Material.—Holotype, U.S.N.M. 127939; paratype, U.S.N.M. 127938; topotypes, U.S.N.M. 127960; U.S.C. 4071 and 4072.

Remarks.—It is possible that the axial structures referred to as tabellae here are really tabulae. A few more or less horizontal elements with a proximal sag were observed locally between the dissepiments and the tabellae; the writer refers to the inner elements as tabellae and the rare periaxial series as tabulae.

Family uncertain

Genus CYSTELASMA Miller, 1891

Stumm (1948, pp. 68, 69) has recently reviewed the genus and has redescribed several species.

CYSTELASMA INVAGINATUM Easton, new species

Plate 1, figures 11, 20, 24

Externals.—Small, curved, ceratoid to cylindrical, and contorted, from 1 cm. to 3 cm. long, and with the calyx from 6 mm. to 8 mm. in diameter. Theca thin. Interseptal ridges faint to absent. Irregularly spaced rugae occur. Prominent constrictions indicate rejuvenescence, and a coral may be contorted (geniculate) at one or more of the constrictions. Apical angle about 35° when coral is regularly flared. Two of the high geniculate paratypes have strong spinelike processes indicating the side of attachment along recumbent individuals.

Calyces.—Calyces opening at a right angle to the axis, extremely deep, usually without tabulae on their floors. Septa thin and marginally retracted distally; slightly swollen proximally and at the bottom of the calyx. Secondary septa not observed.

In a paratype, U.S.N.M. 127942 (diameters 4.5 mm. by 6 mm.), the calyx of which illustrates the early ephebic stage, there are 19 septa about half of which nearly touch axially. The counter septum is longest and most prominent, being slightly thicker and persistently longer than the other septa in the distal portions of the calyx. It occupies the counter fossula formed by somewhat wider spacing between it and each adjacent septum. The latter two septa curve away from the counter septum proximally. The cardinal septum is somewhat swollen but is almost the shortest septum. It occupies the faintly differentiated cardinal fossula formed by the curving away laterally of each adjacent septum. The short right alar septum occupies a true fossula of weak expression, whereas the short left alar septum is fused to the adjacent strong septum on its cardinal side and is bordered on the counter side by an alar pseudofossula. Altogether, seven of the septa are long, including the counter septum, one septum on the cardinal side of each alar septum, and the second and third septa on both sides of the counter septum. The distal edge of a tabula lies deep in the counter fossula but cannot be seen elsewhere.

In the holotype (diameters 7 mm. by 8 mm.), whose calyx illustrates the very late ephebic or the gerontic stage, there are 21 septa. Four tabulae are present in the calyx, inclined cardinally at about 45° to the axis, except where they are abruptly depressed into the nearly vertically walled cardinal fossula. The short cardinal septum crosses the cardinal fossula. Most of the other septa extend out onto the distal surfaces of the tabulae about one-half the radius but retreat in a short distance to their normal length of less than one-quarter the radius.

Internal structure.—Where the theca of the holotype is broken away, internal structure can be seen. Tabulae are complete and are inclined steeply. They are quite irregularly spaced, from less than 1 mm. to more than 2 mm. apart. Notable features are their crowding at geniculations and their approximately parallel arrangement. This latter feature transgresses other structure so that the tabulae are steeply inclined proximally and may be nearly vertical or at a low angle in other portions of the coral, depending upon the directions in which the coral chanced to grow.

In the proximal portion of the holotype is a stage similar to that in the figured calyx of the paratype. Eighteen septa are present, arranged as in the paratype. Fossulae are discernible in the cardinal, counter, and right alar positions.

The apex of the paratype (diameter about 1.5 mm.) has six septa and a tabula.

Comparison.—Cystelasma invaginatum resembles *C. septatum* Greene, 1901, more closely than it resembles other American species, particularly in the prominence of the metasepta (rather than having majors other than protosepta represented by ridges on the interior of the calyx). *C. invaginatum* differs from *C. septatum* and from all other species of the genus, however, in having the tabulae inclined steeply proximally, instead of having them horizontal.

Occurrence.—Unit 3, 1 specimen, possibly 2 others; unit 1, 1 specimen; undifferentiated, 15 specimens.

Material.—Holotype, U.S.N.M. 127941; paratype, U.S.N.M. 127942; topotypes, U.S.N.M. 127958, U.S.C. 4065, 4270.

Remarks.—Cystelasma invaginatum may be confused with *Amplexus* or with amplexoid phases of other genera, notably *Caninia.* Convergence of this nature has led authors to make *Amplexus* the catchall that it has been. *C. invaginatum* is readily distinguished from *Amplexus* by the steeply sloping tabulae and by the swollen septa.

C. invaginatum possesses morphologic features of a low order of specialization, yet related to the other species of the genus. It is apparent from the geniculate form that *C. invaginatum* could change its direction of growth one or more times. Presumably the impelling cause would be either an effort to achieve better position with regard to current and food while standing erect on the sea floor, or to right itself after having become recumbent through some accident. There is no indication on the apical portions of the corals examined that the species was attached to any solid foreign object; hence, it must be assumed that *C. invaginatum* grew from the sea floor directly. This assumption tends to be substantiated by the fact that the apical portions of some specimens show a cylindrical phase in early maturity, followed by rapid flaring of the individuals; these phenomena can be interpreted as an initial effort to increase the speed of elongation in order to get above the ocean floor, followed by normal flaring of the skeleton when favorable conditions of growth were attained. Identical changes in shape are known for other rugose corals, although the writer is not aware of previous attempts to explain the changes. In *C. invaginatum* the animal did not increase in diameter after maturity, but did continue to build up its skeleton to form the cylindrical phase of late maturity. It is quite possible that the organism fell over because its considerable length and weight proved to be too much of a strain for its feeble method of fixation to the substratum. In this case the recumbent animal would grow in a new direction in order to get above the zone of moving sediment and into a more favorable environment. The foregoing explanation is difficult of absolute proof, but at least utilizes ecologic considerations in explaining the morphology of one geniculate coral species. Better evidence than the foregoing has been marshaled (Easton, 1945, p. 628) for *Amplexus adnatus,* in which spines of attachment bear a definite relationship to geniculations.

In terms of evolutionary development, *C. invaginatum* is more primitive than *C. lanesvillense, C. septatum,* and *C. tabulatum* (all from the Salem limestone of Meramec age) in one or more of the following features. Ridgelike metasepta in most *Cystelasma* must be from an earlier septate condition, such as exists in *C. invaginatum* and to a lesser degree in *C. septatum.* Dissepiments in many strains of corals progressively occur higher and higher in corallites as evolution progresses, hence *C. invaginatum* with dissepiments in early stages is more primitive in this character than are species like *C. lanesvillensis* and *C. septatum.* The thin theca with faint septal grooves sometimes present, is more primitive than the very thick, nongrooved thecae of the higher species. These evolutionary features indicate that *C. invaginatum* occurs in strata older than the Salem limestone.

Order Tabulata

Family FAVOSITIDAE

Genus **PLEURODICTYUM** Goldfuss, 1829

1829. *Pleurodictyum* Goldfuss, Petrefacta Germaniae, vol. 1, p. 113.

Michelinia of authors.

Remarks.—Paleontologists are not even in approximate agreement as to the taxonomic status of *Pleurodictyum.* Several schools of thought exist with diverse interpretations of *Pleurodictyum, Michelinia,* and related genera or subgenera. As previously utilized (Easton, 1943, p. 136; 1944, p. 55), the writer retains *Pleurodictyum* for *Michelinia* of authors.

PLEURODICTYUM SUBRAMOSUM Easton, new species

Plate 1, figures 15, 16

Description.—Pleurodictyum with nearly ramose cylindrical corallites arising from a massive region of polygonal or subcylindrical corallites. Epitheca with numerous fine encircling wrinkles.

Mature calyces 7 mm. or 8 mm. in diameter and up to 5 mm. deep. More or less complete tabulae irregularly spaced but usually notably depressed at one place. Calyx walls may be free and lined with obscure septal traces or spines, or may be covered with vesicular tabulae.

Where two corallites are in contact, irregularly spaced, large, generally oval mural pores are present. When mural pores are roughly in line, five occur in 3 mm.

Comparison.—Pleurodictyum subramosum differs from *P. expansum* (White) in changing from massive to ramose habit, in having septal spines, and in having funnel-like calycal floors. Its growth habit is sufficient to distinguish it from other species of *Pleurodictyum* known to the writer.

Occurrence.—Undifferentiated, 4 specimens.

Material.—Holotype, U.S.N.M. 127940; paratypes, U.S.N.M. 127943.

Remarks.—Under recent tendencies in the systematics of the tabulate corals, the growth habit of this species would be of sufficient importance for the erection of a new genus. In view of the fact that the best specimen is incomplete proximally, the writer prefers to propose the species as a readily recognizable *Pleurodictyum.*

Family SYRINGOPORIDAE

Genus SYRINGOPORA Goldfuss, 1826

1826. *Syringopora* Goldfuss, Petrefacta Germaniae, vol. 1, p. 76.

Syringopora of authors.

Remarks.—Although several syringoporoid genera have been proposed, the writer is unable to assign specimens of the material under study to any of the genera as described. Under the circumstances, it is better to use the old genus *Syringopora* as generally understood and avoid possible further systematic complications. The material at hand approaches *Kueichowpora* but also has affinities with *Tetrapora.*

Remarks.—Among the detritus from acidization of the limestone is a large amount of fragmentary coralline material of doubtful affinities. Much of it is probably referable to *Syringopora,* but some may be *Cladochonus.* The fragments in question are recumbent series of budded tubes, with the individual corallites becoming erect. Other examples show a roughly syringoporoid alignment of corallites with irregularly placed connecting processes. Some corallites are hollow and others contain tabular structures, but the hollow ones may be the result of differential silicification which did not allow preservation of the tabulae. In any case, examples occur frequently which show traces of septal spines. It is probable that these fragments represent the ontogenetic change from recumbent to erect habit of growth in *Syringopora.*

SYRINGOPORA TUBIFERA Easton, new species

Plate 2, figure 10; text figure 3

Description.—Corallites subparallel, 1.5 mm. in diameter, and about 4 corallites occurring in 10 mm. Connecting processes prominent, in four rows. The processes in one plane are more consistently present than are those in the other plane; the former are 3 mm. to 4 mm. apart and are slightly arched; the latter may be locally as abundant as the former and may be located at the level of the former. Epitheca thin with faint encircling striae. In some instances open ends of corallites are lined internally with rows of very faint septal spines, there being about 30-34 in each corallite.

In transverse section the corallites are circular or nearly so. Small septal spines line the epitheca. Tabulae appear as concentric rings or ovals, varying in number from 2 to 4.

In longitudinal section the tabulae are sharply curved proximally and fuse at their inner ends to form a slender open tube located axially and occupying about one-fourth to one-fifth of the diameter. Tabulae are about 0.5 mm. apart at their proximal ends.

Occurrence.—Unit 1, 2 specimens; unit 2, 1 specimen; undifferentiated, 3 specimens.

Material.—Holotype, U.S.N.M. 127954; paratypes, U.S.N.M. 127955a, b; topotypes, U.S.C. 4073, 2 specimens; U.S.C. 4074, 1 specimen; fragmental topotypes, U.S.N.M. 127955.

Comparison.—This species differs from *Syringopora harveyi* White in having mural processes in four rows, much shorter septa (really septal spines), fewer and longer tabulae, and a nontabulate central tube.

SYRINGOPORA, new species A

Externals.—This species is *principally* characterized by its slender and closely packed corallites. The corallites are about 1.0 mm. in diameter and about six subparallel rows occur in 10 mm. Details of connecting processes and of external structure were not observed.

Occurrence.—Unit 3, 4 specimens; unit 1, 1 specimen.

Material.—U.S.C. 4075, 4 specimens; 4076, 1 specimen.

SYRINGOPORA, new species B

Externals.—A very closely constructed *Syringopora* observed in the field was not collectable. Its corallites are about 4 mm. in diameter.

Occurrence.—Unit 1, fragmentary specimen.

FIG. 3.—Transverse section of several corallites in a colony of *Syringopora tubifera* Easton, × 4, holotype, U.S.N.M. 127954.

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BRACHIOPODA AND PELECYPODA

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(Plates 3-7)

INTRODUCTION

All the brachiopods described herein, except one species as noted below, came from the small knob of Represo limestone located 1½ miles west-northwest of Bisani, in northwestern Sonora. Nearly all the specimens from this knob come from the middle cherty limestone of 14-feet thickness (Cooper and Arellano, 1946).

The collection of brachiopods is small and most of the specimens are fragmentary. This unfortunate condition was brought about by the necessity of dissolving them from limestone. These silicified specimens are generally very fragile and the rocks much fractured. Many of the specimens fell apart and could not be saved. Others had to be patched together. In spite of all these difficulties 21 genera and 25 species are described. A few of the specimens, although fragmentary, are exceptionally good, such as the *Reticularia cooperensis* which are the first good interiors to be figured for this genus.

The age of the Represo brachiopods is clearly Early Mississippian (Kinderhookian) but some species suggest an early Osagian age or Medial Mississippian age. *Cyrtospirifer latior* (Swallow), *Hustedia circularis* (Miller), and *Reticularia cooperensis* (Swallow) are characteristic Chouteau species, whereas *Crurithyris laevicula* (Rowley), *Cyrtina burlingtonensis* (Rowley), *Leptaena,* and *Dielasmoides,* although present in the lower Mississippian, range into the Osagian (Burlington).

Absence of productids is noteworthy but this may be due to incomplete or selective silicification. Productids are not abundant in the Chouteau fauna and their absence in this one may be due to a facies condition. Actually the outcrop from which these fossils were taken is very small and the specimens collected may not represent a good sample of the fauna.

Specimens of one species of brachiopod were taken from the Venada limestone in the small hill 1½ miles west of Bisani. These brachiopods belong to the genus *Perditocardinia* now known only from the Warsaw to Ste. Genevieve divisions of the Middle Mississippian and thus younger than the Represo fauna.

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M. H. Nitecki, Curator, Walker Museum, University of Chicago, kindly lent some of Stuart Weller's types, which were useful in settling certain systematic problems. My thanks also go to the Bursary Aid Program, Yale University, and M. F. Williams, for aid in making the plates, and to Mrs. M. B. Beach for typing the manuscript.

BRACHIOPODA

SYSTEMATICS

Suborder DALMANELLOIDEA Moore 1952

Family RHIPIDOMELLIDAE Schuchert 1913

Genus RHIPIDOMELLA Oehlert, 1890

RHIPIDOMELLA cf. R. MISSOURIENSIS (Swallow), 1860

Plate 3,A, figures 1-3

1860. *Orthis missouriensis* SWALLOW, Trans. St. Louis Acad. Sci., vol. 1, pp. 639-640.

1914. *Rhipidomella missouriensis* WELLER, Geol. Surv. Illinois, Monogr. 1, pp. 148-149, pl. 20, figs. 1-8.

Weller's subdivision of the Mississippian *Rhipidomella* is based chiefly on internal features, but to some extent on the exteriors. Three of the species he recognized, *R. missouriensis* (Swallow), *R. oweni* Hall and Clarke, and *R. burlingtonensis* (Hall), resemble each other very closely externally and require confirmation of interior details for accurate specific designation. The Represo collection contains only a single complete specimen and fragments of two others, none of which reveals internal characteristics. On the basis of size and shape the species appears closest to *R. missouriensis*.

Figured specimen.—U.S.N.M. 127910.

Genus PERDITOCARDINIA Schuchert and Cooper, 1931

PERDITOCARDINIA cf. P. DUBIA (Hall), 1857

Plate 3,B, figures 4-7

1857b. *Orthis dubia* HALL, Trans. Albany Inst., vol. 4, p. 12.

1914. *Rhipidomella dubia* WELLER, Geol. Surv. Illinois, Monogr. 1, pp. 160-161, pl. 83, figs. 9-10.

1932. *Rhipidomella* (*Perditocardinia*) *dubia,* Schuchert and Cooper, Mem. Peabody Mus. Nat. Hist., vol. 4, pt. 1, p. 135, pl. 19, figs. 12, 16-17, 20-22.

Examples of shells closely resembling Hall's species are present in this collection and come from the Venada limestone in the small hill 1½ miles west of Bisani. The beds containing *P. dubia* are younger than the Chouteau because Hall's species ranges from the Warsaw to the Ste. Genevieve horizons, so far as is presently known, and both of these overlie the Chouteau equivalents in the Mississippi Valley sections.

Figured specimens.—U.S.N.M. 127911a, b.

Family SCHIZOPHORIIDAE Schuchert and LeVene, 1929

Genus SCHIZOPHORIA King, 1850

SCHIZOPHORIA SULCATA Sanders, new species

Plate 3,C, figures 8-22

Exterior.—Shell transverse, a little wider than long, widest at mid-length; margins rounded; hinge line straight; cardinal margins obtuse to rounded; lateral profile biconvex, with dorsal valve having greater convexity; anterior commissure rectimarginate; front margin slightly emarginate; sulcus faint on both valves, more prominent on dorsal valve. Ventral interarea gently apsacline, gently curved; beak faintly curved; umbone small, pointed; dorsal interarea orthocline, gently curved; beak curved, umbone pointed. Surface multicostellate, some costellae hollow with holes leading to exterior. Shell finely punctate.

Ventral interior.—Delthyrial cavity deep; teeth stout, clublike, with posterior surface parallel to interarea and with small accessory sockets; crural fossettes oblique; dental plates located directly under teeth, but forming walls of delthyrial cavity and edge of delthyrium, continued forward as ridges bounding muscle field; muscle field bilobate, divided by narrow ridge whose base widens anteriorly to form raised, inverted V-shaped prominence; adductors small, borne on median ridge; diductor scars elongate, divergent, each pair separated by a faint low ridge. A large trunk of the pallial sinuses originates at the forward edge of the diductor impression.

Dorsal interior.—Notothyrial cavity wide, deep, bounded by divergent, slightly curved brachiophore supporting plates, which are continued anterolaterally as faint ridges bounding muscle field; brachiophores stout, slightly recurved over dental sockets, not separable from supporting plates; fulcral plates curved, attached to inner overhanging edge of palintrope; very faint denticle along free inner edge of palintrope, just lateral of sockets. Cardinal process prominent; shaft a narrow septumlike ridge; myophore bilobate, with muscle markings on posterolateral sides; accessory cardinal processes present on floor of notothyrial cavity between shaft and brachiophore supporting plates. Muscle area large, divided by faint, low median ridge. Pallial sinuses prominent, four originating near median line, two on each side of the median ridge and two more at anterior extremities of ridges separating adductors.

Types.—Holotype, U.S.N.M. 127915a; figured paratypes, U.S.N.M. 127915b-h; unfigured paratype, U.S.N.M. 127915.

Distinguishing characters.—The biconvex lateral profile of this species is very characteristic and somewhat unusual for *Schizophoria*. The species is further distinguished externally by the sulcus on each valve, especially by the prominent sulcus on the dorsal valve, a feature that inspired its name.

This species resembles *S. sedaliensis* Weller, 1914, but that species lacks a sulcus on the dorsal valve. *S. chouteauensis* Weller, 1914, is also biconvex, but seems to have a deeper ventral valve and lacks the dorsal sulcus. Unfortunately the interior details of Weller's species are not well known, so other possible differences that may exist between *S. sulcata* and the two species externally resembling it cannot be determined.

Remarks.—An interesting example of repair of a shell break made during the lifetime of the animal is shown near the anterior margin of the specimen figured on plate 3C, figure 17 (U.S.N.M. 127915e).

Suborder STROPHOMENOIDEA Maillieux 1932

Family LEPTAENIDAE Cooper, 1956

Genus LEPTAENA Dalman, 1828

Leptaena as here described follows the long usage expressed in Weller (1914) and elsewhere. The writer has made no attempt to trace the original usage and genotype to determine if his usage corresponds exactly to the original.

McCoy (1844, pp. 116-117) proposed *Leptagonia* based on *Producta analoga* Phillips, 1836, but McCoy's name has not been used because *P. analoga* Phillips has hitherto been regarded as a *Leptaena*. The interior of Phillips's species is unknown, so far as the writer is aware, but when known might provide a basis for generic distinction. *Leptaenella* Sarycheva and Sokolskaja, 1952, also based on *Producta analoga* Phillips, is a synonym of *Leptagonia* McCoy. Furthermore, the name *Leptaenella* is preoccupied by Fredericks (1917), for a genus based on *Leptaena rhomboidalis ventricosa* Hall, 1857a, *Leptaenella* Sarycheva and Sokolskaja is thus a homonym as well as a synonym and must be discarded.

LEPTAENA COOPERI Sanders, new species

Plate 4,A, figures 1-5

Most Mississippian leptaenas are referred to *L. analoga* (Phillips), 1836, a Lower Carboniferous species from England, but the internal morphology of Phillips's species is still undescribed. Rather than assign the present specimens to a widely used species whose interior is poorly known and where interiors are unavailable for comparison, the author erects a new species for these Mexican shells, based on their internal morphology. This new species appears to differ externally (and the few interior details that can be seen from the illustrations) from the shells Weller (1914) assigned to *L. analoga* (Phillips) and also from *L. convexa* Weller.

Exterior.—Shell transverse, twice as wide as long, widest at hinge line, flattened, planoconvex, with posterior portion of ventral valve gently convex, corresponding part of dorsal valve flat, sharply geniculate anteriorly, the point of geniculation on the dorsal valve being sharply angular in front and becoming more obtuse toward cardinal extremities. Cardinal extremities acute, pointed; front margin semielliptical, slightly emarginate; hinge straight; ventral interarea apsacline, narrow, gently concave; beak slightly curved; delthyrium closed at apex by a broad pseudodeltidium. Dorsal interarea anacline, nearly obsolete; beak only faintly pointed. Surface of both valves multicostellate, with much finer pattern of concentric lirae superposed on costellae; both of these modified by larger, irregular, rounded concentric corrugations.

Ventral interior.—Notothyrial cavity broad, deep, semicircular, forming great sunken pitlike area for muscle attachment, bounded posterolaterally by thickened valve margin supporting teeth, anteriorly by a curved elevated ridge, apex with triangular flattened area; teeth blunt, elongate, clublike, crenulated, with long axis directed laterally, with growth track forming crenulated area from beak along outer edge of delthyrium, bounded posteriorly by small accessory sockets which merge laterally into a small groove along inner edge of cardinal area and apparently extending to cardinal extremity. Muscle areas occupying pitlike notothyrial cavity, with posterior portion smooth, undivided; separated for most of extent by a wide, rounded ridge which bears elongate adductor impressions, with pointed median ridge located atop this broader rounded ridge. Diductor impressions not shown on shells examined. Remainder of interior of valve papillose, except for large pallial trunks at front of muscle field.

Dorsal interior.—Interarea separated from rest of valve by a faint ridge; notothyrium wide, low, filled by cardinal process; chilidium fused to posterior face of cardinal process, with median groove leading to beak over space between two lobes of cardinal process; bilobed cardinal process with diductor scars on vertical posterior face; dental grooves rounded, widely divergent, crenulated, bounded on both sides by ridgelike outer and inner socket plates, floored by posterior wall of valve; muscle area diamond-shaped, occupying about one-fifth of the area within elliptical visceral region, bounded posterolaterally by stout rounded ridges parallel to ridge made by inner socket plate, merging posteriorly with lobe of cardinal process, anterolaterally by edge of raised muscle platform, divided medianly by a Y-shaped ridge which culminates anteriorly in a pointed, raised knob and divides posteriorly to join bounding ridges which lead to cardinal process at about right angles; posterior adductor field a flattened area just anterior to this junction of ridges, with anterior adductors occupying deep elliptical pits on opposite sides of narrow median ridge just posterior to pointed anterior termination of median ridge; pallial trunks diverge widely from anterior adductor impressions; remainder of visceral area papillose.

Types.—Holotype, U.S.N.M. 127916a; figured paratypes, U.S.N.M. 127916b, c.

Remarks.—Demanet (1934, pl. 5, fig. 7) illustrated the interior of a species from Tournai, Belgium, referred to *Leptaena analoga* (Phillips), which closely resembles *L. cooperi.* These Mexican shells agree in general with the shells illustrated by Demanet, but appear to differ significantly in certain proportions. Large collections might invalidate these distinctions, but comparison of *Leptaena cooperi* with Demanet's *L. analoga* (Phillips) shows the Belgian specimens to be wider, with extended cardinal extremities, and with slightly less abrupt geniculation than in *L. cooperi.* Interiorly, the visceral area of the dorsal valve is slightly more than semielliptical, bisected by the straight hinge line in the Belgian specimens, with the muscle area distinctly raised and the median septum extending about two-thirds of the distance across the visceral area. In *L. cooperi,* on the other hand, the visceral area forms a nearly complete ellipse, slightly indented along the front edge, the muscle area is not so prominently raised, and the median septum extends to just the midpoint of the visceral area.

Family SCHUCHERTELLIDAE Stehli, 1954

Genus SCHUCHERTELLA Girty, 1904

Schuchertella is thought to differ from *Schellwienella* in lacking dental plates. This difference holds true for the specimens of this collection, but G. A. Cooper (personal communication) indicates variability in the development of "dental plates" may invalidate the supposed generic distinction based on this feature alone. The dorsal interiors of the shells here assigned to *Schuchertella* differ considerably from the corresponding parts of shells referred to *Schellwienella,* and might ultimately provide a reliable basis for generic distinction if this information can be obtained from the type species of the two genera concerned.

SCHUCHERTELLA species

Plate 4,B, figures 6-14

Exterior.—Only fragments of the valves near the hinge line are preserved, and they represent an apparently flattened, biconvex schuchertellid bearing rounded, threadlike costellae separated by implantation in the interspaces of smaller costellae which gradually increase in size anteriorly; interarea flat, delthyrium bounded by wide perideltidial areas.

Ventral interior.—Thickened teeth occurring along inner edges of delthyrium, unsupported below; pseudodeltidium closing delthyrium to apex, fused to inner edges of growth track of tooth; muscle marks not strongly impressed into shell.

Dorsal interior.—Cardinalia fused together; cardinal process bilobed, erect, in plane of commissure; base divided, platformlike, overhanging outer surface of dorsal valve at apex, with base of each half fused to stout, rounded ridges, forming the inner socket plates (brachiophores), which taper anterolaterally to rounded bladelike ends; sockets not excavated from shell, formed by upward growth of stout inner socket plate-brachiophore, bounded posteriorly by margin of valve; chilidium fused to base of cardinal process. No muscle marks impressed on shell.

Figured specimens.—U.S.N.M. 127917a-c.

Remarks.—The dorsal interiors of many of the Mississippian strophomenoids are poorly known; consequently, the writer is in a poor position to assess the significance of the variability of these structures or to follow the changes during growth of an individual. Other specimens in the collection show a median ridge on the inner side of the cardinal process and large muscle areas separated by a faint, low, rounded median ridge. These have also been assigned here, but largely by default, as too few specimens are available to evaluate the significance of these changes.

Genus SCHELLWIENELLA Thomas, 1910

SCHELLWIENELLA UMBONATA Sanders, new species

Plate 4,C, figures 15-21

A large dorsal valve and a smaller fragment of the hinge portion of a ventral valve are presumed to belong together and are made the basis of a new species of *Schellwienella.* Though numerous species of this genus have been described, the internal characters of the dorsal valve are scarcely known. Weller (1914) described several new species from single dorsal valves only, and as that valve seems to be the more useful one for specific determination, a new species is here erected even on the basis of the admittedly somewhat incomplete material. The dorsal valve shown conceivably could belong to *Derbyia* or *Orthotetes.* However, status of our knowledge of the dorsal cardinalia in these genera does not provide confirmatory evidence on this possibility.

Exterior.—Shell transverse, a little less than twice as wide as long, semicircular in plan, widest at or just anterior to hinge line; hinge straight; cardinal extremities blunt, nearly right angles. Ventral valve flattened, interarea plane, apsacline; pseudodeltidium completely closing delthyrium. Dorsal valve convex, rotund, with greatly swollen umbonal region, greatest convexity just posterior to middle, the median profile sloping abruptly posteriorly and more gradually anteriorly; cardinal margins flattened, with slightly concave contour; fold and sulcus lacking; dorsal interarea narrow, plane, anacline. Surface multicostellate, with slight reticulation where threadlike concentric lirae cross narrow costellae. Surface ornament poorly preserved, but costellae of several sizes present, especially posteriorly.

Ventral interior.—Teeth stout, divergent, supported by thin dental plates; muscle area not visible; median ridge faint, low, and rounded.

Dorsal interior.—Notothyrium wide, low, filled completely with erect cardinalia, except for growth track of dental groove along outer margins; chilidium fused to outer side of cardinal process; dental sockets divergent, bounded posterolaterally by interarea, floored by stout fulcral plates which are fused to brachiophores, and inseparable from inner walls of sockets; cardinal process erect, fused to posterior wall of valve and brachiophores, with diductor attachment areas marked by closely set parallel striations, bounded laterally by stout rounded ridges; interior side of cardinalia nearly smooth except for irregular, offcenter ridge. Adductor field deeply impressed, circular, separated by a broad, low, rounded median ridge, which extends the full length of the muscle area.

Types.—Holotype, U.S.N.M. 127918a; figured paratype, U.S.N.M. 127918b.

Distinguishing characters.—The swollen umbone and flattened, slightly concave cardinal extremities of the dorsal valve are especially characteristic of this species, as compared with others previously described, but it must be admitted that this comparison is made upon this single specimen versus a very small number of specimens of the other species. How the cardinalia compare with other species of the genus, unfortunately, cannot be stated.

Suborder CHONETOIDEA Muir-Wood, 1955

Family CHONETIDAE Hall and Clarke, 1895

Genus PLICOCHONETES Paeckelmann, 1930

PLICOCHONETES GENICULATUS (White), 1862

Plate 3,F, figures 30-32

1862. *Chonetes geniculata* White, Proc. Boston Soc. Nat. Hist., vol. 9, p. 29.
1914. *Chonetes geniculatus* Weller, Geol. Surv. Illinois, Monogr. 1, pp. 92-93, pl. 8, figs. 35-42.

Discussion.—Paeckelmann (1930, pp. 222-223) proposed *Plicochonetes* as a subgenus of *Chonetes,* based on *Chonetes buchiana* de Koninck, 1844, for Devonian and Carboniferous chonetids with radially plicated shells, which were assigned by de Koninck (1847) to the "plicosae" and a few to the "striatae" and "rugosae." No internal characteristics were cited.

The present shells are referred to Paeckelmann's genus on the basis of external ornamentation. The assignment to *P. geniculatus* likewise is based on external characters. The present shells agree well with Weller's (1914, pp. 92-93) description of White's decidedly concavo-convex species, though the Mexican shells are a little larger than the ones figured by Weller. *G. glenparkensis* (Weller, 1906) is similar but has a wider hinge line and more definite auriculations.

Other specimens in the collection show interior details of the ventral valve and indicate flat, rounded, unsupported, shelflike hinge teeth flattened parallel to the hinge line, and a short median septum.

Certain other specimens in the collection (not illustrated) may belong to *Chonetes logani* Norwood and Pratten (1855) because of their crenulated ornamentation and slightly wider hinge line.

Type.—Holotype, U.S.N.M. 127914.

Suborder TEREBRATULOIDEA Muir-Wood, 1955

Family DIELASMATIDAE Schuchert and LeVene, 1929

Genus GIRTYELLA Weller, 1911

GIRTYELLA species

Plate 5,C, figures 12, 13

Two fragments of dorsal valves are assigned to *Girtyella* species on the basis of punctate shell structure and the presence of a concave hinge plate supported by a median septum anteriorly. The loops are not preserved. The specimens are too incomplete to attempt species assignment.

Figured specimens.—U.S.N.M. 127923a, b.

GIRTYELLA? species

Plate 5,C, figures 9-11

This small terebratuloid assigned to *Girtyella?* yields no clue as to its interior details. Whether it belongs with the incomplete dorsal valves of *Girtyella* species above is conjectural.

Figured specimen.—U.S.N.M. 127922a.

Genus DIELASMOIDES Weller, 1911

Stehli (1956) has revealed that the dorsal interior of the genotype of *Dielasma* has a sessile cruralium with crura arising from the walls of the cruralium near the inner socket plates, a plate arrangement like that of the species upon which Weller (1911) erected the genus *Dielasmoides.* Stehli (pp. 300-301) therefore regards *Dielasmoides* as a junior synonym of *Dielasma,* as the latter is now known. However, he also indicates (p. 301) that the genotype of *Dielasma* has a cardinal process, a feature which is likewise clearly shown on the etched silicified specimens of *Dielasma* sp. from the Middle Permian of Texas (pl. 40,B, fig. 6). The Mississippian shells in this collection clearly lack a cardinal process. The present writer therefore recognizes *Dielasmoides* Weller, 1911, as a distinct genus from *Dielasma* King, 1859, as restricted by Stehli (1956), on the basis of the absence of a cardinal process in *Dielasmoides.*

DIELASMOIDES species

Plate 5,D, figures 18-20

Two incomplete specimens showing the dorsal interior morphology of *Dielasmoides* occur in this collection. The external configuration cannot be determined from these fragments, so species assignment is not attempted. Weller (1914) lists only one species of *Dielasmoides, D. bisinuata* Weller, in the genus. Even though specific assignment is not made, the shells here discussed probably belong in a different species than *D. bisinuata,* as the Mexican specimens are very much thicker.

Figured specimens.—U.S.N.M. 127925a, b.

DIELASMOIDES?

Plate 5,D, figures 14-17

The generic assignment of the specimen illustrated on plate 5,D, figures 14-17, is in doubt because no internal morphology can be determined. The specimen is assigned with query to *Dielasmoides.*

Figured specimen.—U.S.N.M. 127924.

Genus BEECHERIA Hall and Clarke, 1894

In his study of the genotype species of *Dielasma* King, 1859, (*D. elongatus* Schlotheim, 1816), Stehli (1956, pp. 300-301) showed that the dorsal interior plate structure of this Permian species from Europe closely resembles that of the Mississippian species from the United States which Weller (1911) took as the genotype of *Dielasmoides,* but that the European species contains a cardinal process and does not have the plate structure commonly regarded as characteristic of *"Dielasma"* by Weller (1914) and other authors. Stehli also pointed out that *Beecheria* Hall and Clarke, 1894, which has been suppressed as a synonym for *"Dielasma,"* should be revived for this group of shells widely misnamed *Dielasma.*

Beecheria is characterized by unusual plates on the floor of the dorsal valve that support the crura and the position of the crural bases. Each crural plate and associated plate unites to form a structure that resembles the pointed roof of a house. These plates are attached to the floor of the dorsal valve and are entirely separate from the inner socket-plate–fulcral-plate structure that encloses the teeth.

BEECHERIA species

Plate 5,E, figures 21, 22

An incomplete specimen on the posterior portion of a large species of *Beecheria* occurs in the collection. The complete shape and type of folding cannot be determined in the absence of the anterior part of the specimen. The interior morphology of the dorsal valve, however, is well preserved, and clearly indicates the genus *Beecheria,* as revived by Stehli (1956). The loop is only partially preserved.

Although the specimen is fragmentary, it preserves a hole bored by some predatory organism. The death of this individual could be attributed to the boring organism.

Figured specimen.—U.S.N.M. 127927.

Suborder RHYNCHONELLOIDEA Moore, 1952

Family CAMAROTOECHIIDAE Schuchert and LeVene, 1929

Genus CAMAROTOECHIA Hall and Clarke, 1894

CAMAROTOECHIA species

Plate 5,A, figures 1-3

Exterior.—Shell subtriangular, with lateral margins straight, front margin straight, anterior corners curved; about as wide as long, widest just anterior to midlength; biconvex, with both valves about equally deep and with flattened profile; both valves deepest at midlength; folding reverses as shell matures, with the dorsal valve in young stages bearing a small median sulcus, becoming a low fold in maturity, and the ventral valve having a raised median portion, not sharply set off from the contour of the valve posteriorly, becoming a wide, flattened sulcus near front margin of mature shell. Costae simple, rounded, defined on beaks, becoming larger and deeper anteriorly, each lateral slope bearing about five costae, the sulcus eight, with furrows a bit wider and flatter than the costae on dorsal valve. Beak erect, pointed, slightly curved; delthyrium narrowly triangular, with small discrete deltidial plates not extending across delthyrium.

Ventral interior.—Dental plates divergent, discrete from walls of valve, forming steep-sided delthyrial cavity, joining valve wall along furrow which bounds sulcus laterally, extending one-fifth the distance to front margin. No muscle marks.

Dorsal interior.—Dental sockets following posterorlateral margin of valve, with socket floor plates curving up and inward to form inner walls of sockets; hinge plate attaching to inner socket plates, divided medially by flat-bottomed, shallow cruralium, supported by a thin median septum, with free edge tapering gradually toward floor of valve and extending about one-third the distance to the front margin; crura slender, joining hinge plate at junction of edge of cruralium and inner side of divided hinge plate; cardinal process lacking. Muscle markings not present on specimen.

Figured specimen.—U.S.N.M. 127919a.

Remarks.—This is a most distinctive shell and can be accurately characterized in spite of the fragmentary condition of the single specimen examined. Its broken condition permitted description of the interior details, which would not have been possible had the only specimen available been complete.

This shell may belong to *Camarotoechia tuta* Miller, but seems much larger than any examples illustrated by Weller (1914, pl. 24, figs. 9-27). Branson (1938, pp. 45-46) regarded *C. tuta* Miller and *C. chouteauensis* Weller (1914) to be the same species, holding Weller's species to be larger forms of Miller's. The *C. tuta* of Branson (1938, pl. 5, figs. 14-18) has unequally deep valves, a feature in common with Weller's *C. chouteauensis,* but which is not shown on Weller's illustrations of *C. tuta.* This shell also approaches some of the specimens of *C. mutata* (Hall) shown in Weller (1914, pl. 24, figs. 53-60). These differ in profile from the other specimens of *C. mutata* (Weller, 1914, pl. 24, figs. 41-48).

DORSISINUS Sanders, new genus

Genotype.—*Centronella louisianensis* Weller, 1914.

Diagnosis.—Smooth-shelled rhynchonellids with deltidium partially closed by incipient deltidial plates, having fold on ventral valve and sulcus on dorsal valve; dorsal interior with cruralium supported by median septum.

Discussion.—*Dorsisinus* is related to *Camarotoechia* Hall and Clarke, *Nudirostra* Cooper and Muir-Wood, 1951 (formerly *Leiorhynchus*), and *Paraphorhynchus* Weller, 1905, by its dorsal interior structure of a cruralium supported by a median septum. *Dorisisnus* differs from all three by its smooth shell and in having a fold on the ventral valve and sulcus on the dorsal valve. The folding of *Dorsisinus* resembles that of *Centronelloidea* Weller, 1914, but *Centronelloidea* is a punctate, loop-bearing terebratulid, whereas *Dorsisinus* is impunctate and contains only crura. The external homeomorphy between these two genera is indeed striking.

The Mexican shells show internal details chiefly, but the material available seems complete enough to confirm the assignment of them to Weller's species. The generic diagnosis is based on study of Weller's original specimens (Walker Museum 6730) and these Mexican interiors. Though the interior details of Weller's specimens cannot be absolutely confirmed, the writer found no punctae in the shells and in several specimens could detect the trace of the dorsal septum through the shell.

Cloud (1942, p. 74) correctly noted that Weller's species is not a terebratulid. Cloud regarded it as an immature rhynchonellid, but the present writer is satisfied that it is a reliable basis for a new genus. This conclusion is strengthend by observations made on some shells in the writer's Tennessee collections.

DORSISINUS LOUISIANENSIS (Weller), 1914

Plate 5,B, figures 4-8

1914. *Centronella louisianensis* WELLER, Geol. Surv. Illinois, Monogr. 1, pp. 241-242, pl. 30, figs. 26-29.

Exterior.—Shells smooth, with oval outline; valves nearly equally biconvex, with ventral valve having slightly greater convexity. Ventral valve with long, slightly curved, pointed beak; delthyrium triangular, partially closed by incipient deltidial plates; umbone bearing well-defined median elevation, becoming broader and less distinct anteriorly. Dorsal valve circular in plan; folding absent in posterior portion, but with wide, shallow, V-shaped sulcus beginning about one-third of the distance to the front margin and becoming wider anteriorly; anterior commissure gently sulcate.

Ventral interior.—Teeth supported by dental plates which are discrete from posterolateral valve wall. Muscle markings not impressed into shell.

Dorsal interior.—Beak pointed, slightly curved; dental grooves follow posterolateral valve wall, with floor of groove curving around to form inner socket plate; hinge plate divided, with outer flat portions attached to inner socket plate, inner edges forming small cruralium, which is supported by prominent median septum. Septum continues forward of cruralium halfway to the front margin. Crura long, slender, arising from inner edges of flat portions of hinge plate, supported below by a thin, vertical plate formed by forward extension of the walls of the cruralium. Muscle attachment areas not impressed into shell.

Types.—Figured hypotypes, U.S.N.M. 127926a-e.

Suborder Spiriferoidea Allen, 1940

Family SPIRIFERIDAE King, 1846

Genus CYRTOSPIRIFER Nalivkin, 1930

Though the spiriferoid species here considered has always been referred to the genus *Spirifer,* discovery of the full morphology of the shell requires that it be assigned elsewhere. Nalivkin's *Cyrtospirifer* appears to be the best resting place for these shells, though it must be admitted that his generic diagnosis is incomplete. Nalivkin emphasized the presence of a transverse delthyrial plate in the apex of the ventral valve as a prominent feature of *Cyrtospirifer* and fully ignored the dorsal interior. On the basis of external ornamentation and the transverse delthyrial plate the present writer assigns these shells to *Cyrtospirifer,* but with full realization of the insecurity of this assignment because of the lack of important interior details of *Cyrtospirifer.* If these Mexican shells are *Cyrtospirifers,* then this is the first record of that genus from undoubted Mississippian rocks. The possession of a transverse delthyrial plate alone scarcely seems a reliable generic character among spiriferids, but the validity of this structure and its distribution among spiriferids awaits further detailed study of this large group of brachiopods.

CYRTOSPIRIFER? LATIOR (Swallow), 1863

Plate 5,G, figures 27-37

1863. *Spirifer latior* Swallow, Trans. St. Louis Acad. Sci., vol. 2, p. 86.
1914. *Spirifer latior* Weller, Geol. Surv. Illinois, Monogr 1, pp. 316-317, pl. 38, figs. 9-13.

Exterior.—Shell spiriferoid, rotund, transverse, about half again as wide as long, widest at hinge; outline semicircular to triangular, with front margin slightly emarginate, cardinal extremities pointed, acute. Valves subequally biconvex, with ventral valve having slightly greater convexity; umbones prominent on both valves. Lateral slopes ornamented by 18 to 20 small, generally simple costae and furrows similar in size, narrowly rounded with most originating at the beak and continuing to front margin, becoming gradually smaller toward cardinal extremities, with a few costae near the fold and sulcus bifurcating on the umbone. Other fine surface markings, if present, not preserved on these specimens. Sulcus on ventral valve costate, narrow, V-shaped, and sharply defined at beak, widening gradually anteriorly; fold on dorsal valve only slightly elevated above the contour of valve; anterior commissure gently uniplicate.

Ventral interarea apsacline, curving gently posteriorly; beak incurved, overhanging; interarea sharply defined from lateral slopes; hinge line nearly fully denticulate, except for small distance on each side of delthyrium, with irregular traces of hinge teeth covering interarea except for small triangular areas on each side of the delthyrium; deltidial grooves prominent. Median costa of sulcus extending from beak to front margin, with other costae in sulcus branching from bounding costa.

Dorsal beak incurved slightly over wide notothryium; interarea orthocline, gently curved, low, sharply defined from lateral slopes; costae of fold originating by bifurcation from a single source on the umbone; fold bounded by furrows which are slightly larger than other furrows on lateral slopes.

Ventral interior.—Hinge teeth thick, supported by prominent, divergent dental plates, joining valve floor well outside borders of sulcus, with transverse delthyrial plate joining dental plates in umbonal region, extending one-fourth to one-third the distance from the beak to hinge line; muscle areas well impressed, forming oval-shaped field extending nearly halfway to the front margin, outlined by forward continuation of dental plates; adductors attaching to low, rounded thickened areas with V-shaped anterior outline between dental plates (pl. 5,G, fig. 32); diductor field enclosing adductors, divided for most of its length by faint, low, rounded median ridge.

Dorsal interior.—Dental grooves bordering notothyrium, widening gradually anteriorly; with interarea forming posterolateral boundary; floor fused to inner side of palintrope; inner socket plates vertical, increasing in thickness and height anteriorly to form prominent triangular terminations. Cardinal process spiriferoid, supported by a pillarlike thickening extending to floor of valve and also supporting posterior portion of inner socket plates; crural bases attaching to lower distal edges of thickened inner socket plates; muscle areas not deeply impressed, divided by a low, rounded median ridge which extends about halfway to the front margin along the floor of the valve.

Types.—Figured hypotypes, U.S.N.M. 127921a-f.

Remarks.—As noted by Weller (1914, p. 317), Swallow's original specimen was not illustrated and has been lost. Weller regarded the specimen in the Greger collection, labeled by Swallow, as an accurate representative of this species and based his description on Greger's specimen. The present usage follows Weller's concept of *S. latior,* which was based only on external characters. The collection provides details on certain internal characteristics. Weller emphasized the rotund form, lack of change of convexity of the ventral valve near the lateral extremities, and lack of elevation of the fold above the contour of the dorsal valve of the distinguishing features of this species and the Mexican shells assigned here agree in all respects.

Genus TYLOTHYRIS North, 1920

TYLOTHYRIS? species

Plate 7,A, figures 1-3

Exterior.—Dorsal valve transverse, widest at hinge, with slightly mucronate cardinal extremities; interarea nearly rectangular, with inner half near cardinal extremities denticulate; each lateral slope ornamented with 8 to 10 simple, rounded costae and similar intervening furrows, fold defined from beak, becoming wider and higher anteriorly, bearing faint median furrow; anterior half of valve bearing well-developed concentric imbricate lamellae, which are lacking on posterior half of valve, other fine surface ornament lacking or not preserved. Shell impunctate.

Interior.—Notothyrium wide, with interarea forming outer edge of narrow dental grooves; inner socket plate thickening and rising above plane of palintrope anteriorly, forming a clublike process which is rounded below and pointed above; floor of sockets formed by a plate attaching to inner surface of palintrope, line of junction of this plate with palintrope forming boundary between denticulate and nondenticulate portions of hinge line; cardinal process spiriferoid, prominent, rising above plane of palintrope, supported only by coalescence of base with crural bases and inner socket plate; crural bases rounded, diverging from base of cardinal process, joined to lower, inner edge of inner socket plate by crural connecting plates.[6]

Muscle field deeply impressed, slightly wider than sulcus, extending about halfway to the front margin, divided by low, rounded median ridge, extending one-third of the way to front margin, each half subdivided by a rounded ridge which coincides with border of fold.

Figured specimen.—U.S.N.M. 127932.

Remarks.—This single distinctive dorsal valve of a spiriferoid shell in this collection warrants special notice because of the cardinalia. These features indicate the shell is similar to *Tylothyris,* but probably belongs to an unnamed genus which the writer discovered among specimens from the Belgian Lower Carboniferous in the collections of the British Museum (Natural History) in 1953.

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[6] Name here used for plates which extend from crural bases to inner socket plates. Crural plates extend from crural bases to floor of valve.

Genus RETICULARIA McCoy, 1844

A diversity of internal structures is concealed beneath a nearly uniform external shape and ornament in reticulariid brachiopods. T. N. George (1932) and Minato (1953) have discussed these shells and have based genera on internal plate arrangement and types of spines. On the basis of their dorsal interiors, the Mexican shells belong to *Reticularia,* as that genus was diagnosed by George (1932). These silicified specimens reveal for the first time the internal morphology of this genus in great detail.

RETICULARIA COOPERENSIS (Swallow), 1860

Plate 6,D, figures 21-30

1860. *Spirifer cooperensis* Swallow, Trans. St. Louis Acad. Sci., vol. 1, p. 463.
1914. *Reticularia cooperensis* Weller, Geol. Surv. Illinois, Monogr. 1, pp. 428-429, pl. 75, figs. 21-33.

The following observations are made on the basis of disjoined individual valves which preserve the hinge structures very well, but which are not complete enough to show the entire external configuration of the shell.

Exterior.—Shell slightly wider than long, widest at midlength, lateral margins circular, cardinal extremities broadly rounded; valves biconvex, with ventral valve having the greater convexity, greatest convexity at midlength; anterior commissure rectimarginate to faintly uniplicate; surface noncostate, but ornamented by narrow concentric, imbricate bands of double-barreled spine bases; shell nonpunctate; internal surface of valves faintly radially striated.

Ventral valve with prominent umbone; interarea small, triangular, faintly striated vertically (trace of fine hinge teeth?), differentiated from lateral slopes by faint angular change of contour, apsacline, curving faintly posteriorly to incurved, overhanging beak; sulcus defined on umbone, narrowly rounded, becoming broadly rounded and ill-defined anteriorly. Dorsal valve with nearly uniform convexity, with fold absent or only faintly raised above contour of valve; interarea narrow, orthocline, curving very faintly rearward to gently curved beak; edge of notothyrium bounded by low ridge along free edge of palintrope.

Ventral interior.—Delthyrium broadly triangular, bounded by stout hinge teeth; dental plates divergent, extending along floor of valve about one-fourth the distance to front margin, continued a little farther anteriorly as faint ridges flanking the muscle area; median ridge low, pointed, extending from beak about halfway to front margin; muscle field not deeply impressed.

Dorsal interior.—Dental grooves widening anterolaterally, floored by a plate which is parallel to the palintrope, joining rear wall of valve just below plane of the palintrope; inner socket plate vertical, becoming thicker anterolaterally, termination club-shaped; crural connecting plates thin, vertical, fused to inner socket plates, supported at rear of valve by a flangelike plate tapering rapidly along the floor of the valve and continuing halfway to the front margin as a thin, low, rounded median ridge; cardinal process spiriferoid, not well differentiated, occupying rear of shell where interarea, dental grooves, and inner socket plates coalesce; overhanging slightly, supported at sides by inner socket plate and crural connecting plates; muscle field not impressed on shell.

Types.—Figured hypotypes, U.S.N.M. 127931a-d.

Remarks.—The present shells agree externally with those assigned to *R. cooperensis* by Weller (1914), but he was unable to illustrate Swallow's holotype which may be lost. Weller's mention of a median septum in the ventral valve and in the dorsal valve of *R. cooperensis* is based on specimens not illustrated, so the writer cannot be certain if a true median septum or only a median ridge is present in *R. cooperensis.* With the possible exception of this median septum which rapidly becomes only a slight, raised rib along the floor of the valve (Weller, 1914, p. 429), the dorsal interior described by Weller agrees with the Mexican shells. No difference exists if one is allowed latitude in interpreting the word "septum."

The genus *Torynifer* Hall and Clarke, 1894, revived by Cooper (1942) resembles *Reticularia* externally, but differs from it in possessing a concave hinge plate supported by a distinct median septum in the dorsal valve. On calcareous specimens one can see the trace of the hinge plate and septum as dark T-shaped lines at the rear of the dorsal valve. If the type of *Spirifer cooperensis* Swallow bears this internal hinge plate and septum it must be assigned to *Torynifer* and another name sought for the shells here described which are true *Reticularias.*

Weller (1914, p. 428) considered *Spirifer hirtus* White and Whitfield, 1862, to be a synonym of *S. cooperensis* Swallow, 1860, and illustrated the holotype of *S. hirtus* (Univ. Michigan No. 1367) under *Reticularia cooperensis.* The possibility of differences of internal plate arrangement among external homeomorphs in this group of shells, however, suggests such synonymy should be suspended until full knowledge of internal morphology of both species is revealed.

Genus CRURITHYRIS George, 1931

CRURITHYRIS LEVICULA (Rowley), 1900

Plate 7,B, figures 4-8

1900. *Ambocoelia levicula* Rowley, Amer. Geol., vol. 25, p. 262, pl. 5, figs. 12-14.

1914. *Ambocoelia levicula* Weller, Geol. Surv. Illinois, Monogr. 1, p. 462, pl. 77, figs. 26-29.

Exterior.—Shell transverse, a little wider than long, widest at midlength; hinge straight; cardinal extremities blunt, rounded; sides nearly straight; front semicircular, faintly emarginate; valves biconvex, the ventral valve having greater convexity, dorsal valve flatly convex; ventral interarea apsacline, nearly catacline, gently curved, rounding broadly onto lateral slopes, only faintly outlined; beak incurved, overhanging; umbone swollen; dorsal interarea anacline; beak gently curved, pointed; ventral sulcus narrow, well defined on umbone, widening only slightly anteriorly; profile of valve straight from median line to flattened central portion; dorsal valve also with faint median sulcus; anterior commissure rectimarginate; delthyrium and notothyrium triangular, open, with no covering plates preserved.

Ventral interior.—Teeth thickened, unsupported by dental plates, joined at apex by small transverse delthyrial plate. No other features observable on specimens examined.

Dorsal interior.—Palintrope overhanging, forming outer boundary of dental sockets; sockets floored by fulcral plate parallel to palintrope, but set a little below it, attaching to posterior wall of valve; inner socket plates inclined toward socket; cardinal process large, clublike, attaching to posterior wall of valve; crura diverging from base of cardinal process and projecting into valve following close along the contour of the valve wall, joined to junction of inner socket plate and fulcral plate by thin crural connecting plate, supported by small crural plates which join valve wall near base of cardinal process; jugum or jugal processes lacking; muscle markings only faintly impressed, appearing elongate and oval in outline.

Types.—Figured hypotypes, U.S.N.M. 127933a-b.

Discussion.—The interior of the dorsal valve of Rowley's species was not described by Weller, so the present assignment rests entirely on the close external similarity of the Mexican shells with Rowley's species. Weller indicated that *Ambocoelia levicula* possesses a smooth exterior but the Mexican shells contain hairlike spines. Whether or not Rowley's species is spinose cannot be established here, but the nearly identical external morphology suggests that fine spines might have been present originally on the specimens studied by Weller, but were not preserved.

Remarks.—The Mexican shells reveal the morphology of the dorsal interior in great detail, and also indicate the presence of a small transverse delthyrial plate in the ventral valve. This latter feature was not noted by George (1931) as occurring in *Crurithyris,* but is so small that it could easily have been unnoticed in the material examined by George. The interior of the complete specimen figured can be seen in part through the open delthyrium and one of the spirals of the lophophore supports is present attached to one of the crura. This specimen confirms the fact that no jugum or jugal processes are present in *Crurithyris.*

Family ATHYRIDAE Davidson, 1884

Genus COMPOSITA Brown, 1849

COMPOSITA OBESA Sanders, new species

Plate 6,C, figures 16-20

Exterior.—Shell about as wide as long, widest at midlength, obese; valves nearly equally convex, the ventral valve with slightly greater convexity; ventral valve with swollen umbone and evenly convex curvature from edge of delthyrium onto lateral slopes, bearing very faint, wide median sulcus; dorsal valve with small umbone, beak slightly incurved, lacking fold; anterior commissure gently and faintly uniplicate.

Dorsal interior.—Dental sockets bounded posterolaterally by wall of valve, with socket floor attaching to posterolateral valve wall just below plane of commissure, curving medially inward and upward; cardinal "process" formed by upward continuation of inner socket plate; crural bases attach to inner socket plate in a plane parallel to and slightly above plane of commissure; hinge plate unsupported, set just below and parallel to plane of crural bases, not extending to umbone, leaving a small triangular visceral foramen just under beak; muscle scars not impressed into shell.

Types.—Holotype, U.S.N.M. 127930a; figured paratypes, U.S.N.M. 127930b, c; unfigured paratypes, U.S.N.M. 127930d,e.

Remarks.—Most Mississippian species of *Composita* have well-defined fold and sulcus, but *C. obesa* shows only faint traces of a sulcus on the ventral valve and no fold on the dorsal valve. The dorsal interiors of the species of *Composita* are poorly known, so the internal features here described cannot be readily compared with those of other species of the genus. The obese appearance of the ventral valve and faint folding are readily recognized external features of this species. *C. lewisensis* Weller, 1914, closely resembles *C. obesa,* but the latter seems thicker and has a more rounded outline. A large suite of specimens for comparison might show *C. obesa* to merge into *C. lewisensis,* but the two appear distinct on the basis of the available specimens.

Genus "CLEIOTHYRIDINA" Buckman, 1906

The writer's unpublished studies of the British and Belgian Lower Carboniferous brachiopods indicate that the taxonomic status of the genus *Cleiothyridina* is in doubt. Pending publication of a clarification, the name is used here within quotation marks.

Two species of this genus occur in this collection.

"CLEIOTHYRIDINA" GLENPARKENSIS Weller, 1914

Plate 6,A, figures 1-11

1914. *Cleiothyridina glenparkensis* Weller, Geol. Surv. Illinois, Monogr. 1, pp. 473-474, pl. 78, figs. 21-24.

Ventral interior.—Hinge teeth stout; dental plates forming walls of rostral cavity, extending a short distance forward of posterolateral wall of the valve; muscle area faintly impressed, extending to about midlength of valve, bounded laterally by very faint ridges.

Dorsal interior.—Dental sockets with outer margin formed by posterior edge of valve; inner socket plate and fulcral plate continuous, with fulcral plate meeting posterolateral valve wall perpendicularly, curving abruptly upward into inner socket plate; inner socket plate curving upward and posterolaterally, forming half of cardinal "process"; cardinal "process" containing fine parallel muscle striations; hinge plate solid, projecting toward opposite valve at a high angle to plane of commissure, with small visceral foramen between hinge plate and posterior wall of valve and between two halves of cardinal "process"; crural bases attaching to lateral edges of hinge plate, projecting into shell in a plane parallel with hinge plate; muscle area not visible. A faint, low, rounded median ridge occurs in the posterior part of the valve.

Types.—Figured hypotypes, U.S.N.M. 127928a-d.

Discussion.—The dorsal cardinalia of the different genera of the athyrids are poorly known. What is known of these structures by the writer indicates that they are similar in many genera. The jugum, possibly a diagnostic structure, is known in only a few species within this large group of brachiopods, and is not known in *"C." glenparkensis.*

Mexican shells assigned here are a little thicker than the specimen illustrated by Weller (1914, pl. 78, fig. 23), but otherwise agree in external configuration. The important external features emphasized by Weller in defining this species are the equal convexity of the valves, the rounded to transversely elliptical outline, and the slight median flattening or faint sulcus present on both valves. Weller did not describe the interior details, which are here added from broken specimens which preserve the hinge structures.

"CLEIOTHYRIDINA" species

Plate 6,B, figures 12-15

Two broken specimens of a much larger species than *"C." glenparkensis* are present in this collection. These are nearly as large as the specimens of *"C." incrassata* (Hall) figured by Weller (1914, pl. 79, fig. 12), but are so incomplete that the writer cannot assign them to any species.

Figured specimens.—U.S.N.M. 127929a, b.

Family CYRTINIDAE Stehli, 1954

Genus CYRTINA Davidson, 1858

CYRTINA BURLINGTONENSIS Rowley, 1893

Plate 7,C, figures 9-24

1893. *Cyrtina burlingtonensis* Rowley, Amer. Geol., vol. 12, p. 308, pl. 14, figs. 15-17.

1914. *Cyrtina burlingtonensis* Weller, Geol. Surv. Illinois, Monogr. 1, pp. 288-289, pl. 35, figs. 22-31.

Three specimens of this species occur in the collection, two complete shells and one fragment of a ventral valve. All show clearly the diagnostic spondylium with median septum continued through the united dental lamellae, possibly like the structure Fredericks (1926) called a tichorhinum, but this could not be verified without thin sections. The two complete specimens preserve the deltidium and reveal a large oval pedicle foramen (pl. 7,C, figs. 10, 21, 22). Weller (1914, p. 288) indicates a small foramen for this species. The writer has not seen Rowley's original specimens and cannot compare directly the size of the foramen between the original and these Mexican specimens. Small importance, however, is assigned to the obvious fact that a large foramen occurs in the specimens under study here.

The outline of the two complete specimens differs somewhat, but this is ascribed to difference in age and a slight variation in rate of growth. The early growth stages are distinctly preserved on both specimens and appear to be very similar. The subconical, erect ventral valve shown in plate 7,C, figure 17, resulted from uniform growth of the whole ventral valve. By contrast, the apsacline profile shown in plate 7,C, figure 11, developed by more rapid growth of the anterior margin, causing the interarea to incline progressively backward in later growth stages.

A fragment of a ventral valve (pl. 7,C, fig. 24) reveals the high median septum and short spondylium, the dental lamellae curving toward the septum close to the cardinal area. Because of the small size of the spondylium and its closeness to the cardinal area, the adductors and diductors may not have been seated within the spondylium, but may have been attached to the sides of the high septum. No muscle markings have been seen to confirm such a view, but it seems likely by reason of the possibility that a large pedicle may have attached to the spondylium and perhaps occupied most of it.

Fredericks (1926) proposed the genus *Davidsonella,*[7] based on *Spirifer septosa* Phillips, 1836, from the British Lower Carboniferous, for cyrtinid shells with special apical plates which he characterized as "spondylium sine tichorino." The completely different external configuration and size of *D. septosa* places it in a different group from the shells here shown. The presence of the "spondylium sine tichorino," which is emphasized as a generic character of *Davidsonina,* may occur in several groups of cyrtinid shells and requires thin sections for verification. The writer therefore declines to assign these Mexican shells to *Davidsonina* because the external morphology of the shells is so different and the interior details of the dorsal valves unknown in both groups.

Types.—Figured hypotypes, U.S.N.M. 127934a-c.

Family SPIRIFERINIDAE Davidson, 1884

Genus PUNCTOSPIRIFER North, 1920

The original diagnosis of *Punctospirifer* was incomplete (North, 1920) and considerable latitude of interpretation has grown up in consequence of this. The genus was diagnosed as consisting of punctate spiriferids which contain a prominent fold and sulcus which is larger than any of the simply rounded lateral costae and which are ornamented over-all by a concentric pattern of imbricate lamellae, and bear a median septum in the ventral valve. Dorsal interior details were not discussed by North, nor was the fine surface ornament.

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[7] Homonym, adjusted to *Davidsonina* by Schuchert and LeVene (1929a, p. 120.).

The writer had the opportunity to study the holotype and topotype specimens of *P. scabricosta* North, the genotype species, in the collections of H. M. Geological Survey and the British Museum (Natural History) in London during the winter of 1953-54, and has elsewhere discussed the results of these observations (Sanders, in preparation). The Mexican collection contains excellent material for illustrating some of the features not described by North. With the additional observations, the following revised and extended diagnosis of *Punctospirifer* is possible:

Punctate spiriferids with fold and sulcus wider than any of simple costae; both valves ornamented by regular pattern of concentric imbricating lamellae, each lamella bearing fine, hairlike spines which lie flat in the plane of the lamella. Ventral interior with median septum ending posteriorly in an apical callosity. Dorsal interior with pillarlike thickening supporting cardinal process, the pillar dividing anteriorly into stout rounded ridges which bound the muscle field laterally; muscle field bisected by low rounded median ridge. Crural bases projecting anteriorly from posterior pillar, attached to inner socket plates by crural connecting plates. Primary lamellae joined by U-shaped jugum.

Distinguishing characters.—The important features of *Punctospirifer* are the width of the rounded fold and sulcus compared to the lateral costae, concentric imbricating lamellae bearing hairlike spines, median septum and apical callosity in ventral valve, and the nature of the dorsal cardinalia. The elements of the dorsal interior are simple and superficially similar in most spiriferinids. Careful study reveals different patterns of arrangement, however, and *Punctospirifer* can be recognized readily on these features alone after some experience.

PUNCTOSPIRIFER SULCIFER, Sanders, new species

Plate 7,D, figures 25-30

Diagnosis.—*Punctospirifers* about twice as wide as long, widest at hinge line, with acute cardinal extremities; costae on both valves slightly flattened on top; bearing fold on ventral valve which contains a median sulcus.

Exterior.—Shell spiriferoid, about twice as wide as long, widest at hinge, cardinal extremities acute, front margin semicircular; valves subequally convex, the ventral valve having greater convexity, nearly subpyramidal, with greatest depth at umbone; dorsal valve gently convex, deepest at midpoint; ventral interarea gently concave, apsacline curving gently backward to slightly incurved beak, sharply defined from lateral slopes; dorsal interarea very small, orthocline, curving gently posteriorly; sulcus of ventral valve narrowly rounded, well defined at beak, widening anteriorly; fold of dorsal valve steep sided, widening regularly forward, bearing small median sulcus; anterior commissure uniplicate; lateral slopes of each valve bearing six to eight simple, narrowly rounded costae separated by similarly shaped furrows; surface covered by regular pattern of closely spaced, concentric imbricate lamellae, each lamella bearing fine hairlike spines lying flat in the plane of the lamella. Shell coarsely punctate.

Ventral interior.—Hinge teeth curving gently inward toward median plane; dental plates slightly divergent, attaching to floor of valve along first furrow outside sulcus, extending about one-fourth the distance to the front margin, united posteriorly by small apical callosity; median septum extending from apical callosity to about midlength, distal edge parallel to convexity of valve, curving abruptly at forward edge. No muscle marks seen.

Dorsal interior.—Notothyrium bounded by thickened inner socket plates; dental sockets defined at umbone, widening anterolaterally, bounded posterolaterally by palintrope, whose inner edge slightly overhangs outer portion of each groove; floor of dental sockets formed by fulcral plate extending from posterior wall of valve to inner socket plate parallel to palintrope; cardinal process spiriferoid, supported by pillarlike thickening at posterior of valve; pillar diverging anteriorly into two stout, low, rounded ridges bounding the muscle field laterally and extending forward along edge of fold about halfway to front margin, and a low, rounded median ridge extending about three-fifths of the way to the front margin; crural bases diverging forward from pillar at base of cardinal process at the same angle as ridges bounding muscle field, attached to thickened inner socket plate by thin crural connecting plate, not otherwise supported. No adductor muscle marks seen.

Types.—Holotype,U.S.N.M. 127935a; figured paratypes, U.S.N.M. 127935b-d.

Distinguishing characters.—*Punctospirifer sulcifer* differs from the previously described species of *Punctospirifer* by its median sulcus on the dorsal fold. Other punctate spiriferids from the Mississippian of the Upper Mississippi Valley described by Weller (1914, pp. 292, 295) which possess imbricate concentric lamellae are *"Spiriferina" subtexta* White and *"Spiriferina" subelliptica* (McChesney). The general configuration of these two species is sufficiently distinct from *P. sulcifer* to prevent confusion. Until the interior details of the above-cited *"Spiriferinas"* are known, their proper generic assignment cannot be made with confidence.

PUNCTOSPIRIFER GLOBOSA Sanders, new species

Plate 7,E, figures 31-36

Description.—Shells about as long as wide, widest just forward of the hinge line; cardinal extremities acute; bluntly rounded; lateral profile rotund, valves about equally biconvex, both being deepest at about midlength; ventral interarea nearly orthocline, gently concave, rounding broadly onto lateral slopes; beak slightly overhanging; each lateral slope bearing four or five simple rounded costae separated by furrows of similar shape; ventral sulcus well defined at the beak, widening gradually toward the front, containing a faint median costa from the umbone forward; dorsal fold similarly bearing a median sulcus; surface ornamented by concentric imbricate lamellae which bear hairlike spines. Shell coarsely punctate.

Types.—Holotype, U.S.N.M. 127936a; unfigured paratypes, U.S.N.M. 127936b.

Remarks.—This species differs from *P. sulcifer* in its much narrower valves, the strong costa in the sulcus of the ventral valve and the strongly incurved ventral beak.

Family RHYNCHOSPIRINIDAE Schuchert and LeVene, 1929

Genus HUSTEDIA Hall and Clarke, 1894

HUSTEDIA CIRCULARIS (Miller), 1892

Plate 5,F, figures 23-26

1892. *Retzia circularis* MILLER, Adv. Sheets, 18th Rep. Geol. Surv. Indiana, p. 62, pl. 9, figs. 32, 34.

1914. *Hustedia circularis* WELLER, Geol. Surv. Illinois, Monogr. 1, pp. 451-452, pl. 76, figs. 47-52.

Two small specimens similar to the shells assigned to *H. circularis* (Miller) by Weller occur in this collection. The internal characters are unknown so the generic assignment is subject to the same uncertainty expressed by Weller (1914, p. 452).

Types.—Figured hypotypes, U.S.N.M. 127920a, b.

PELECYPODA

Genus **PARRALLEDON** Meek and Worthen, 1866

PARALLELODON SULCATUS Weller, 1906

Plate 3,D, figures 23-25

1906. Weller, S., Trans. St. Louis Acad. Sci., vol. 16, pp. 450-451, pl. 2, figs. 6-9.

A single right valve of a *Parallelodon* is referred to *P. sulcatus* Weller.

Figured specimen.—U.S.N.M. 127912a.

Genus **CONOCARDIUM** Bronn, 1834

CONOCARDIUM species

Plate 3,E, figures 26-29

Several well-preserved specimens of a *Conocardium* species occur in the collection. The hinge details are obscured by silicification.

Figured specimen.—U.S.N.M. 127913.

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GASTROPODA

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(Plates 8,A-J, and 9,A; text figure 4)

INTRODUCTION

The Mississippian collection comes from the Represo formation at Bisani, Sonora, Mexico. From them I am able to identify nine genera or subgenera. The startling thing about this gastropod fauna is that its affinities are with the lower Carboniferous faunas of England, Ireland, and northwestern Europe and very little with the better known Mississippian faunas of the United States or Nova Scotia. The meaning of this is difficult to interpret with the little information available to me. Although the time factor may enter into the question it seems to me that so striking a resemblance in general terms is more likely due to facies, a facies in Mexico much more similar to that of northwest Europe than to that of the Mississippi Valley and northern Rocky Mountains from which come the richest and best-known gastropod faunas of the American Mississippian. Considering the time aspect these American faunas are of middle or possibly early upper Mississippian age.

At first glance it may seem significant that two of the gastropod genera from Mexico, *Platyschisma* and *Phanerotinus,* are represented in the United States only in the little-known gastropod fauna of the lower Mississippian Northview shale. But the force of this coincidence is greatly weakened by the range of both genera throughout both the Tournaisian and Viséen in Belgium. However, the fact that both *Platyschisma* and *Phanerotinus* occur only in the lower Mississippian so far as is known in North America coupled with the close affinity of one of the species of *Baylea* with *B. yvanii* of the Belgian Tournaisian suggests that the Mexican fauna is also of early Mississippian age.

SYSTEMATICS

BELLEROPHON species

Plate 8,A, figures 1, 2

The collection includes three small specimens of a species of *Bellerophon,* probably juveniles. Except that the species has no umbilici there is nothing very much that one can say about it, and even this has little significance. The genus *Bellerophon* is abundant throughout the world in rocks from Devonian to Permian age at least and its actual range is even a little greater. The species can neither be identified nor described from the material at hand.

Figured specimen.—U.S.N.M. 127988a.

BAYLEA aff. B. YVANII (Leveillé), 1835

Plate 8,B, figures 3-6

This is a turreted pleurotomarian with the slit and selenizone just within the outer margin of the whorl shoulder. In respect to its narrow pleural angle (about 50°) and its exclusively even revolving ornamentation it is very close indeed to the genotype, *B. yvanii* (Leveillé) from Tournai, Belgium, as identified by de Koninck in 1883. There is a possibility that it is identical with the Belgian species but with only the old and inadequate literature as a basis for judgment it is impossible to be certain.

It is interesting to note that this and the following species are the only two species of the genus *Baylea* as yet to be recorded from Mississippian beds in the Western Hemisphere although somewhat advanced species occur throughout the Pennsylvanian and even Permian beds of the United States. It is above all interesting that the affinities of both Mexican species are with those of the European Mississippian forms and not with the hitherto recognized forms from the American Pennsylvanian or Permian.

Figured specimens.—U.S.N.M. 127986a, b.

BAYLEA species

Plate 8,G, figures 15-16

A somewhat less-turreted species than the foregoing with a wider pleural angle (about 61°). It has a narrower whorl shoulder and fewer revolving lirae. However, its slit and selenizone are just within the margin of the shoulder as is characteristic for the genus. Although it is clearly of the group within the genus that occurs only in Mississippian rocks, a group that includes the genotype, it is not closely comparable with any described species. The material, a single specimen, is too poor to form a basis for a newly described species.

Figured specimen.—U.S.N.M. 127984.

BORESTUS species

Plate 8,C, figures 7, 8

This species is represented by a single rather poor specimen but seems clearly referable to *Borestus* Thomas, 1939. Although the genotype of *Borestus* and several other species were derived from late lower Carboniferous beds in Scotland the species is not close enough to European species to warrant detailed comparisons. The genus ranges throughout the Pennsylvanian in the United States and possibly into the lower Permian but is known from Mississippian beds only in Europe. The single specimen is too poorly preserved to employ it as the basis for describing a new species.

Figured specimen.—U.S.N.M. 127987.

RHINEODERMA cf. R. NYSTII de Koninck, 1883

Plate 8,E, figures 10, 11

This species is clearly referable to the genus *Rhineoderma* Koninck 1883 and appears to resemble most closely *R. nystii* de Koninck from Assiz III. However, it is impossible to establish either identity or close affinity, for not only is the Mexican specimen badly preserved in its details but de Koninck's dsecriptions and figures are inadequate. *Rhineoderma* ranges throughout the Belgian lower Carboniferous and is represented by several species in the American middle Mississippian Salem and Brazer limestones. It shows no close affinities with the species from the United States. It has not been reported from the Pennsylvanian or younger beds anywhere.

Figured specimen.—U.S.N.M. 127985.

PLATYSCHISMA species

Plate 8,H, figures 17-19

This species is a typical representative of the genus *Platyschisma*, 1844, hitherto authentically known only from Europe where it ranges throughout the lower Carboniferous and from the Northview sandstone of Kinderhookian age in the United States. The reported Devonian occurrences refer to what is now regarded as a different and not closely related genus. Again, on account of the poor preservation of the Mexican material it is impossible to do more than identify the genus.

Figured specimen.—U.S.N.M. 127990a.

STRAPAROLUS (EUOMPHALUS) species A

Plate 8,I, figures 20, 21

This species is a typical member of the subgenus *Euomphalus*. *Euomphalus* has a long range in the late Paleozoic (Devonian-Permian) and few faunas of Mississippian, Pennsylvanian, or Permian age of both hemispheres are without one or more species. Because of the great similarity between numerous species one needs the best of specimens, preferably many of them, to make positive identifications. Although the specimens in the Mexican collection are more numerous than those of other species and somewhat better preserved, specific identification or description is not warranted.

Figured specimen.—U.S.N.M. 127983a.

STRAPAROLUS (EUOMPHALUS) species B

Plate 8,D, figure 9

This species is a member of the group for which de Koninck in 1881 proposed the name *Phymatifer.* However, in respect to the characters that are supposed to distinguish *Phymatifer* from *Euomphalus,* evenly spaced tubercles on the upper and lower angles of the whorl, there is the most complete intergradation. Consequently, I regard the name as a junior synonym of the subgeneric name *Euomphalus* Sowerby (Knight, 1934, p. 114).[1] The phymatiferoid euomphalids are also widespread and long ranging. The single specimen in the Mexican collections is far too imperfect for more than subgeneric identification.

Figured specimen.—U.S.N.M. 127982.

PHANEROTINUS cf. P. PARADOXUS Winchell

Plate 8,J, figure 22

This openly coiled straparolid genus is abundant in the European lower Carboniferous but is almost unknown in the Mississippian of the United States. The sole recorded occurrence in the United States is in the Northview sandstone, Kinderhookian, where a species very similar to the Mexican species has been described. Neither the Mexican specimens nor the description or figures of the species described are adequate for precise identification.

Figured specimen.—U.S.N.M. 127989a.

PLATYCERAS (PLATYCERAS) species A

Plate 9,A, figures 1-5

The collections contain some 15 specimens of platyceratids which, as is usual in this genus of stationary life habit, are highly variable in respect to details of shape and of the apertural margin. All but one

[1] Knight, J. B., The gastropods of the St. Louis, Missouri, Pennsylvanian outlier: VII. The Euomphalidae and Platyceratidae. Journ. Paleont., vol. 8, No. 2, pp. 139-166, 1934.

specimen have the hooked apex of the subgenus *Orthonychia,* but one has the coiled apex of the typical subgenus. This specimen differs from all the others, moreover, in that at maturity its margin on the right side was produced periodically into a gutterlike spine. Beside the spine that was open at the apertural margin four other abandoned spines, or their broken bases, can be counted in a row above it. The earlier half of the whorl was spineless. Other than growth lines and the spines the shell is without ornamentation. The growth lines delineate irregularities of the apertural margin which seem to reflect irregularities of the object to which it was attached, presumably a crinoid calyx. I am unable to assign any definite function to the periodic gutterlike spines on this or on other species of *Platyceras* that bear them.

Platyceras (s.l.) has a long range, Silurian-Permian, and is usually abundant where crinoids are present. In facies without crinoid remains *Platyceras* is also absent. Unless species are characterized by distinctive ornamentation most of them are very difficult to discriminate and have little value for time correlations.

Figured specimen.—U.S.N.M. 127992.

PLATYCERAS (ORTHONYCHIA) species A

Plate 8,F, figures 12-14

This species has the hooked apex of the subgenus *Orthonychia* instead of the coiled apex of *Platyceras* (s.s.). In all other respects the two subgenera are very similar and had similar habits. Unlike the foregoing species this one does not bear a row of spines. Like it, it is without finer ornamentation other than growth lines and on this account it is very difficult to characterize. Specimens of both species are of about the same size and general form but the form in both is quite variable.

Figured specimens.—U.S.N.M. 127993a, b.

CEPHALOPODA

By Arthur K. Miller
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(Plate 9,B)

TRIBOLOCERAS DIGONUM (Meek and Worthen)

Plate 9,B, figures 6-8; text figure 4

1860. *Nautilus* (*Discus*) *digonus* Meek and Worthen, Proc. Philadelphia Acad. Nat. Sci., p. 470.
1866. *Nautilus* (*Trematodiscus*) *digonus* Meek and Worthen, Geol. Surv. Illinois, vol. 2, pp. 163-164, pl. 14, figs. 9a-9e.
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1893. *Triboloceras* (*Tremat.*) *digonum* Hyatt, Texas Geol. Surv., Ann. Rep. 4, pp. 418-419.
1894. *Nautilus digonus* Keyes, Missouri Geol. Surv., vol. 5, p. 222.
1898. *Triboloceras digonum* Weller, U. S. Geol. Surv. Bull. 153, p. 635.
1899. *Triboloceras digonum?* Weller, Trans. St. Louis Acad. Sci., vol. 9, pp. 45-46, pl. 5, figs. 17, 18.
1901. *Triboloceras digonum* Weller, Journ. Geol., vol. 9, p. 143.
1928. *Triboloceras digonum* Moore, Missouri Bur. Geol. and Mines, ser. 2, vol. 21, pp. 66, 68, 95, 100, 104, 124.
1929. *Coelonautilus* (*Triboloceras*) *digonus* Schmidt, Tierische Leitfossilien des Karbon, Gürich's Leitfossilien, Lief. 6, p. 58, pl. 14, figs. 5, 6.
1939. [1938]. *Triboloceras digonum* Miller and Furnish, Missouri Univ. Studies, vol. 13, No. 4, pp. 149, 150, 153-156, pl. 39, figs. 1-11; pl. 40, figs. 2-8; pl. 41, figs. 3, 4; pl. 43, fig. 5; pl. 45, fig. 4.
1947. *Triboloceras digonum* Miller and Youngquist, Journ. Paleont., vol. 21, pp. 113, 114, 115, pl. 27, figs. 5, 6.
1949. *Triboloceras digonum* Miller, Downs, and Youngquist, Journ. Paleont., vol. 23, pp. 602, 603, 607, pl. 97, figs. 6, 7; pl. 99, figs. 12-15.

A single representative of this well-known somewhat variable species was obtained in Sonora. It is entirely silicified, slightly distorted, not very well preserved, and incomplete both adapically and adorally.

This specimen represents about three-quarters of a volution of the loosely coiled adapical portion of the conch. Near its adapical end (which is poorly preserved) it appears to have been more or less subcircular or subelliptical in cross section and to have had a diameter of something like 6 or 7 mm. However, it is rapidly expanded orad, particularly in a lateral direction, and near its adoral end is almost semicircular in cross section as it is nearly flat (slightly convex) ventrally, subangular laterally, and broadly rounded dorsally. The maximum height and width attained by the preserved portion of the conch measure about 15 mm. and 27 mm. respectively.

On the surface of the specimen there are prominent angular longitudinal ridges which are separated by relatively wide, broadly rounded grooves. It is estimated that on the adoral part of the specimen there are some 15 of these ridges on the flattened ventral portion of the conch and some 20 of them on the corresponding rounded dorsal portion. The nature of the sutures and the siphuncle cannot be ascertained, though near the midlength of the specimen there are traces of transverse structures that may represent septa.

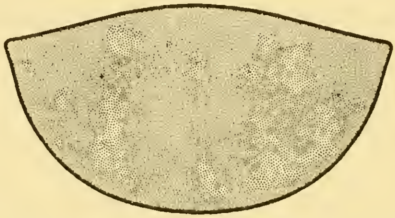

FIG. 4.—*Triboloceras diconum* (Meek and Worthen). Diagrammatic cross section of the adoral portion of the specimen represented by figures 6-8 on plate 9, B, $\times$ 2.

Remarks.—This species was originally described from the Rockford limestone of Indiana, and it has since been found to be of widespread occurrence in the Chouteau limestone (and the Northview shale) of Missouri, equivalent beds in Illinois, the Caballero formation of New Mexico, and the upper part of the Redwall limestone of Arizona. With the possible exception of the last, the containing strata in each case are Kinderhookian in age. Miller and Furnish divided the Missouri representatives of this species into six varieties, and the Sonora individual appears to be referable to their most abundant form, *T. d. semicirculare,* in which also belong the few specimens known from New Mexico and Arizona. It seems likely that all these individuals lived in a Kinderhookian sea that extended from Indiana southwest across Illinois and Missouri to New Mexico, Arizona, and Sonora.

Occurrence.—Represo beds, small hill 1½ miles north-northwest of Bisani, Sonora, Mexico.

Figured specimen.—U.S.N.M. 127991.

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Small hill from which came most of the specimens described in this report. Most of the fossils were taken from the darker limestones forming most of the hill. View from the east.

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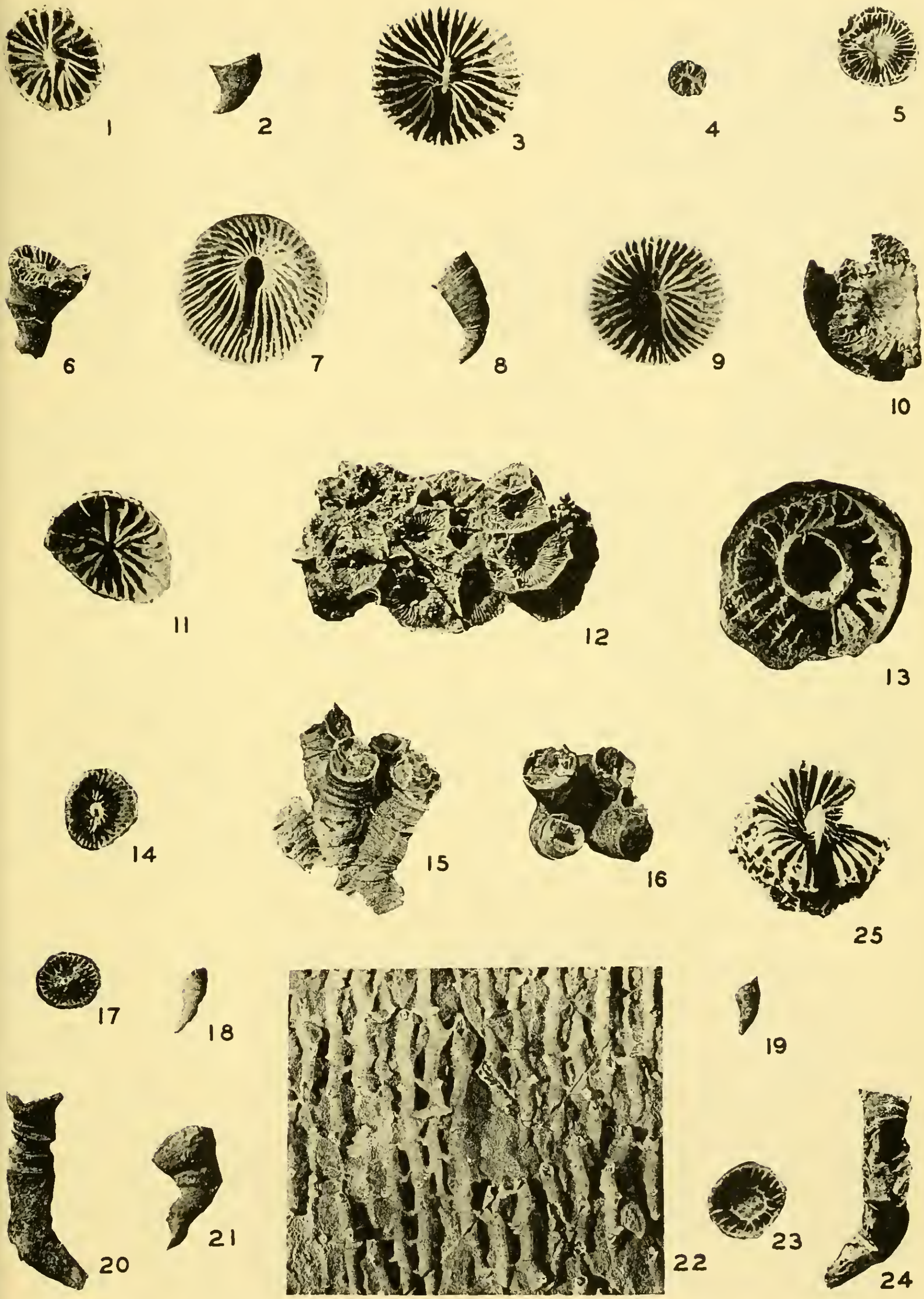

MISSISSIPPIAN CORALS FROM NORTHWESTERN SONORA

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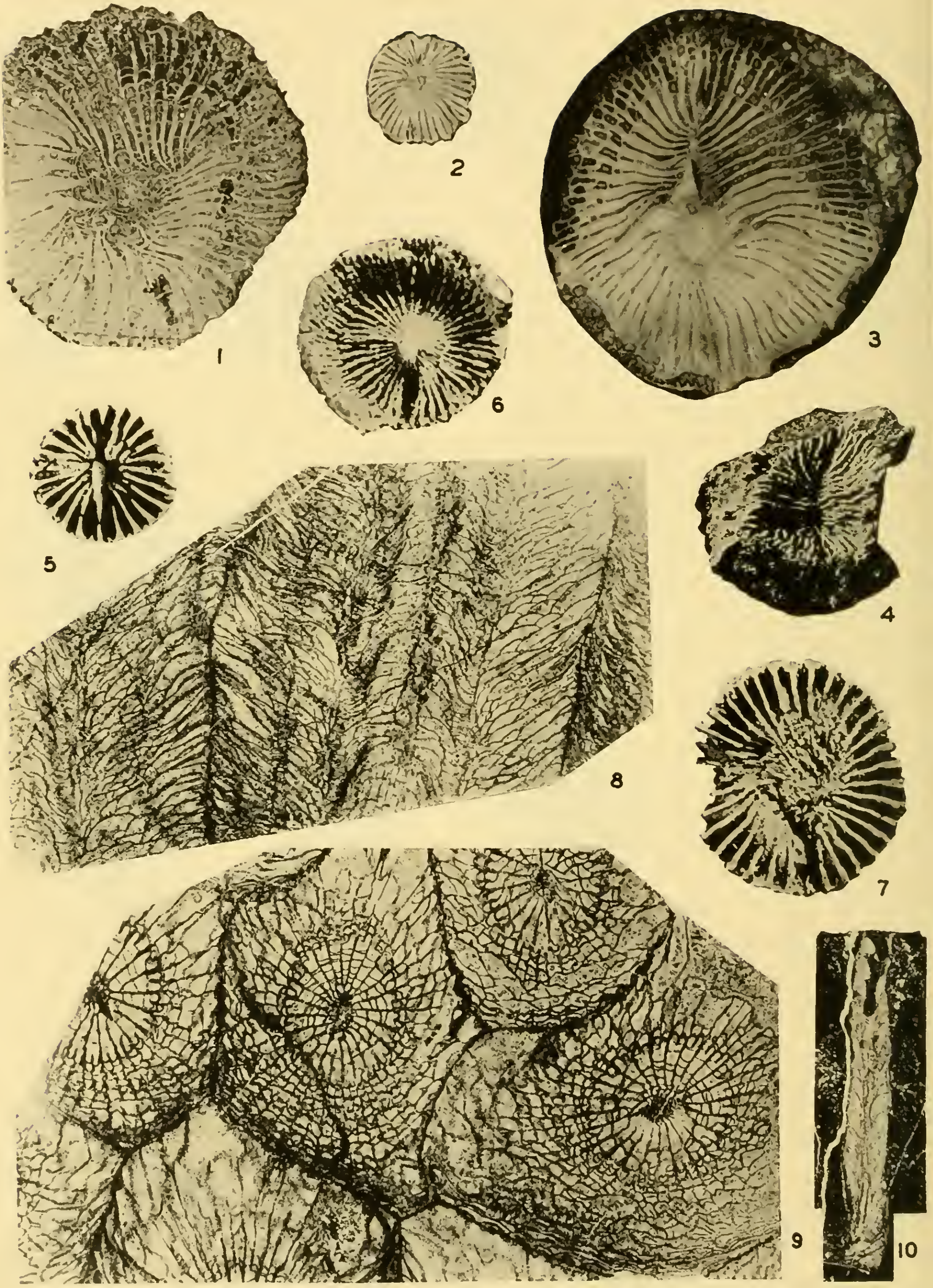

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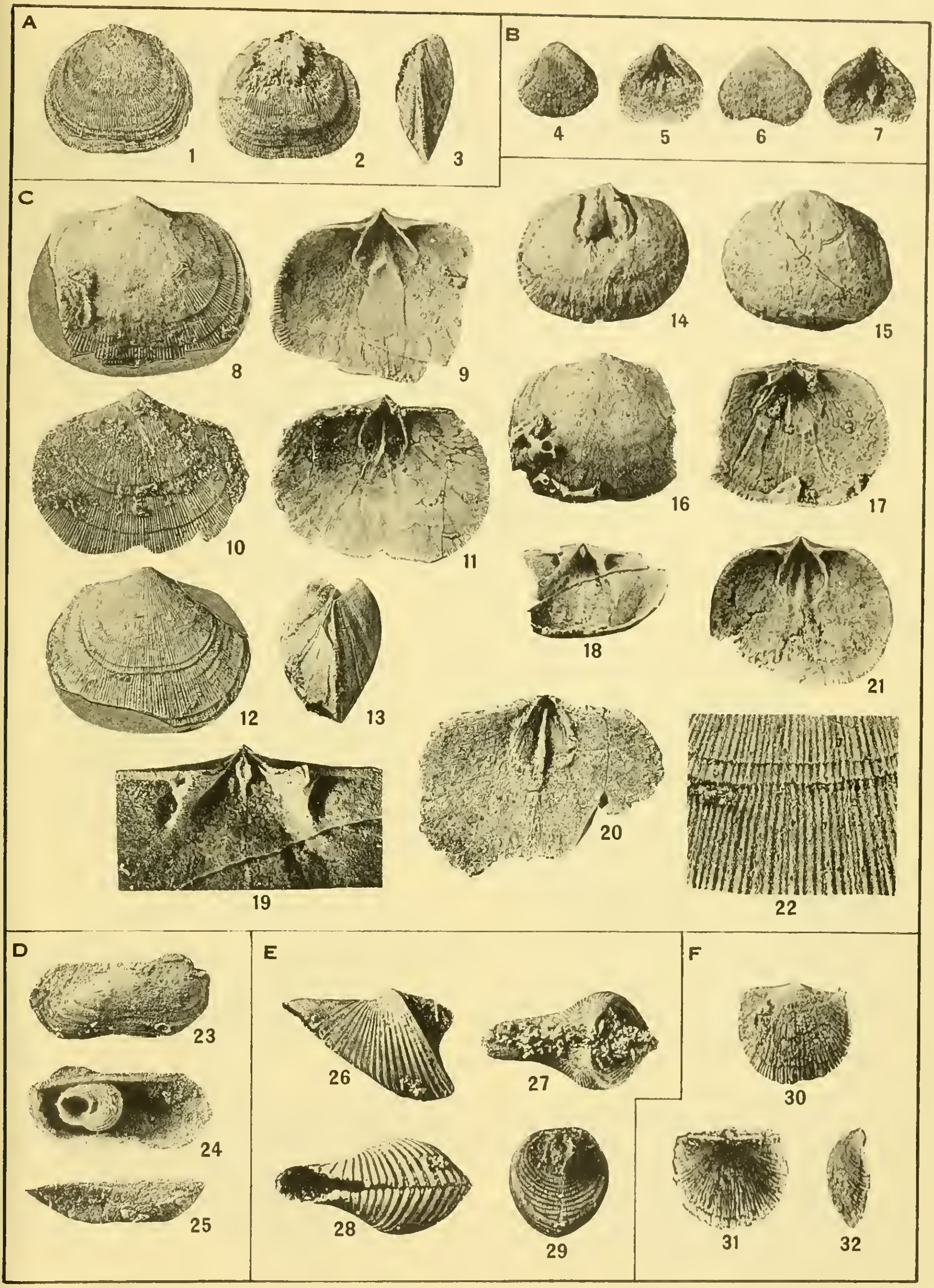

BRACHIOPODA AND PELECYPODA

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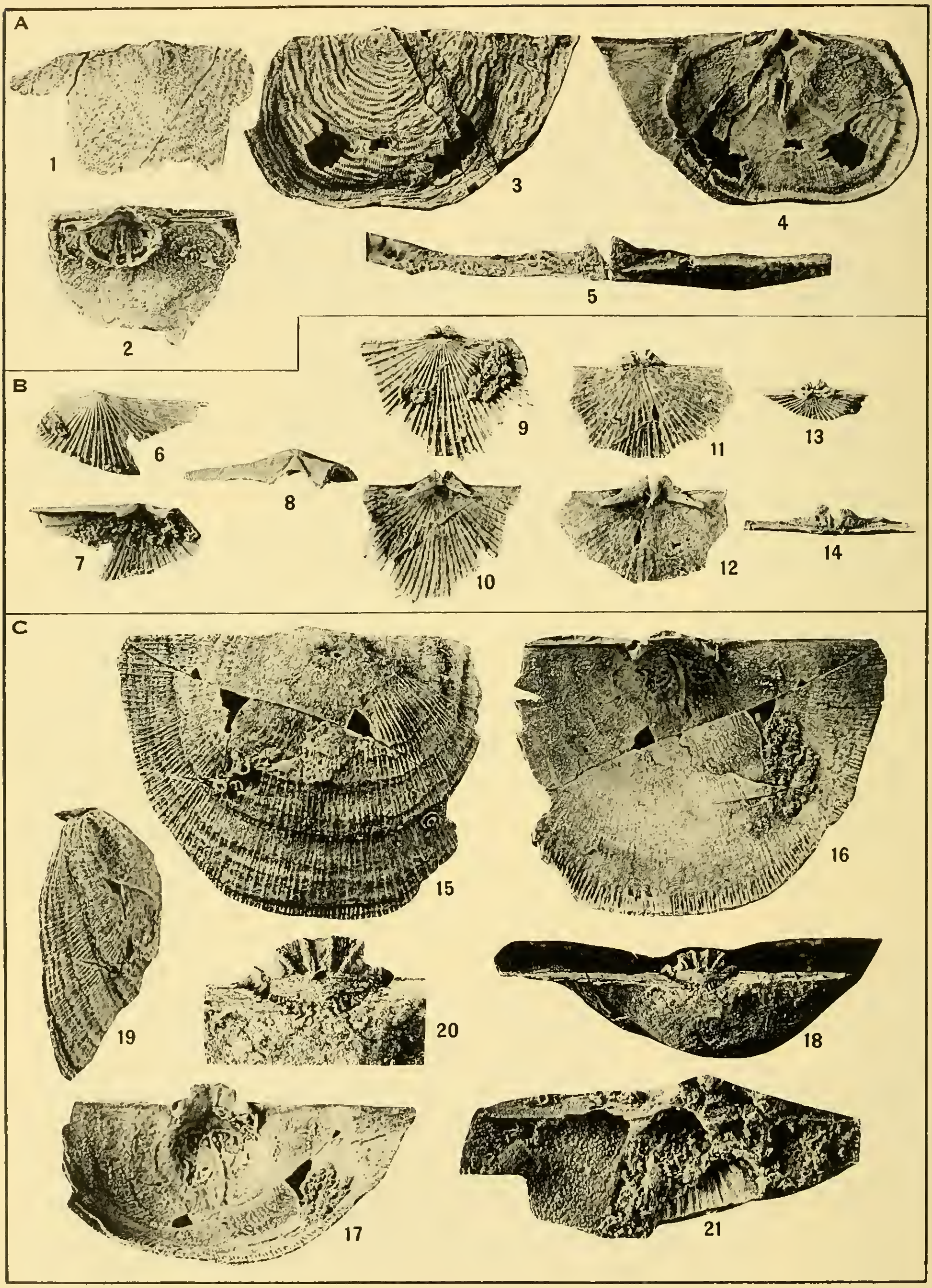

BRACHIOPODA

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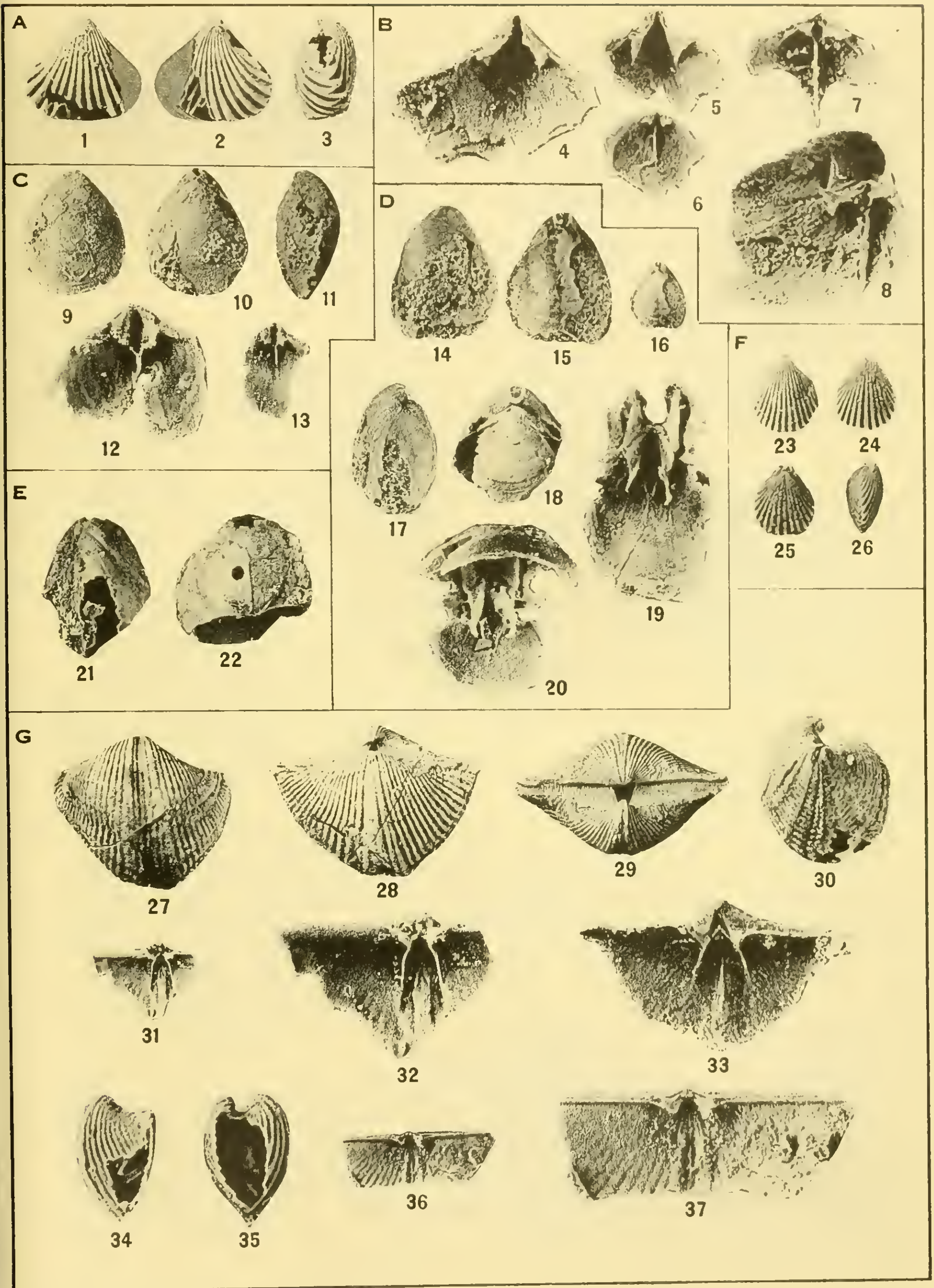

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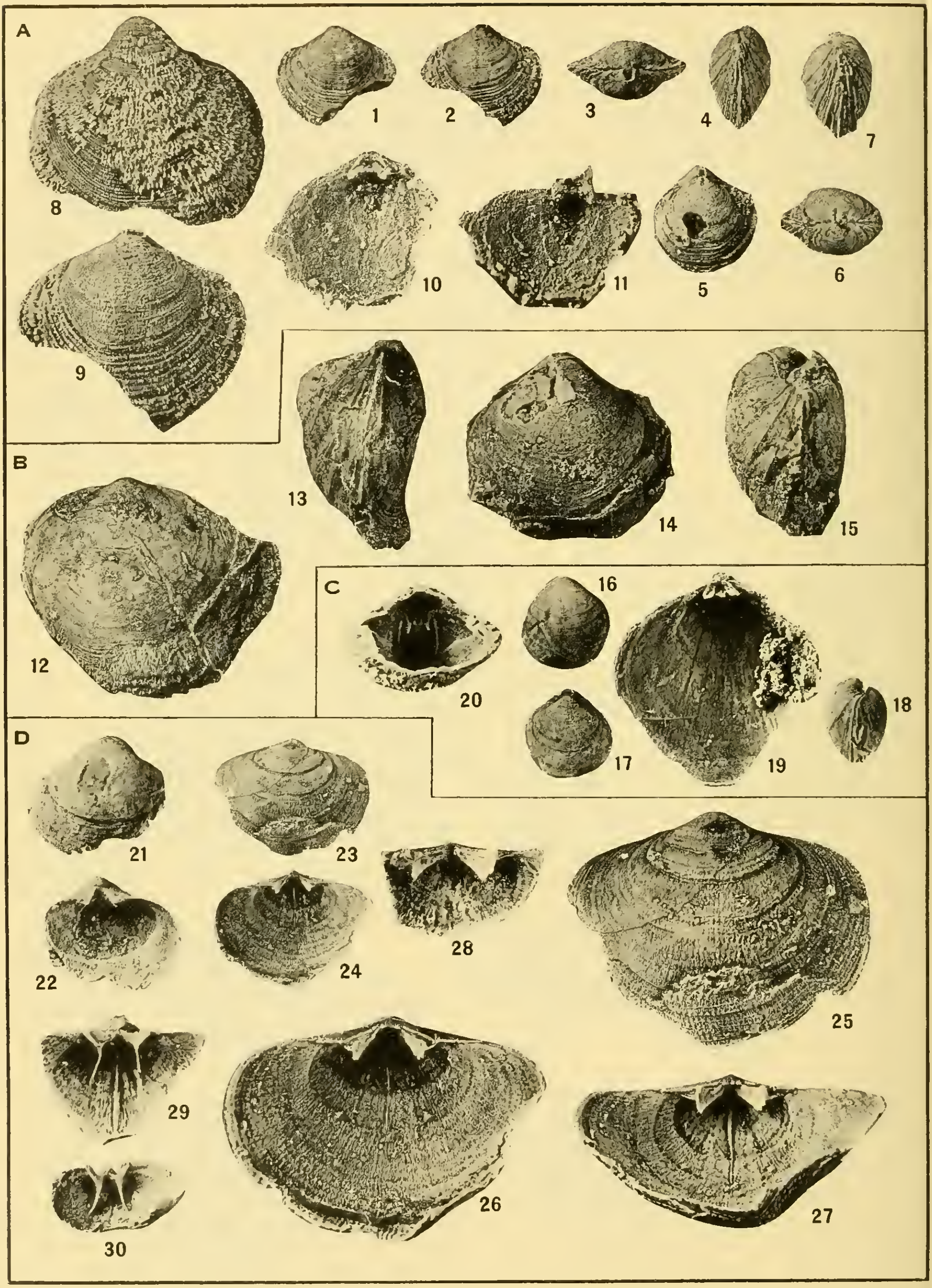

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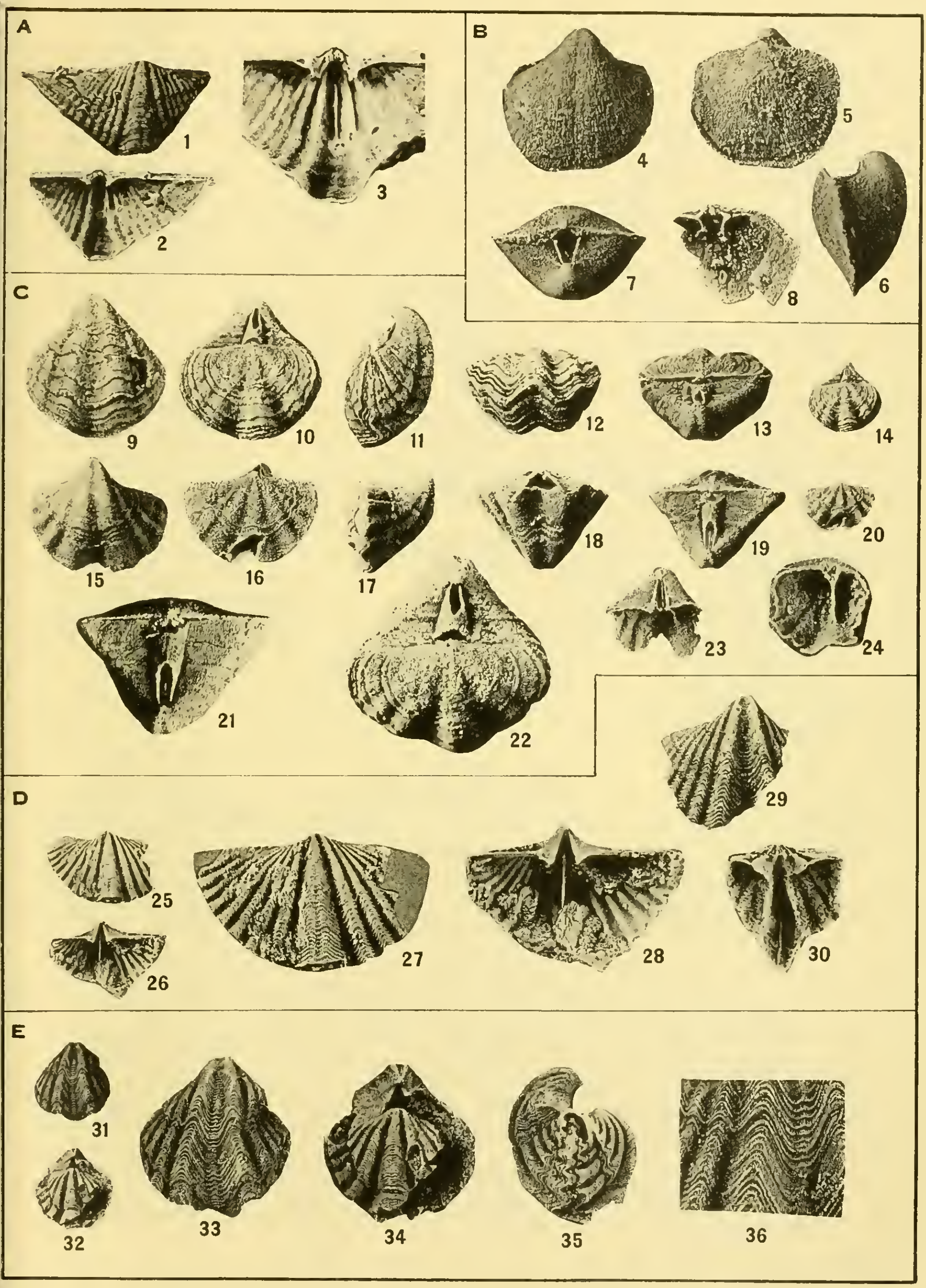

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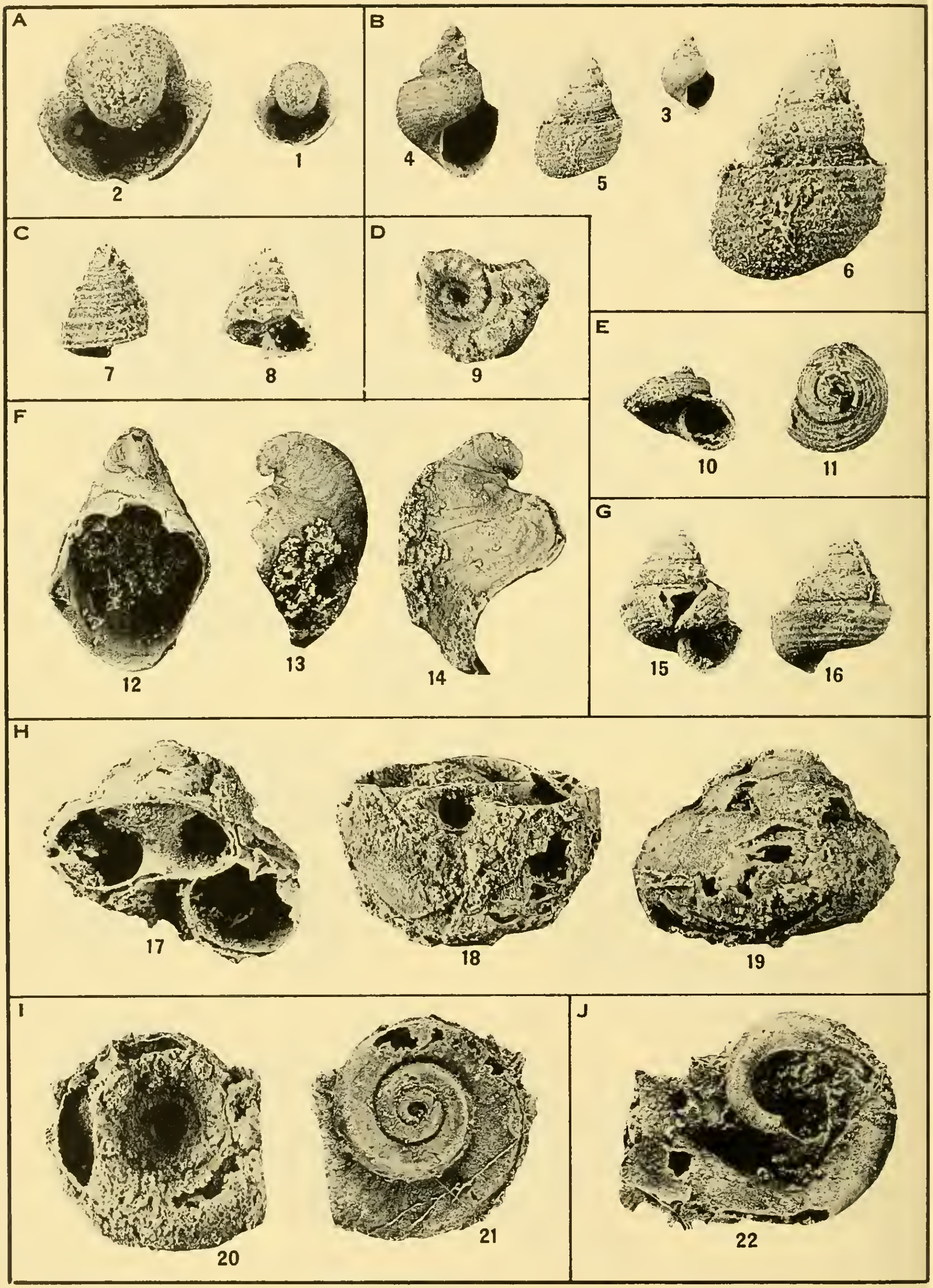

GASTROPODA

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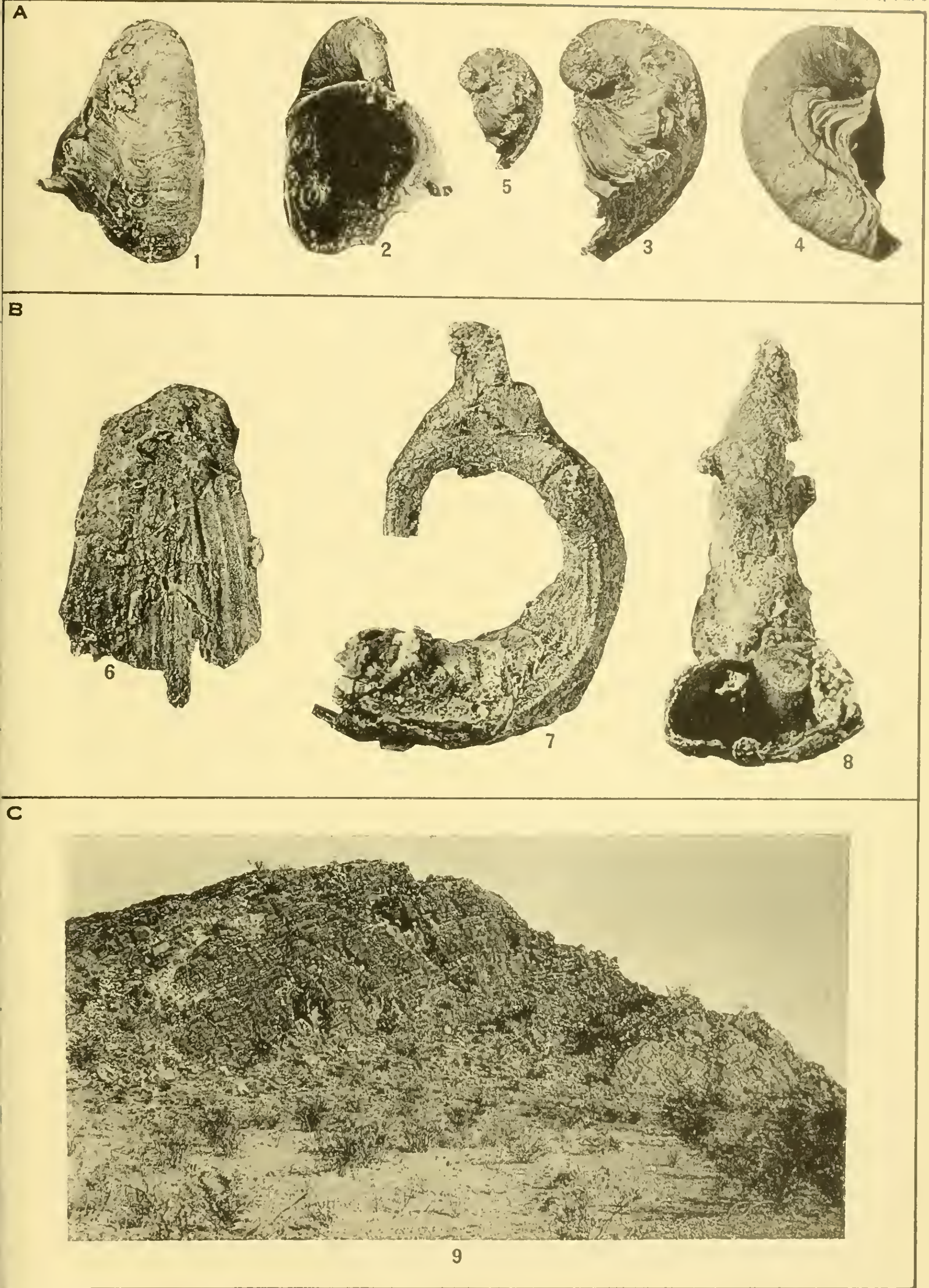

GASTROPODA, CEPHALOPODA, AND HILL OF MISSISSIPPIAN REPRESO LIMESTONE

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