BRYOZOAN FAUNAS OF THE STONES RIVER GROUP OF CENTRAL TENNESSEE.

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CONTENTS.

ILLUSTRATIONS

MAPS

TABLES

PLATES

Introduction.

In 1915 the State Geological Survey and the University of Tennessee employed Dr. J. J. Galloway and the writer to make a survey of the geology and soils in the central part of the state. A county was chosen as the unit of area for this work. The study of the geology of Rutherford County was completed the first season, and the results published in a report written by Dr. Galloway. It contains a discussion of the topography, descriptive, structural, and historical geology, and natural resources of the area, with an areal geological map and numerous diagrams.

Collections of fossils from the separate divisions of the Stones River beds were made at every favorable locality during the first field season (1915) and during the second (1916) when the writer returned to complete the soil mapping. A study of the material collected was made at Indiana University under the efficient and authoritative direction of Dr. E. R. Cummings and aided by the useful suggestions of Dr. J. J. Galloway. The results of the paleontologic work forms the basis for this paper. The identifications and a portion of the descriptions were completed before making a visit to the U. S. National Museum to compare the new and old forms with the unpublished material of Dr. E. O. Ulrich and Dr. R. S. Bassler. It was discovered that they had the following species described and photographed:

Ceramoporella grandis, new species.
Ceramoporella ingenua, new species.
Monticulipora compacta, new species.
Monticulipora discula, new species.
Monticulipora intersita, new species.

In order to avoid complications of nomenclature by introducing new names for the used but unpublished ones the following given by Ulrich and Bassler were adopted:

*Anolotichea *explanata*.
*Mesotrypa *crustulata*.
*Mesotrypa *dubia*.
*Constellaria *lamellosa*.
*Nicholsonella *frondifera*.
*Hallopora *spissata*.
*Batostoma *subcrassum*.
Batostoma *dendroidea*.
Bastostoma *conferta*.
Batostoma *inutilis*.
*Stromatotrypa *lamellata*.
*Rhinidictya *tabulata*.
*Stictoporella *cribrilina*.

Photographs of those above marked with an asterisk (*) were furnished by Dr. Bassler. The descriptions are the individual work of the writer and where the new forms were independently recognized from his collections a cotype was used. For the privilege to publish the descriptions of the new species prepared by Ulrich and Bassler, which increases the value of this paper as a paleontological contribution, expressions of gratitude are due to Dr. Ulrich and Dr. Bassler.

GENERAL GEOLOGY OF THE STONES RIVER GROUP OF CENTRAL TENNESSEE.

The formations of the Stones River group outcrop upon the crest and west slope of Nashville dome in Rutherford, Wilson, Bedford, Marshall, Davis, Cannon, Williamson and Murray counties, where the Stones, Duck, Harpeth and Cumberland rivers have eroded their valleys through the younger beds.

In 1851 J. M. Safford[1] studied the limestones in central Tennessee and gave the name Stones River to the series of beds that appeared at the surface in the bluffs along that stream. In 1869[2] he published a description of the formations and considered the group equivalent in age to the Trenton of New York at which time he abandoned the name he had formerly used.

Twenty-eight years later Winchell and Ulrich[3] revived the name Stones River and included within the group the Carters' limestone, and in 1900 Safford and Killebrew[4] redefined the group and published a brief description of the formations.

The upper member of the Stones River group occurs in the Columbia, Tennessee, quadrangle and was studied by Hayes and Ulrich[1] in 1903, and lists of fossils from the lower members are published in the folio.

The Carters limestone was transferred from the Stones River to the Black River group in 1915 by Mr. Ulrich.[2] Further study and mapping of the limestones of Stones River age was done by Ulrich and Bassler during 1908 in the Woodbury, Tennessee, quadrangle, but a report has not yet been published.

The following table gives the names and chronological order of the divisions of the Stones River group as developed in central Tennsesee: (Formations present are given in *italics*.)

Cenozoic				
Mesozoic				
Paleozoic	Permian			
	Pennsylvanian			
	Mississippian			
	Devonian			
	Silurian			
	Ordovician	Cincinnatian		
		Mohawkian		
		Chazyan	Blount	
			Stones River	*Lebanon*
				Ridley
				Pierce
				Murfreesboro
				Mosheim
		Big Buffalo series		
	Canadian			
	Ozarkian			
	Cambrian			
Proterozoic				

Murfreesboro limestone. Safford referred to the Murfreesboro limestone as the "Central limestone" in his Geology of Tennessee published in 1869[1], because it occurred in the center of the state. The name of this formation was changed to Murfreesboro limestone in 1900 by Safford and Killebrew[2] when they believed that the city of Murfreesboro was near the center of its

[1] Am. Jour. of Sci. and Arts, 2nd ser., Vol. XII, p. 352.
[2] Geol. of Tenn., p. 258.
[3] Geol. of Minn., Vol. III, Pt. II, p. xc, (1897).
[4] Elem. Geol. of Tenn., p. 125, (1900).
[1] U. S. Geol. Survey Folio 95 (1903).
[2] U. S. Nat. Bull. 92, Pl. II.

circular outcrop, but they confused the Murfreesboro and Ridley limestones at this time.

The Murfreesboro limestone is the oldest formation exposed on the Nashville dome and outcrops only in Rutherford County upon the crests of secondary upfolds that occur along the valleys of Stones River and its tributaries. Thus, instead of a single area in which the formation appears at the surface, there are numerous small and isolated localities.

The beds consist of thick layers of bluish gray, dense, bituminous limestones with much disseminated chert which appears upon weathered surfaces in small irregular masses. At Lascassas, Rutherford County, the lower fifteen feet of the twenty-seven feet exposed consists of sandy, laminated, ripple-marked and sun-cracked limestone, which is evidence that the sea was shallow and the shore line probably not far distant during the closing stage of the deposition of the Murfreesboro limestone.

Fossils are few and difficult to obtain from the unweathered limestone; but in the residuum resulting from the weathering of many feet of the formation, and in the cherty masses upon the surface of the exposed rock, silicified specimens occur in considerable abundance. Some of the best localities are near the Central Normal School, at Murfreesboro, and upon the bluffs of Stones River near the Nashville pike. *Salterella billingsi, Lophospira perangulata, Liospira abrupta, Helicotoma tennesseensis, H. declivis* are the most abundant species and are characteristics of the formation.

The maximum exposure of this limestone is seventy feet, with the basal beds not exposed.

Pierce limestone. This formation was named by Safford[1] in 1869, from the splendid outcrop near Pierce's Mill, one-half mile south of Walter Hill, Rutherford County. It consists of several lithological members as follows: The lower four to six feet is a massive dove-colored, coarsely crystalline limestone. The next one to two feet consists of thin bedded dense light blue limestone interbedded with coarsely crystalline layers which are fossiliferous. Upon this lies a massive coarsely crystalline bed having a thickness of four feet and containing few fossils. The upper fifteen to eighteen feet is made up of thin beds of dense unfossiliferous calcareous layers interbedded with coarsely crystalline limestone two to three inches thick and containing abundance of fossils. Seams of shale separate the numerous layers.

The total thickness of the formation varies from twenty-five to twenty-eight feet, it outcrops in narrow irregular belts about the areas of the Murfreesboro limestone, and it is easily recognized by the great abundance of fossils of which there is a predominance of bryozoa. The following forms are characteristic and abundant: *Nicholsonella pulchra, N. frondifera, Anolotichia explanata, Stictoporella cribrilina.*

The Pierce limestone apparently lies conformably upon the Murfreesboro

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[1]Geol. Tenn. (1869), p. 259.
[2]Elem. Geol. Tenn. (1900).
[1]Geol. Tenn. (1869), p. 261.

except at Lofton, Rutherford County, where the upper ten feet of the Murfreesboro is absent.

Ridley limestone. This limestone was named by Safford[1] in 1869 from the exposure at Ridley's Mills (now Davis' mill) near Jefferson, Tennessee. Only the lower thirty feet of the formation are exposed at this locality. The Ridley limestone has a much wider surface distribution than the older formations of the Stones River group. It accurs in Rutherford, Wilson, Bedford, Marshall, Williamson, and Davidson counties. Its thickness varies from 95 to 120 feet.

The formation consists of massive, dense, light blue, bituminous limestone with considerable chert, appearing upon the weathered surfaces. These characters are much like those of the Murfreesboro limestone, and it is not surprising that Safford confused the formations lithologically. The faunas, however, are decidedly different, but in many outcrops fossils do not occur and correlation is uncertain except where the contacts with either the Pierce or the Lebanon are seen.

The Ridley limestone is in most places apparently conformable upon the Pierce, except near Jefferson, Rutherford County, where the contact is slightly undulating. The small variation in thickness of the Pierce limestone does not indicate a prolonged period of erosion. The following are among the most characteristic and abundant fossils: *Camerella varians, Hebertella bellarugosa, Gonioceras anceps, Orbignyella sublamellosa, Liospira convexa, Protorhyncha ridleyana* and *Stromatocerium rugosum.*

Lebanon formation. This formation was called the "glade limestone" by Safford in 1869[1], since it is the surface rock beneath the extensive "cedar glades" of central Tennessee. In 1900 Safford and Killebrew[2] changed the name to "Lebanon limestone" presumably from the splendid outcrops of the formation in the town of Lebanon, Wilson County. The thickness measured by Safford[3] near Readyville, Rutherford County, is 118 feet. Other measurements in other localities show a variation from 80 to 120 feet.

The outcrops of this limestone extend over a considerable area in Rutherford, Wilson, Cannon, Bedford, Marshall, Maury, Williamson, and Davidson counties, and almost everywhere valuable cedars grow in the shallow Lebanon soil. The formation consists of thin layers of dense, light blue, fossiliferous limestone separated by seams of shale. In some sections a massive coarsely crystalline unfossiliferous bed of limestone occurs near the base. Ripple-, rill- and wave-marks are common in different parts of the formation, indicating that shallow water conditions prevailed at different times during the deposition of the beds.

Some layers of the formation are made up almost wholly of a single species of *Plectambonites* as seen two miles south of Murfreesboro. Other abundant and characteristic fossils are: *Scenidium anthonense, Batostoma libana, Escharopora briareus, Phragmolites grandis,* and *Zygospira saffordi.*

The Lebanon lies with apparent conformity upon the Ridley.

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[1]Geol. Tenn. (1869), p. 261.
[1]Geol. Tenn. (1869), p. 258.
[2]Elem. Geol. Tenn. (1900), p. 125.
[3]Geol. Tenn. (1869), p. 263.

PALEONTOLOGY OF THE STONES RIVER GROUP OF CENTRAL TENNESSEE.

In correlating the formations of Stones River age in other localities with the beds in central Tennessee, it has been found necessary to have available a complete list[1] of the fossils described from the Murfreesboro, Pierce, Ridley, and Lebanon formations.

Murfreesboro Limestone.

Ctenodonta gibberula Salter.
Cyclonema (? Gyronema) praeciptum Ulrich.
Cyrtoceras ? stonense Safford.
Cryptospira tortilis Ulrich.
Dinorthis deflecta (Conrad).
Eccliomphalus contiguus Ulrich.
Ectomaria prisca extenuata Ulrich.
Eotomaria canalifera Ulrich.
Eotomaria labiosa Ulrich.
Gonioceras occidentale Hall.
Helicotoma declivis Ulrich.
Helicotoma subquadrata Ulrich.
Helicotoma tennesseensis Ulrich and Scofield.
Leperditia fabulites (Conrad).
Liospira abrupta Ulrich and Scofield.
Liospira americana (Billings).
Liospira decipiens Ulrich.
Liospira progne (Billings).
Liospira subconcava Ulrich.
Lophospira bicincta (Hall).
Lophospira centralis Ulrich.
Lophospira perangulata (Hall).
Lophospira procera Ulrich.
Lophospira (?) trochonemoides Ulrich.
Maclurites magnus Lesueur.
Maclurites nitidus (Ulrich and Scofield).
Modiolopsis (?) consimilis Ulrich.
Nicholsonella frondifera, new species.
Nicholsonella pulchra Ulrich.
Ophiletina sublaxa depressa Ulrich and Scofield.
Orthis tricenaria Conrad.
Pianodema subaequata (Conrad).
Plectoceras bondi (Safford).
Pterygometopus troosti (Safford).
Raphistomina modesta Ulrich.

[1]The list of fossils is compiled from Bulletin 92 U. S. Nat. Mus. and from the study of collection made from the different formations of the Stones River group.

Salterella billingsi Safford.
Tetranota bidorsata (Hall).
Trochonema bellulum Ulrich.
Whiteavesia saffordi (Ulrich).
Zittelella varians (Billings).

Pierce Limestone.

Anolotichia explanata, new species.
Batostoma conferta, new species.
Batostoma dendroidea, new species.
Batostoma inutilis, new species.
Batostoma ramosa, new species.
Batostoma suberassum, new species.
Ceramoporella grandis, new species.
Caramoporella ingenua, new species.
Chasmatopora sublaxa (Ulrich).
Coeloclema consimile, new species.
Coeloclema inflatum, new species.
Coeloclema pierceanum, new species.
Columnaria alveolata, Goldfuss.
Constellaria lamellosa, new species.
Corynotrypa delicatula (James).
Corynotrypa tennesseensis, Bassler.
Dinorthis deflecta (Conrad).
Diplotrypa catenulata, new species.
Eccyliomphalus contiguus, Ulrich.
Escharopora angularis Ulrich.
Escharopora confluens Ulrich.
Eurychilina subradiata Ulrich.
Graptodictya dendroidea, new species.
Graptodictya fruticosa, new species .
Hallopora florencia, new species.
Hallopora spissata, new species.
Hebertella bellarugosa (Conrad).
Helopora spiniformis (Ulrich).
Hemiphragma irrasum (Ulrich).
Heterotrypa patera, new species.
Heterotrypa stonensis, new species.
Leperditia fabulitis (Conrad).
Liospira americana (Billings).
Liospira progne (Billings).
Lophospira bicincta (Hall).
Maclurites magnus Lesueur.
Mesotrypa crustulata, new species.
Mesotrypa dubia, new species.
Monticulipora compacta, new species.

Monticulipora discula, new species.
Monticulipora intersita, new species.
Nicholsonella frondifera, new species.
Nicholsonella pulchra Ulrich.
Orbignyella multitabulata, new species.
Orbignyella sublamellosa Ulrich and Bassler.
Orthis tricenaria Conrad.
Pachydictya cf. fimbriata.
Pachydictya cf. foliata.
Pachydictya senilis, new species.
Paleocrinus culcatus Safford.
Pianodema stonensis (Safford).
Pianodema subaequata (Conrad).
Protorhyncha ridleyana (Safford).
Pterygometopus troosti (Safford).
Rafinesquina incrassata (Hall).
Rhinidictya nashvillensis (Miller).
Rhinidictya tabulata, new species.
Stictoporella cribrilina, new species.
Stromatotrypa incrustans, new species.
Stromatotrypa lamellata, new species.
Stromatotrypa regularis, new species.
Strophomena incurvata (Shepard).
Tetradium syringoporoides Ulrich.
Zygospira saffordi Winchell and Schuchert.

Ridley Limestone.

Anolotichia explanata, new species.
Camarella varians, Billings.
Chasmatorpora sublaxa (Ulrich).
Constellaria lamellosa, new species.
Ctenobolibina subcrassa, Ulrich.
Dekayella ridleyana, new species.
Dianulites cf. petropolitanus.
Dinorthis deflecta (Conrad).
Drepanella ampla, Ulrich.
Eccyliomphalus contiguus Ulrich.
Escharopora suberecta (Ulrich).
Gonioceras anceps Hall.
Hallopora spissata, new species.
Hebertella bellarugosa (Conrad).
Helopora spiniformis (Ulrich).
Hemiphragma irrasum (Ulrich).
Leperditia fabulites (Conrad).
Liospira americana (Billings).

Liospira convexa Ulrich and Scofield.
Liospira progne (Billings).
Lophospira bicincta (Hall).
Maclurites magnus Lesueur.
Monticulipora discula, new species.
Nicholsonella frondifera, new species.
Orbignyella sublamellosa Ulrich and Bassler.
Orthis tricenaria Conrad.
Pachydictya cf. foliata.
Pianodema stonensis (Safford).
Pianodema subaequata (Conrad).
Protorhyncha ridleyana (Safford).
Pterygometopus troosti (Safford).
Rafinesquina incrassata (Hall).
Rhinidictya nashvillensis (Miller).
Rhinidictya tabulata, new species.
Stictoporella cribrilina, new species.
Stromatotrypa lamellata, new species.
Stromatocerium rugosum Hall.
Strophomena incurvata (Shepard).
Tetradium syringoporoides Ulrich.
Zittella varians (Billings).

Lebanon Limestone.

Arthroclema striatum Ulrich.
Batostoma libana (Safford).
Camarotoechia orientalis (Billings).
Ceramoporella grandis, new species.
Ceraurinus scofieldi (Clarke).
Chasmatopora sublaxa (Ulrich).
Cleiocrinus tessellatus (Troost).
Columnaria alveolata Goldfuss.
Corynotrypa delicatula (James).
Corynotrypa tennesseensis Bassler.
Dinorthis deflecta (Conrad).
Drepanella elongata Ulrich.
Drepanella macra Ulrich.
Eccyliomphalus contiguus Ulrich.
Escharopora briareus (Ulrich).
Escharopora libana (Safford).
Escharopora ramosa (Ulrich).
Eurychilina subradiata Ulrich.
Fletcheria incerta (Billings).
Hebertella borealis (Billings).
Hebertella bellarugosa (Conrad).
Helopora spiniformis (Ulrich).

Hemidictya lebanonensis, new species.
Hudsonaster narrawayi (Hudson).
Leperditia fabulites (Conrad).
Liospira americana (Billings).
Liospira progne (Billings).
Lophospira bicincta (Hall).
Maclurites magnus Lesueur.
Monticulipora discula, new species.
Nicholsonella frondifera, new species.
Nicholsonella pulchra Ulrich.
Orbignyella nodosa, new species.
Orthis tricenaria Conrad.
Pachydictya cf. foliata.
Phragmolites grandis (Ulrich).
Pianodema subaequata (Conrad).
Primitiella limbata Ulrich.
Pterotheca saffordi (Hall).
Pterygomatopus troosti (Safford).
Rafinesquina incrassata (Hall).
Rhinidictya basalis (Ulrich).
Rhinidictya lebanonensis, new species.
Rhinidictya tabulata, new species.
Rhinidictya trentonensis (Ulrich).
Scenidium anthonense Sardeson.
Schmidtella subrotunda Ulrich.
Solenopora compacta (Billings).
Streptelasma (?) parasiticum Ulrich.
Stromatotrypa lamellata, new species.
Strophomena incurvata (Shepard).
Tetradium syringoporoides Ulrich.
Tetranota sexcarinata Ulrich and Scofield.
Trigonidictya irregularis, new species.
Trochonema eccentricum Ulrich.
Trochonema umbilicatum latum Ulrich.
Zygospira saffordi Winchell and Schuchert.

STRATIGRAPHY AND PALEONTOLOGY OF THE STONES RIVER LIMESTONE (OUTSIDE OF CENTRAL TENNESSEE).

Eastern Tennessee. In the "Revision of the Paleozoic System"[1] Dr. Ulrich advocates the idea of compensatory oscillation of the various basins or troughs in eastern Tennessee during the early Ordovician period and in this manner accounts for the absence in one and the presence in another area of the different beds of the Stones River and later formations.

The Mosheim basin covered an area which became a number of separate troughs during later stages. The deposit made at this time is referred to the lowest Stones River and is older than any formation exposed in the central basin of Tennessee. Little has been published concerning the fauna of the Mosheim and apparently its age is determined by its occurrence upon the upper Knox of Canadian age and below the Lenoir limestone of undoubted Stones River age.

The Lenoir limestone was identified by Safford and Killebrew and referred to by them in the Elementary Geology of Tennessee (1900) as the "Maclurea limestone" from the abundance of *Maclurites magnus* which it contains. A fossil list of twenty-two species consisting of brachiopods, gastropods, trilobites, ostracods, corals, and sponges is published in Bulletin 92 of the United States National Museum. In comparing this list with the faunas of the Central Basin it is found that two species, *Maclurites magnus* and *Zittela varians*, which are characteristic of the middle Stones River, occur in both areas. Zittela variens is found in the Ridley limestone and Maclurites magnus in all divisions of the Stones River in the Central Basin area, which indicates that the Lenoir limestone is probably equivalent in age to more than the Pierce formation as expressed by Dr. Ulrich. It is possible that the bryozoan fauna concerning which little is published will further restrict the boundaries.

Virginia. The Stones River group is present in the western part of Virginia, where it is represented by a thickness of 900 feet of heavily bedded dolomitic layers interbedded with pure, dove-colored limestones. The thickness diminishes southward. The presence of the dove-colored beds and the growth of cedars in the soil upon the formation are conspicuous characters that distinguish the Stones River from other limestones of this region, features which are identical with the type area of the Stones River in central Tennessee.

Until the study of the fossils from the limestones in West Virginia was made by Dr. Bassler,[1] all the beds were included within the Chickamauga limestone, but he has correlated the lower part of the series with the Stones River of eastern Tennessee, on the basis of the occurrence of *Leperditia fabulites* (Conrad), *Lophospira serrulata* (Salter), *L. perangulata* (Hall), and a single *Tetradium*, probably *Tetradium syringoporides* Ulrich and also because of lithologic similarity and stratigraphic position. The group of fossils undoubtedly determines the age to be equivalent to that of the Stones River limestone in the central basin of Tennessee.

West Virginia, Maryland and Pennsylvania. At Martinsburg, West Virginia, 675 feet of limestone is referred by Ulrich and Stoss to the Stones River. They measured the following section:[1]

4.	Light to dark drab limestone banded with thin earthy or magnesian seams	275	feet
3.	Similar beds, less well exposed	200	feet
2.	Dark gray to dove-colored fine even-grained pure limestone (quarried)	100	feet
1.	Similar fine-grained, dove-colored limestone increasing downward in magnesium (quarried)	100	feet
	Total	675	feet

[1]Bulletin Geol. Soc. of Amer. Vol. 22.
[1]Cement Resources of Virginia. Bull. II—A, 1909.

The thickness of the Stones River limestone increases as traced northward into Maryland and Pennsylvania reaching 1000 feet in the Mercersburg-Chambersburg quadrangle. In these states it outcrops in elongated areas due to the great amount of faulting, folding, and erosion. Massive and thin-bedded limestones interbedded with magnesian layers and dove-

[1]U. S. Geol. Survey Folio 170, p. 7.

colored purer limestones with considerable chert characterizes the formation lithologically.

The following fossils identified from collections made at Guilford Springs, Pennsylvania, are from the dove-colored, cherty limestone members:[1]

Girvanella cf. chazyensis.
Tetradium syringoporides.
Hebertella borealis.
Hebertella vulgaris.
Dinorthis cf. platys.
Strophomena aff. charlottae.
Maclurites magnus.
Lophospira bicincta.
Isochilina cf. amiana.
Ampyx halli.

A comparison of this list with those from the Stones River group in central Tennessee indicates an equivalent age.

Near Bellefonte, Pennsylvania, J. L. Collie[2] has referred 253 feet of fossiliferous limestone to the Stones River. From the lower horizon of these beds *Bathyrurus extans*, *Strophophema filitexta* and *Protorhyncha ridleyana* were identified which correlates the bed with the Ridley limestone of Central Tennessee. The beds above were regarded as of Lebanon age from the occurrence of *Lophospira milleri* and the great abundance of *Leperditia fabulites*. Below the Ridley beds and above the highest fossiliferous horizon containing Beekmantown species, there are 2335 feet of unfossiliferous dolomite the upper part of which may be equivalent in time to the Murfreesboro and Pierce limestones of the Central Basin area in Tennessee.

Eastern New York and Western Vermont. Through the work of Raymond and others upon the lower Chazy of New York and Vermont (Day Point and Crown Point limestones), there is made available a considerable faunal list which is published in Bulletin 92 of the United States National Museum. A comparison of the 64 species from the Day Point limestone with other Chazyan faunas shows that it is more closely related to the Appalachian Stones River than to the limestones of the interior area. *Camarella longirostris* Billings, *Bumastus globosus* (Billings) *Bucania sulcatina* Emmons, *Eurychilina latimarginata* Raymond, *Holopea scrutator* Raymond, *Scenella pretensa* Raymond, *Stylaria parva* (Billings) are characteristic Chazyan forms of the Appalachian-Champlain embayment and are found in the Day Point limestone of New York and the Lenoir limestone of eastern Tennessee.

The Crown Point limestones apparently lie conformably upon the Day

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[1]U. S. Geol. Survey Folio 170, p. 8.
[2]Geol. Soc. of Amer. (1908).

Point. One hundred five species are identified from the collection made from this formation of which the following appear in the Lenoir limestone of eastern Tennessee:

Camarella varians Billings.
Dinorthis platys Raymond.
Dinorthis strophomenoides (Raymond).
Eurychilina latimarginata (Raymond).
Hebertella vulgaris Raymond.
Holopea scrutator Raymond.
Leperditia limatula Raymond.
Maclurites magnus Lesueur.
Rafinesquina incrassata (Hall).
Raphistoma stamineum (Hall).
Scenella robusta Raymond.
Stylaria parva (Billings).

The comparison leads to the conclusion that the Chazy basin of New York and of eastern Tennessee were directly connected and inter-migration took place freely. Only three of the above species occur in central Tennessee, these being the only representatives of the migrants from the Atlantic coastal area that reached the Gulf of Mexico Embayment and the basins of the eastern Chazyan seas.

Kentucky, Central New York and Canada. The beds deposited during the Stones River time in the state of Kentucky are exposed at the base of the falls at Highbridge. The following species collected from that locality are characteristic of the Lebanon:

Drepanella ampla Ulrich.
Drepanella elongata Ulrich.
Eurychilina aequalis Ulrich.
Eurychilina granosa Ulrich.
Liospira progne (Billings).

There is no known deposit of Stones River age outcropping in the state of Ohio, but the distinctly Stones River fauna occurring in the Pamelia limestone of central New York indicates that a passageway existed which connected the latter area with Kentucky and Tennessee.

The following is a list of fossils occurring in the Pamelia limestone as recorded in Bulletin 92, United States National Museum:

Bathyurus acutus Raymond.
Cyrtodonta breviuscula Billings.
Helicotoma whitcaresiana Raymond.
Isochilina ? clavigera (Jones).
Isochilina clavigera clavifracta (Jones).
Leperditella ? labellosa Jones.
Leperditia amygdalina Jones.
Leperditia balthica primaeva Jones.
Leperditia fabulites (Conrad).

Liospira americana (Billings).
Liospira decens (Billings).
Liospira progne (Billings).
Lophospira bicincta (Hall).
Maclurites magnus Lesueur.
Nanno kingstonensis Whiteaves.
Orthis tricenaria Conrad.
Pianodema subaequata (Conrad).
Pterygometopus troosti (Safford).
Strophomena incurvata (Shepard).
Tetradium syringoporoides Ulrich.

Of these twenty species, ten occur in the divisions of the Stones River in Tennessee. Ostracods are abundant throughout the formation, and gastropods, cephalopods, corals, and trilobites are common in the lower part.

A pebbly conglomerate and sandstone occurs at the base of the Pamelia and extends northward beyond the limit of the limestone into Canada, where it is named Rideau sandstone.

Near L'Original, Canada, the following species have been collected from limestones that are equivalent in age to the Pamelia of New York:

Leperditia amygalina Jones.
Leperditia balthica primaera Jones.
Leperditia fabulites Conrad.
Liospira decens (Billings).
Liospira progne (Billings).
Nanno kingstonensis Whiteaves.

STRATIGRAPHIC CORRELATIONS.

The sea in which the Stones River beds of the interior area of North America were deposited is designated as the Gulf of Mexico Embayment[1]. It came in from the south, spreading from the Gulf of Mexico region to Oklahoma and central Tennessee during the early Stones River time where the Simpson formation and the Tennessee limestone of that age were respectively deposited. The embayment spread northward into Kentucky and covered central New York and southern Canada during the Lebanon time. The basal conglomerate at the bottom of the Pamelia (the New York deposit), the thinness of that formation, its increasing near-shore facies as it is traced northward into Canada, its apparent conformity beneath the lower Chambersburg beds of Valcour age in Pennsylvania, and the numerous fossils which it contains that are similar to the upper Stones River fossils of Tennessee, has led to the correlation of the Pamelia with the Lebanon beds, by Ulrich.

The Appalachian and Champlain troughs had direct connections with the Atlantic and the faunas of the one mingled freely with the other, but the marked differences of the faunas of the interior basin suggest the existence of a barrier separating the eastern and interior Chazyan seas. Cush-

[1]See Paleographic Maps, pages 305-307.

ing[1] states that in New York during the early Stones River time deposition was confined to the Champlainian trough, and following the retreat of that sea to the northwest into the St. Lawrence Gulf at the close of the Crown Point stage, the Gulf of Mexico Embayment came into central New York from the south, bringing in species and genera similar to the southern interior faunas. During the upper Pamelia time the gulf connections were restricted and somewhat later the sea was drained from the New York region and the Champlain trough became again the area of deposition during the upper Chazyan (Valcour stage).

BRYOZOAN FAUNAS OF THE STONES RIVER GROUP[2].

The earliest known bryozoan, *Heteronema priscum*, is a ctenostomatous form and occurs in the Ungulite sandstone at Jegelecht Falls, Esthonia, Russia. In Sweden this standstone has been referred to the basal Ordovician by Swedish geologists from the presence of the fossil *Obolus apollinis*. The earliest American form is a species of Nicholsonella from the Beekmantown of Arkansas. Following these occurrences in chronological succession comes the earliest prolific fauna of the Stones River limestone in central Tennessee. Considerable work has been done on the bryozoan faunas of the early Mohawkian beds that occur in different places in North America but up to this time very little has been published. The description of several species collected from the Stones River of the Central Basin area in Tennessee and published in the "Final Report of the Geological and Natural History Survey of Minnesota," Volume 3, 1893, by E. O. Ulrich, is the most important paleontological contribution. The published work on the bryozoan fauna in other localities has been of a general nature and in many cases the author only suggested that a considerable fauna of bryozoa was indicated by the numerous fragments of this class of fossils. In other cases collections containing abundance of bryozoa have been made and laid aside until more time was available to study them. The present report is the most extensive publication up to this time based upon new and described forms of the Stones River bryozoa. The full value of the work cannot be realized until the faunas of other areas have been studied in detail and some of the conclusions reached may be modified when the information from other areas is available. Considerable work has already been done by the writer upon the bryozoa from the Chazy of New York which will form the basis of a subsequent paper.

Murfreesboro fauna. The bryozoa collected are few and poorly preserved and it is only the large trepostomatous species that can be identified from the exterior surface, which are included in the table showing the range and distribution of all the Stones River forms. The interior structure of all of the observed specimens is destroyed by silicification. No gtenostomata are reported from the Murfreesboro or later divisions of the Stones River.

Pierce fauna. Bryozoa are very abundant in the Pierce limestone. The Order Cyclostomata is represented by five genera and nine species. All

[1]Geol. Soc. of Amer. (1901).
[2]Reference table, page 308.

forms are members of the family Ceramoporidae. The twelve trepostomatous genera are represented by twenty-four species. The Batostoma, Hallopora and Nicholsonella are most abundant and appear in every locality from which collections have been made. Seven genera and twelve species belong to the order Cryptostomata. Graptodictya, Rhinidictya and Escharopora are the most abundant in number of specimens.

Ridley fauna. Bryozoa in the Ridley limestone are not usually conspicuous. Orbignyella occurs in many of the outcrops of the formation, but good collecting localities for the other forms are rare.

Lebanon fauna. In many localities bryozoans are abundant. The Cryptostomata are most abundant in genera and species, but the large Trepostomatous forms are most conspicuous.

Arthoclema striatum Ulrich. Numerous species that are identical with the Black River forms are found in the Lebanon formation.

Chasmatopora sublaxa (Ulrich). This species is a long ranged simple cryptostomatous bryozoan. It is very abundant in the Pierce beds and is common in all other divisions of the Stones River.

Escharopora briareus (Ulrich), *E. libana* (Safford), *E. ramosa* (Ulrich), are common and characteristic of the Lebanon formation. The forms in the Pierce have been referred to *E. angularis* Ulrich, and *E. confluens*, which are common in the Black River of Minnesota.

Helopora spiniformis (Ulrich) is common in the Pierce, Ridley, and Lebanon limestones.

Numerous examples of Pachydictya resembling in all important features the *P. foliata* of the Black River of Minnesota, are compared with that species. It is abundant and grows slightly larger than the Minnesota forms.

Corynotrypa delicatulata (James) is reprsented by numerous and well preserved specimens in the Pierce and Lebanon limestone. *Corytrypa tennesseensis* Bassler is not so abundant as *C. deliculata* but many small fragments of zoaria occur in the Pierce outcrop at Ward's Mill, Rutherford County.

Mitoclema cinctosum Ulrich occurs in many places in the Ridley limestone and is abundant at Almaville, Tennessee.

Batostoma libana (Safford) was described by Safford in 1869 and is redescribed in this paper as a common and characteristic fossil of the Lebanon limestone. *Batostoma suberasum*, new species, has not been described from the Chazy of New York but specimens in the collections made by Dr. E. R. Cumings are similar to the Tennessee species.

Diauulites cf. *petropolitanus* is very abundant in the Ridley limestone and is usually poorly preserved. It is closely related to *D. petropolitanus* Dybowoski.

Hemiphragma irrasum (Ulrich) is abundant in the Pierce and Ridley limestone. It shows slight variations from the Black River species of Minnesota but it is not thought advisable to suggest a new name at this time.

Nicholsonella pulchra Ulrich and *N. frondifera* new species, are the very abundant and most conspicuous trepostomatous bryozoa of the Stones River beds. Forms apparently identical to these occur in the lower Chazy of New York.

Orbignyella nodosa, new species, is very abundant in the Lebanon limestone near Big Spring, Tennessee.

Orbignyella sublamellosa Ulrich and Bassler, was first described from the Pierce beds near Murfreesboro, Tennessee, but further stratigraphic study of the Stones River group has shown that it is much more abundant and widely distributed in the Ridley limestone than any other species in that formation.

RANGE AND DISTRIBUTION OF OTHER SPECIES OF THE STONES RIVER GROUP IN CENTRAL TENNESSEE.

The table (page 310) is given to express briefly the relation of the Mollusca, ostracode sponge and coral faunas from the Central Basin region with the faunas of Stones River age from other localities and those of younger age found in Tennessee and elsewhere.

DESCRIPTONS OF GENERA AND SPECIES ORDER CYCLOSTOMATA BUSK.

The arangement of the zooecia, the form of the zoarium, and the presence or absence of interstitial cells and vesicular tissue are the important characters upon which the families and genera of this order is founded.

The zooecia are simple and short, with minutely porous calcareous walls. Diaphragms are absent. The apertures are rounded, slightly raised, bent outward, and inoperculate. Ovicells are present.

Family Ceramoporidae Ulrich.

Members of this family may be identified by the more or less oblique aperture with an elevated lunarium often developed into a hood. The cell walls are minutely porous and composed of irregularly laminated and intimately connected tissue. Maculae of mesopores or of zooecia longer than the average occur at regular intervals. Diaphragms are few; mesopores are generally present, irregular and free from tabulation.

Genus Ceramoporella Ulrich. Genotype: Ceramoporella distincta Ulrich. Ceramoporella Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, p. 156. Miller, N. A. Pal., 1889, p. 297. Ulrich, Geol. Surv. Illinois, 8, 1890, pp. 380, 464; Geol. Minnesota, 3, 1893, p. 328. Procta, Syst. Sil. Centre Boheme, 8, pt. 1, 1894, p. 15. Ulrich, Zittel's Textb. Pal. (Engl. ed.), 1896, p. 267. Simpson, 14th Ann. Rep. State Geol. New York for 1894, 1897, p. 564. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 23. Bassler, ibid., 292, 1906, p. 20. Grabau and Shimer, N. A. Index Fossils, 1, 1907, p. 121. Cummings, 32d Rep. Dep. Geol. Nat. Res. Indiana, 1908, p. 742. Bassler, Bull. U. S. Nat. Mus., 77, 1911, p. 81; Zittel-Eastman Textb. Pal., 1913, p. 327.

Zoarium consists of incrustations often superposed, forming masses, zooecial tubes are short and thin-walled, with apertures that are more or less oblique, oval, surrounded by mesopores; the lunarium is developed into a prominent hood-structure.

Ceramoporella grandis n. sp. Plate I, Figs. 4-6. The colony grows into very irregular small masses, epithecated below and composed of superimposed contorted layers. Zooecial apertures are but slightly oblique, generally appearing somewhat rhomboidal at the surface. The lunarium is thick but not very prominent in the specimen described. It occupies one-third of the circumference of the aperture. Maculae are scarcely distinguishable. The interior walls are rather thick, including numerous rounded mesopores; the number of these varying, however, in different parts. The zooecia are subovate with irregularly laminated walls; diaphragms are wanting.

This species is distinguished from *C. robusta* by its inconspicuous maculae, somewhat smaller and exteriorly less rounded cells and more numerous mesopores. The latter are rarely seen at the surface, being apparently included within the subquadrate zooecial wall, for which reason the species is probably related to *C. inclusa* and *C. ingenua*, but separated from those species by its laminae growth, thicker layers, heavier walls and less oblique apertures. The orifices of *C. grandis* are not bidenticulate as in *C. inclusa* and *C. ingenua*.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Holotype: 54581 U. S. Nat. Mus.

Ceramoporella ingenua n. sp. Plate I, Figs. 1-3. The zoarium forms thin laminae, contorted, covered below by a concentrically striated epitheca; as far as observed it does not grow in superposed layers. The cell is of the *C. inclusa* type, the elliptical zooecial aperture itself together with generally three mesopores being included within a raised rim somewhat rhomboidal in outline. Maculae are quite inconspicuous.

C. ingenua is distinguished from *C. inclusa* by free habit of growth and larger zooecial spaces, these being as 3:4 or 4:5. The walls of *C. ingenua* are somewhat thicker than *C. inclusa*.

In *C. grandis* the cell mouths do not show the mesopores and the ovate zooecial aperture as in *C. ingenua*.

Occurrence: Pierce limestone, Stones River group, Murfreesboro, Tennessee.

Holotype: 54579 U. S. Nat. Mus.

Genus Coeloclema Ulrich. Genotype: Diamesopora vaupeli Ulrich.

Coeloclema Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, p. 137; 7, 1884, p. 49 (not defined). Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, pp. 24, 211. Bassler, Bull. U. S. Geol. Surv., 292, 1906, p. 21. Grabau and Shimer, N. A. Index Fossils, 1, 1907, p. 122. Cunnings, 32d Ann. Rept., Dept. Geol. Nat. Res. Indiana, 1908, p. 742. Bassler, Bull. U. S. Nat. Mus., 77, 1911, p. 83; Zittel-Eastman Textb. Pal., 1913, p. 328.

Diamesopora (part) Ulrich, Geol. Surv. Illinois, 8, 1890, pp. 380, 467; Geol. Minnesota, 3, 1893, p. 330; Zittel's Textb. Pal. (Engl. ed.), 1896, p. 268.

Zoarium forms hollow branches lined with a striated epitheca; zooecia are short, tubular and thick-walled; apertures are oval, oblique, with a hood-like lunarium.

Coeloclema piercearum n. sp. Plate II, Figs. 1-2. The zoarium consists of hollow, cylindrical branches, lined with a wrinkled epitheca, and averaging 1 to 1.5 mm. in diameter. The inner cavity is usually filled with clay and fragments of foreign organic remains.

The lunaria are well developed, thick, distinct, and form four-fifths to nine-tenths of a complete circle about .1 mm. in diameter. The apices of the lunarium cause a decided constriction in the aperture and in a few cases nearly separate it, making the resemblance of the zooecial openings to the figure eight quite striking.

The zooecia are irregularly distributed over the surface, in some parts separated by mesapores, and in others, in contact on one or two sides; four to six zooecia occur in 2 mm. The zooecial tubes are short; the earlier portion is recumbent on the thecal membrane for a short distance and then turning outward, approach the surface perpendicularly.

Mesopores are irregular in shape and size and thick-walled as shown in tangential sections.

No diaphragms were observed in either the zooecia or mesopores.

Occurrence: Pierce limestone Walter Hill, Rutherford County, Tennessee.

Holotype: 238-14. Indiana University.

Coeloclema inflatum n. sp. Plate II, Figs. 3-5. The zoarium consists of hollow, cylindrical, branching stems, 1.5 to 2.5 mm. in diameter. The inner surface is lined with wrinkled epitheca and the cavity usually filled with fragments of foreign material. The zooecial layer is from .5 to .8 mm. in thickness.

Mesopores are few, small and unequally distributed among the zooecia, being more numerous in the inconspicuous maculae where they frequently separate the zooecial walls.

The apertures are oval and irregularly distorted forms surrounded by thick walls.

The lunarium is thin, broadly curved, often as wide as the short diameter of the aperture. The ends of the crescent are inflated, turn outward, and lie imbedded in the wall of the zooecia.

The primitive zooecia have thin walls, and lie along the thecal lining for a slight distance (.1 to .3 mm.), then turn outward and approach the surface nearly perpendicularly.

Diaphragms are absent in both zooecia and mesopores.

Occurrence: Pierce limestone, one and one-fourth miles south of Florence, Rutherford County, Tennessee.

Holotype: 240-20. Indiana University.

Coeloclema consimile n. sp. Plate II, Figs. 6-7. The zoarium consists of cylindrical, ramose, hollow stems from 1.5 to 2.5 mm. in diameter. The zooecial layer varies from .5 to 1 mm. in thickness and rises from a wrinkled epitheca.

The zooecial apertures are distorted ovals in cross-sections, with thick walls and almost completely separated by the numerous small mesopores and interstitial tissue.

The lunaria are thick, of slightly greater curvature than the walls of the aperture, and forms a semicircle. The attenuated ends of the crescent are bluntly rounded. Within the lunarial curve the aperture is narrowed sufficiently to accommodate the thickness of the lunarium, but is not distinctly constricted as in *Coeloclema pierceanum* n. sp.

The zooecial tubes in *C. consimile* bend outward in a more uniform and broader curve from the thecal membrane than in the associated forms.

Mesopores are more numerous in this species than in C. alternatum of the Eden of Cincinnati.

Occurrence: ,Pierce limestone, 1 mile southwest of Lascassas, Rutherford County, Tennessee.

Holotype: 241-17. Indiana University.

Genus Anolotichia Ulrich. Genotype: Anolotichia ponderosa Ulrich. Anolotichia Ulrich, Geol. Surv., Illinois, 8, 1890, pp. 381, 474; Geol. Minnesota, 3, 1893, p. 326; Zittel's Textb. Pal. (Engl. ed.), 1896. p. 268. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 24. Brabau and Shimer, N. A. Index Fossils, 1, 1907, p. 123. Bassler Bull. U. S. Nat. Mus., 77, 1911, p. 91; Zittel-Eastman Textb. Pal., 1913, p. 328.

Zoarium ramose, digitate, laminate or incrusting; zooecial tubes are comparatively large, subpolygonal, long and intersected by more or less remote diaphragms; lunarium slightly elevated at the surface and traversed internally by two to six minute vertical, closely tabulated tubes; mural pores present.

Anolotichia explanata n. sp. Plate III, Figs. 1-4. Zoarium is explanate, and lamellose, forming dome-like masses by the superposition of laminar expansions which vary from one to three mm. in thickness. The largest specimen observed is 70 mm. in diameter and from 10 to 30 mm. in depth.

The surface is smooth with about 5 inconspicuous maculae of large zooecia in one sq. mm.

The tangential section shows the zooecia to have large, direct, polygonal, relatively thin-walled apertures; four to five in 2 mm. Mesopores are few, occurring more frequently in the maculae than elsewhere. Lunaria are distinct crescents with ends projecting slightly into the zoecial cavity. Three to six vertical tubuli traverse internally each lunarium.

In the longitudinal section the zoecial tubes rise at an acute angle from a thin epithelium and bend almost immediately directly towards the surface. Thin complete diaphragms one to three tube diameters apart cross the zoecial tubes. The wall structure as shown in the figure, is characteristic of the genus.

Anolitichia explanata is distinguished from *A. ponderosa* and *A. impolite* by the form of the zoarium, and from the expansive species of the European types by its more robust growth, greater length of the zoecial tubes and more diaphragms.

Occurrence: Pierce limestone, Murfreesboro, Tennessee. 1¼ m. N. W.

of Salem, and 1¼ m. S. E. of Blackman, Rutherford County, Tennessee. Ridley limestone: Sulphur Springs, 4 m. N. W. of Murfreesboro, Tennessee.

Holotype: U. S. Nat. Mus.

Paratypes: 239-2, 3, 4, 5; 240-1, 23. Indiana University.

TREPOSTOMATA.

Family Monticuliporidae Nicholson (emended Ulrich).

The most important character of this family as defined by Ulrich is the occurrence of the cystiphragms in the zooecial tubes. In Mesotrypa and Orbignyella these structures appear as curved diaphragms. The zoarium has a lamellate, massive, ramose, bifoliate incrusting or frond method of growth.

Genus Monticulipora D'Orbigny. Genotype: Monticulipora D'Orbigny, Prodr. Pal., 1, 1850, p. 25. Edwards and Haime, Mon. British Foss. Corals, Pal. Soc., 1854, p. 264, footnote. Pictet, Traiti de Pal., 2d ed., 4, 1857, p. 443. Milne-Edwards, Hist. at. des Corall, 3, 1860, p. 272. Eichwald, Leth. Rossica, 1, 1860, p. 492. Salter, Cat. Camb. Sil. Foss., 1873, p. 108. Dekoninck, Nouv. Rech. Anim. Foss. Terr. Carb. Belgique, 1872, p. 141. Lindstrom, Ann. Mag. Nat. Hist., 4th ser., 18, 1876, p. 5. Nicholson, Pal. Tabulate Corals, 1879, p. 269. Zittel Handb. Pal., 1, 1860, p. 614. Nicholson, genus Monticulipora, 1881, p. 99. Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, pp. 153, 232. Roemer, Leth. geog., pt. 1, Leth. Pal., 1883, p. 468. Foord, Contr. Micro-Pal. Cambro-Sil., 1883, p. 7. Frech, zeits. d. d. geol. gesell., 37, 1885, p. 951. Waagen and Wentzel, Pa. Indica, 13th ser., 1886, p. 874. James, Amer. Geol., 1, 1888, p. 386. James and James, Jour. Cin. Soc. Nat. Hist., 10, 1888, p. 158. Miller, N. A. Geol. Pal., 1889, p. 197. Reminger, Amer. Geol., 6, 1890, pp. 102-121. Ulrich, Geol. Surv. Illinois, 8, 1890, pp. 370, 407; Amer. Geol., 10, 1892, p. 57; Ulrich, Geol. Minnesota, 3, 1893, p. 217. James, Jour. Cincinnati Soc. Nat. Hist., 15, 1893, p. 155; Zittel's Textb. Pal. (Engl. ed.), 1896, p. 103, 272. Lindstrom, Kongl. Sven. Vet. Akad. Handb., 32, No. 1, 1899, p. 52. Sardeson, Neues Jahrb. Min., Geol. Pal., Beilage-Band, 10, 1896, p. 347. Simpson, 14th Ann. Rep. State Geol. New York for 1894, 1897, p. 577. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 28. Procta, Syst. Sil. du Centre Boheme, 8, pt. 2, 1902, p. 312. Ulrich and Bassler, Smiths. Misc. Coll., Quart., 47, 1904, p. 15. Grabau and Shimer, N. A. Index Fossils, 1, 1907, p. 127. Cumings, 32d Ann. Rep. Dep. Geol. Nat. Res. Indiana, 1908, p. 750. Bassler, Bull. U. S. Nat. Mus., 77, 1911, p. 179; Zittel-Eastman Textb. Pal., 1913, p. 331.

Peronopora (in part) Nicholson, genus Monticulipora, 1881, p. 215.

The early reference given refer to Monticulipora in its broader sense at the time it contained a heterogeneous collection of species. Its present limitation is due to the work of Ulrich, which places the genus on a definite basis with the following principal differentiating characters: Cystiphragms occur both in the peripheral and axial region; the walls of the zooecia and mesopores have a granulose structure; acanthopores are usually numerous but may be wanting, having a granulose character, an indefinite outline, and no central perforation; mesopores are variable in number; diaphragms occur in both sets of tubes. The zoaria consist of frond, ramose, massive, laminate and incrusting types.

Monticulipora intersita, Ulrich and Bassler. Plate IV, Figs. 1-2. The zoarium consists of parasitic expansions, 1 to 3 mm. thick, with faintly distinguished clusters of larger zooecia on the surface.

The zooecia are thin walled and angular with the usual granular wall structure.

The diaphragms and cystiphragms are crowded much as in *M. discula* except that the opening left by the cystiphragms is nearly always open on one side and subtriangular in shape. Mesopores are abundant and closely tabulated, having generally three diaphragms in the same distance in which two cystiphragms occur in the zooecial tubes. Acanthopores are wanting.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Holotype: 43878, U. S. Nat. Mus.

Monticulipora discula, Ulrich and Bassler. Plate IV, Figs. 3-4. The zoarium forms small discs that are attached to foreign bodies. They are less than 12 mm. in diameter and about .5 mm. in thickness. The zooecia are thin walled, angular, and nine of the average size occur in 2 mm. A cross-section of the cystiphragms tangentially forms large oval openings. The zooecial tubes are crowded with diaphragms (3 to 4 in a tube diameter). Acanthopores are apparently wanting. Mesopores are very few and occur in clusters only.

Occurrence: Pierce limestone, Morfreesboro, Tennessee.

Holotype: (103) U. S. Nat. Mus.

Monticulapora compacta. Ulrich and Bassler. Plate IV, Figs. 5-6. The colony grows into an upright ramose zoarium with compressed solid branches. The surface is even with maculae of the larger zooecia rather indistinct.

There are eight to nine apertures in 2 mm. The wall and acanthopore structure is similar to the *M. incompta*. The acanthopores are strong, occurring at most angles of the zooecia and in various horizons within the axial region of the zooarium.

Mesopores are few and scattered.

Diaphragms and cystiphragms are closely crowded, 2 to 3 in a tube diameter in the axial region and becoming more numerous towards the surface where there are from 25 to 30 in 2 mm.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Holotype; (21) U. S. Nat. Mus.

Genus Orbignyella, Ulrich and Bassler. Genotype: Orbignyella sublamellosa Ulrich and Bassler. Orbignyella Ulrich and Bassler, Smiths. Misc. Coll. (quart. issue), 47, 1904, p. 18. Bassler, Bull. U. S. Geol. Surv., 292, 1906, p. 26; Bull. U. S. Nat. Mus., 77, 1911, pp. 181, 182.

Monticulipora (part) Ulrich. Jour. Cincinnati Soc. Nat. Hist., 5, 1822, pp. 153, 232; Geol. Surv. Illinois, 8, 1890, pp. 370, 407.

Zoarium consists of parasitic and laminate expansion which in some species rises into domed or globular masses. The wall structure resembles the Heterotrypidae more than the Monticuliporidae. The acanthopores are well developed and sharply defined. The cystiphragms, which appear as curved diaphragms, form the basis for the assignment of the genus to the family Monticuliporidae.

Orbignella nodosa. n. sp. Plate V, Figs. 1-2. The zoarium forms small and large incrusting expansions, that rise into nodular masses of irregular forms and sizes, by superposition of layers; nodules are unequally distributed. Slabs have been collected on which there are numerous colonies that are contiguous and overlap one another, forming an incrustal covering of many square inches. The nodules vary in height from .5 mm. to 10 mm., with a corresponding variation in width.

The surface is even; twenty-four maculae of large zooecia occur in one sq. cm.

The zooecia are polygonal, and have relatively thick wall; 8 to 9 occur in 2 mm. Mesopores are absent. Acanthopores are about as numerous as the zooecia, located at the tube angles, and of large size, causing slight inflection of the zooecial walls in most cases.

The zooecial tubes of each laminar expansion are about .7 mm. long, with 3 to 4 horizontal or from 1 to 3 cystoid diaphragms in the space of one tube diameter.

The nodular zoarium, lack of monticules, and more numerous cystoid diaphragms distinguish the species from *Obignyella weatherbyi*. *Orbignyella lamellosa* has large zooecia, less curved diaphragms, and much longer zooecial tubes than *O. nodosa*. The large acanthopores and zoarial forms of *O. nodosa* are distinct differences which separate it from *O. sublamellosa*.

Occurrence: Lebanon limestone, Big Springs, Rutherford County, Tennessee.

Holotype, 248-16. Indiana University.

Orbignyella multilabulata. n. sp. Plate V, Figs. 3-4. Zoarium, laminated, depressed, conical domes, rising from a wide base. The lower surface of the mass is covered with a wrinkled epitheca. The type specimen is 9.5 cm. in diameter and 2.5 cm. high. The surface is smooth, with inconspicuous clusters of large zoecia.

Mesopores are very few, occurring in the maculae only. The zoecia are angular, thin-walled; 8 to 8½ in 2 mm. Large well developed acanthopores with distinct lumen are present at most every tube angle.

The zooecial tubes of a single lamina are 1 to 3 mm. long, crossed by 4 to 5 horizontal diaphragms in the space of one tube diameter. Cystoid, curved or infundibular diaphragms occur in every tube.

The crowded horizontal diaphragms, thickness of laminae, large acanthopores, and manner of zooecial growth, are a combination of characters not found in any other species of the genus yet described.

Occurrence: Pierce limestone; in sink hole at Almaville, Rutherford County, Tennessee.

Holotype: 244-17. Indiana University.

Genus Mesotrypa Ulrich. Genotype; Diplotrypa infida Ulrich. Diplotrypa (in part Nicholson, Paleozoic Tabulate corals, 1879, p. 312; genus Monticulipora, 1881, pp. 101, 155. Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, p. 153. Foord, Contr. Micro-Pal. Cambro-Sil., 1883, p. 13. Ulrich Geol. Surv. Illinois, 8, 1890, p. 378.

Mesotrypa Ulrich, Geol. Minnesota, 3, 1893, p. 257. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, p. 30. Bassler, Bull. U. S. Geol. Surv., 292, 1906, p. 27. Grabau and Shimer, N. A. Index Fossils, 1, 1907, p. 130. Hennig, Archiv. fur Zool., 4, No. 21, 1908, p. 29. Bassler, Bull. U. S. Nat. Mus., 77, 1911, p. 196.

Zoarium hemispheric, conical, discoidal or incrusting. It is generally free with an epithica covering the base; zooecia are polygonal or circular with curved, and sometimes funnel-shaped diaphragms, which are probably modified cystiphragms; zooecia more or less separated by angular mesopores, which become smaller with age, and are intersected by numerous diaphragms; acanthopores generally present.

Mesotrypa crustulata n. sp. Plate V, Figs. 5-6. The zoarium of this species forms incrusting expansions about 2 mm. in thickness. In the type specimen the zoarial mass consists in part of superimposed layers and attains a height of 8 to 10 mm. On the surface small low monicules of large zoecia and numerous mesopores are irregularly distributed, varying from 1 to 3 mm. apart. In places the surface rises into conical-like tubercles .5 to 1 mm. high, and from 8 to 12 mm. apart.

The zoecia are thick-walled at the surface, circular, regularly arranged, and in contact on 3 or 4 sides; 7½ to 8 intermonticular and 5½ monticular zooecia occur in 2 mm.

The acanthopores are small, inconspicuous, and unequally distributed, 6 to 7 about a zooecia in some areas and in others no acanthopores are present.

Mesopora are abundant; more numerous at the base than in the mature zone. Diaphragms are closely set; 13 to 15 in the distance of one mm.

The diaphragms in the zooecia are in rather definite parallel transverse horizons, separated by a distance equal to 1½ to 2½ tube diameters. Two to six diaphragms ¼ to ½ tube-diameters apart are present in each zooecia at the elevation of the common horizons. Curved and cystoid diaphragms occur in the mature part of the zooecial tube only.

The segregation of the small and inconspicuous acanthopores into areas closely associated with the monticular zooecia, the zonal arrangement of the diaphragm and the localization of the curved and cystoid diaphragms in the peripheral portion of the zoarium are the conspicuous differentiating characters of the species.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Holotype: (92) U. S. Nat. Mus.

Mesotrypa dubia. n. sp. Plate VI, Figs. 1-2. Zoarium consists of thin expansions 2 mm. in thickness. Small inconspicuous maculae, consisting of zooecia slightly larger than the average and less number of mesopores than are present in the intermacular area, occur on the surface at intervals of 2 mm.

Mesopores are abnudant, slightly beaded, irregular in shape, size and distribution; about 15 diaphragms cross the tubes in the distance of one mm.

The zooecia are relatively thin-walled, subcircular or polygonal, in contact on 2 or 3 sides mostly, less frequently on four; 7 or 8 occur in 2 mm.

The acanthopores are few and of medium size. There are rarely more than one or two in two square mm. The central lucid spot is distinct; the outer boundary is definite.

Curved and horizontal diaphragms are present throughout the zooecial tube, separated from ½ to 1 tube-diameter apart.

The irregular distributed zooecia and mesopores, the few acanthopores of medium size, and form of zoarium are distinguishing combination of characters for this species.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Holotype: (93) U. S. Nat. Mus.

Family Heterotrypidae Ulrich.

This family includes those trepostomatous bryozoans having zooecia with straight diaphragms, clearly defined acanthopores, and walls of a dual character; the outer wall is amalgamated with the outer one of the adjacent zooecia and shown as a light colored band lying between the inner and distinctly zooecial walls of darker and finely laminated tissue.

Dekayella Ulrich. Genotype: Dekayella obscura Ulrich. Dekayella Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, p. 155; ibid., 6, 1883, p. 90. Miller, N. A. Geol. Pal., 1889, p. 184. Ulrich, Geol. Surv. Illinois, 8, 1890, p. 372; Geol. Minnesota, 3, 1893, p. 269; Zittel's Textb. Pal. (Engl. ed.), 1896, p. 273. Simpson, 14th Ann. Rep. State Geol. New York for 1894, 1897, p. 589. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 31. Cumings, Amer. Geol., 29, 1902, p. 200. Ulrich and Bassler, Smiths. Misc. Coll., 47, 1904, p. 24-27. Grabau and Shimer, N. A. Index Fossils, 1, 1907, p. 132. Bassler, Bull. U. S. Nat. Mus., 77, 1911, p. 205; Zittel-Eastman Textb. Pal., 1913, p. 333.

This genus has been briefly and adequately described by Ulrich and Bassler in 1904 as follows:

"Zoarium erect, ramose or frondescent; two sets of acanthopores, large and small; mesopores variable, generally more or less numerous; diaphragms numerous."

Dekayella ridleyana, n. sp. Plate VI, Figs. 3-4. The zoarium consists of large, thick, irregular fronds. The type specimen varies from 8 to 12 mm. in thickness. The greatest observed height is 80 mm.

The surface is even and maculae of large mesopores are small and inconspicuous.

The zooecia are polygonal, thick walled; 9 to 9½ apertures in 2 mm.

Mesopores are few and seldom observed in shallow tangential sections of old specimens.

Acanthopores are numerous, 2 to 6 about a zooecium, and of two sizes.

In the tangential sections the walls appear amalgamated and a distinct crenulation is observed from the longitudinal section in the axial region.

Dialphragms are few and unequally distributed in the immature zone and close set in the mature where 2 to 4 cross the tube in the space of one tube diameter.

The method of growth of this species distinguishes it from the associated forms.

Occurrence: Ridley limestone, 2½ miles northwest of Salem, Rutherford County, Tennessee.

Holotype: 245-6, 10. Indiana University.

Genus Heterotrypa Nicholson. Genotype: Monticulipora frondosa D'Orbigny. Heterotrypa (in part) Nicholson, Pal. Tabulate Corals, 1879, p. 291; genus Monticulipora, 1881, pp. 101, 103. Zittel, Handb. Pal., 1, p. 615. Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, p. 155; ibid., 6, 1883, p. 83. Foord, Contr. Micro-Pal. Cambro-Sil., 1883, p. 20. Ulrich, Jour. Cincinnati Soc. Nat. Hist., 6, 1883, pp. 83-85. Roemer, Leth. geog., pt. 1, Leth. Pal., 1883, p. 471. Rominger, Amer. Geol., 6, 1890, pp. 114, 119. Ulrich, Geol., Surv. Ill., 8, 1890, pp. 371, 413; Geol. Minnesota, 3, 1893, p. 267. Zittel's Textb. Pal. (Engl. ed.), 1896, p. 104. Ulrich, Zittel's Textb. Pal. (Engl. ed.), 1896, p. 273. Simpson, 14th Ann. Rept. State Geol. New York for 1894, 1897, p. 579. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 31. Cumings, Amer. Geol., 29, 1902, p. 199. Ulrich and Bassler, Smith. Misc. Coll., Quart., 47, 1904, pp. 24, 25. Bassler, Zittel-Eastman Textb. Pal., 1913, p. 333.

Zoarium erect (ramose or) frondescent; acanthopores of one kind; small; mesopores varying in number, generally abundant, sometimes wanting almost entirely. With the addition of the words enclosed in parenthesis the description of the genus is taken from the "Revision of the Paleozoic Bryozoa" by Ulrich and Bassler.

Heterotrypa patera n. sp. Plate VI, Figs. 5-6. Zoarium ramose, about 5 to 10 mm. in diameter. Surface is smooth, with small maculae composed of mesopores, surrounded by zooecia slightly larger than the average; about 4 in ¼ sq. cm.

Tangential sections show the zooecia to be subcircular and thick-walled. A very thick cingulum consisting of laminated secondary tissue, surrounds each aperture. A thin dark line separates the cingulum from the true zooecial wall which forms an angular boundary between the zooecia and appears finely granular, light colored and amalgamated. The acanthopores are small, with a distinct, minute central lucid spot and an indefinite outer boundary; 5 to 10 among 10 zooecia.

The zooecia in the axial region are crossed by diaphragms from 1 to 3 tube-diameters apart. From the immature region the zooecial tubes proceed outward in a gradual curve, increasing sufficiently in the peripheral zone to cause the zooecia to open perpendicularly at the surface. The walls and cingulum increase in thickness from the early mature region to the periphery, closing the mesopores and rounding the apertures of the zooecia. Two to three diaphragms occur in the zooecia of the mature zone in the distance of one-tube diameter.

Many of the characters of *H. patera* are very similar to *H. microstigma* from the Richmond, but the much less number of acanthopores and the absence of inflections of the zooecial walls by the acanthopores in H. patera serve to differentiate them.

Occurrence: Pierce limestone: 2 miles northwest of Murfreesboro, Tennessee, at Stokes Gannon's ford.

Holotype: 242-4. Indiana University.

Heterotrypa stonensis n. sp. Plate VIII, Figs. 1-2. Zoarium ramose; 7 to 15 mm. in diameter. The surface is smooth; monticules are absent; small inconspicuous maculae of clusters of large zooecia are numerous, .2 to .5 mm. across and 2 to 2.5 mm. apart, measured from center to center.

The zooecia are thick-walled, and subcircular. A completely developed cingulum is present in each zooecia. The true zooecial wall is angular, finely granular, amalgamated and separated from the cingulum by a distinct dark line of contact; 8 to 9 zooecia occur in 2 mm.

The acanthopores are of medium size, with indefinite boundary; 2 to 3 about each zooecia. The central lumen is very small and mostly indistinct.

Mesopores are very few, being absent in most of the tangential sections.

The zooecial tubes in the immature region are thin-walled and crossed by very few diaphragms. They turn outward in a slight curve to the initial mature region where the bending is subangular and short. Thruout the deep mature zone the tubes proceed directly to the surface.

Diaphragms in the mature region are spaced about one-fourth to one-half tube diameter apart. Coalesced and infundibular diaphragms are present.

The scarcity of diaphragms in the axial region, the thinner cingulum and inconspicuousness and zooecial composition of the maculae of *Heterotrypa stonensis* separates it from *H. patera*.

The greater abundance of acanthopores, presence of numerous diaphragms in the axial region and the well developed maculae of *H. microstigma* distinguish it from *H stonensis*.

Occurrence: Pierce limestone; two miles northwest of Murfreesboro, Tenn., at Stokes Gannon's ford.

Holotype: 242-5. Indiana University.

Family Constellaridae. Ulrich.

The zooarium is ramose, frondescent, laminar or incrusting. The stellate maculae is probably the most obvious character of this family but greater importance is assigned to the granular wall structure in the mature region, and the presence of hollow spines or granules which occur in the place of true acanthopores. Mesopores are angular and usually abundant.

Genus Constellaria Dana. Genotype: Ceriopora constellata (Van Cleve, M. S.), Dana. Constellaria Dana, Zoophyta, 1846, p. 537. Edward and Haime, Mon. d. Polyp. Foss. d. Terr. Pal. (Arch. Mus. d'Hist. Nat., 5), 1851, pp. 154, 278. Pictet, Traite de Pal., 2d ed., 4, 1857, p. 154. Nicholson, Pal. Ohio, 2, 1875, p. 214; Pal. Tab. Corals, 1879, p. 292. Zittel, Handb. Pal., 1, 1880, p. 615; Genus Monticulipora, 1881, p. 97. Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, p. 156; 6, 1883, p. 265. Roemer, Leth. geog., pt. 1, Leth. Pal., 1883, p. 485. James and James, Jour. Cincinnati Soc. Nat. Hist., 11, 1888, p. 29. Ulrich, Geol. Surv. Illinois, 8, 1890, pp. 374, 423. Rominger, Amer. Geol., 6, 1890, p. 113. Ulrich, Geol. Minnesota, 3, 1893, p. 311; Zittel's Textb. Pal. (Engl. ed.), 1896, p. 276. J. F. James, Jour. Cincinnati Soc. Nat. Hist., 18, 1896, p. 117. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 34. Grabau and Shimer, N. A. Index Fossils, 1, 1907, p. 135. Cumings, 32d Ann. Rept., Dept. Geol. Nat. Res. Indiana, 1908, p. 742. Bassler, Bull. U. S. Nat. Mus., 77, 1911, pp. 218, 219; Zittel-Eastman Textb. Pal., 2d ed., 1913, p. 334. Stellipora Milne-Edwards Hist. Nat. des Corall, 3, 1860, p. 281 (in part). Dybouski, Du Chaetetiden d. Ostbalt, Silur.-Form., 1877, p. 42.

The following definition is from the Zittel-Eastman textbook as given by Bassler:

"Zoaria growing erect (into solid branches) from attached local expansion. Surface with depressed stellate maculae, the spaces between the rays elevated and occupied by two or three short rows or clusters of closely approximated zooecial apertures. Mesopores aggregate in the maculae, internally with gradually crowding diaphragms."

The words in parentheses were added by the author.

Constellaria lamellosa n. sp. Plate VII, Figs. 3-5. The zoarium consists of thin laminar expansions, .3 to 1.5 mm. in thickness. The base is covered with a wrinkled epitheca that assumes the general form of the object upon which the colony grows. Cylindrical, tubular stems grow upward from the expanded portion.

The maculae are irregular stellate, aggregations of mesopores that are raised slightly above the surface; about 9 in ¼ sq. mm. The macular rays are of variable size and shape and extend between clusters of contiguous subangular zooecia. The intermacular zooecia are circular and completely separated by mesopores; about 8 in 2 mm.

Diaphragms in the zooecial tubes are few, more numerous in the peripheral region than in the earlier portion. The mesopores are crowded with diaphragms throughout, about 7 in .5 mm. The mesopores originate in the early primitive zone and extend to the surface.

The internal structure of this species agrees completely with the generic description, and for that reason is assigned to Constellaria. The manner of growth of the zoarium is quite different from any other described species of the genus.

Occurrence: Pierce limestone, Murfreesboro, Tennessee; 1 mile southwest of Lascasses, at Stones River Bridge, Rutherford County, Tennessee.

Holotype: 53993 U. S. Nat. Mus.

Paratypes: 241,—10, 24, 25; 245-15. Indiana University.

Genus Nicholsonella Ulrich. Genotype: Nicholsonella ponderosa Ulrich.

Nicholsonella Ulrich, Geol. Surv. Illinois. 8, 1890, pp. 374. 421. Miller, N. A. Geol. Pal., 1889, p. 313. Ulrich, Geol. Minnesota, 3, 1893, p. 313; Zittel's Textb. Pal. (Engl. ed.), 1896, p. 276. Simpson, 14th Ann. Rept. State Geol. New York for 1894. 1897, p. 590. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 34. Bassler, Bull. U. S. Geol. Surv., 292, p. 37. Grabau and Shimer, N. A. Index Fossils, 1, 1907, p. 136. Cumings, 32d Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 751. Bassler, Bull. U. S. Nat. Mus., 77, 1911, p. 224; Zittel-Eastman Textb. Pal., 1913, p. 334.

Zoaria consist of flattened branches, fronds or laminations. Mesopores are usually numerous. The walls of both zooecia and mesopores are traversed longitudinally by minute tubuli, which appear at the surface as granular acanthopore-like structures. A calcareous deposit in the outer zone obscures the walls of the mesopores. Because of the granular structure which is present in the outer zone of specimens of this genus it has been referred to the family Constellaridae.

Nicholsonella frondifera, n. sp. Plate VII, Figs. 6-7. The zoarium consists of wide flattened frond-like growths, 30 to 50 mm. wide, from the margin of which rise branches 15 to 20 mm. wide that frequently divide and anastomose. The thickness of the branches varies from 5 to 11 mm. The highest specimen seen measured 10 cm.

The surface is even and granulose. The zooecia of the mature zone are circular, completely separated by mesopores. Five to seven large, distinct, granular masses (cross-section of longitudinal tubuli in tangential sections) surround each zooecium.

The internal structure as seen from the longitudinal section is similar to *Nicholsonella pulchra* with the exception that diaphragms are more numerous in the mesopores of the mature region and the longitudinal tubuli are larger, fewer, and more clearly defined in *N. frondifera.*

The habit of growth in addition to the different internal characters separates *N. frondifera* from *N. pulchra*, its associated species.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Ridley limestone: Almaville; 2 m. W. of Lascasses; South side of Marshall Knob; 2½ m. NW. of Salem; Rutherford County, Tennessee.

Lebanon limestone: Big Springs, Rutherford County, Tennessee.

Holotype: 54043 U. S. Nat. Mus.

Paratypes: 244-3, 4, 5. Indiana University.

Family Halloporidae Bassler.

(Calloporidae Ulrich)

This family includes trepostomatous bryozoans with ramose, subfrondescent, massive or discoidal zoaria, having zooecial tubes that are thin-walled, attaining full size slowly, tabulated in the attenuated proximal end, and separated more or less completely by angular mesopores. Acanthopores are wanting.

Genus Hallopora Bassler. Genotype: Callopora elegantula Hall. Callopora Hall, Amer. Jour. Sci., ser. 2, vol. ii, 1851, p. 400; Pal. New York, 2, 1852, p. 144. Nicholson, Pal. Province, Ontario, 1874, p. 61; Geol. Mag., N.

S., 1, 1874, p. 13. Hall, 28th Ann. Rept. New York State Mus., 1879, p. 114. Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, pp. 154, 251. Foerste, Bull. Sci. Lab. Denison Univ., 2, 1887, p. 172. Hall and Simpson, Pal. New York, 6, 1887, p. 15. Miller, N. A. Geol. Pal., 1889, p. 295. Ulrich, Geol. Surv. Illinois, 8, 1890, pp. 372, 416; Geol. Minnesota, 1893, 3, p. 275; Zittel's Textb. Pal. (Engl. ed.), 1896, p. 275. Simpson, 14th Ann. Rept. State Geol. New York for 1894, 1897, p. 588. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, pp. 36, 186. Grabau, Bull. Buffalo Nat. Sci., 7, 1901, p. 167; Bull. New York State Mus., 9, 1901, p. 167. Cumings, 32d Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 741. Bassler, Bull. U. S. Geol. Surv., 292, 1906, pp. 40. Grabau and Shimer, N. A. Index Fossils, 1, 1907, p. 139. Henning, Archiv. für Zoöl., 4, 1908, p. 48. Hallopora Bassler, Bull. U. S. Nat. Mus., 77, 1911, pp. 325-326; Zittel-Eastman Textb. Pal., 1913, p. 337.

Zoaria ramose and bushy and often anastomosing. The zooecia are thin-walled in the immature region, and attain full development slowly. Diaphragms are closely arranged in the tapering proximal portion of the zooecial tube, few or absent in the middle part, and few to numerous in the mature peripheral region. The apertures of the zooecia in the perfect state are closed by perforated ornamental covers which form diaphragms as the growth of the zooecial proceed. Acanthopores are absent.

Hallopora spissata n. sp. Plate VIII, Figs. 1-2. Zoarium consists of irregularly ramose, subcylindrical branches 5 to 10 mm. in diameter and from 1 to 2 cm. in length. The surface is smooth; maculae are absent. Zooecia are direct, angular, and thick-walled; 4 or 5 in 2 mm. Mesopores are entirely absent at the surface in completely matured specimens.

In the tangential sections the zooecia are polygonal and in contact with each other on all sides. In sections of the surface of the submature zone or in tangential sections of immature specimens the zooecia are subcircular, separated at some of the angles by intercellular spaces (mesopores). Where the walls of adjacent zooecia are in contact the boundary between them is marked by a well defined dark line.

The vertical sections show that few mesopores in which diaphragms are closely arranged are present at the bend from the immature to the mature region. They seldom reach the surface except in young specimens. In the axial region the narrow tapering zooecia which are scarcely wider than the mesopores are crowded with diaphragms. They are absent in the completely developed zooecial tubes of the submature portion and in some of the zooecia of the mature zone. From one to three diaphragms usually are present near the bend of the immature and mature portions. The peripheral zone is narrow, varying from ¾ to 1 mm. The walls thicken rapidly from the bend toward the surface, closing the mesopores and making the apertures subcircular.

Hallopora spissata differs from *H. splendens* in having a narrower mature zone, less number of diaphragms in the submature and mature portions of the zooecial tubes and much thicker walls at the periphery of mature specimens. The less number of diaphragms, thicker walls and more direct apertures distinguish this species from *H. ampla*.

Occurrence: Pierce limestone: Murfreesboro, Tennessee; Ward's Mill and Almaville, Rutherford County, Tennessee.

Holotype: Cat. 44519 U. S. Nat. Mus.

Paratypes: 238-22, 23, 24, 25; 244-8, 9, 18; 245-18. Indiana University.

Hallopora florencia n. sp. Plate VIII, Figs. 3-4. Zoarium forms subcylindrical branches, 1.5 to .3 mm. in diameter. The surface is smooth and without maculae.

The zooecia are oval, thin-walled, 7 to 8 in 2 mm. and usually in contact on two sides only.

Mesopores are numerous and crossed by close-set diaphragms.

In the axial region diaphragms are present in the zooecial tubes from the proximal ends to the beginning of the decided curvature in the early submature region, and average one tube diameter apart. In the remaining portion diaphragms are very few or absent and when present they occur near the periphery. This character is known to be persistent from the study of the numerous sections of separate localities and is considered worthy of the recognition accorded it here.

The zoarium of this species is similar in size to *H. dumalis*, but the diaphragms in *H. dumalis* occur throughout the zooecial tube.

Occurrence: Pierce limestone, 1¼ miles southwest of Florence, Rutherford County, Tennessee.

Holotype: 240: 13. Indiana University.

Family Trematoporidae Ulrich.

Zoaria ramose, incrusting or massive. The zooecial tubes in the axial region are thin-walled, and usually constricted where the diaphragms occur; wall thickened in the mature region; the divisional line of contact zooecia is conspicuous. Acanthopores are more or less abundant. Mesopores are usually numerous, of large size, and with apertures closed.

The beaded form of the zooecial tubes and mesopores formed by the constrictions of the walls when diaphragms occur, the crinulation of the walls in the axial region, and the general looseness and obscurity of the structure are characters quite unlike that of any other family of the integrated Trepostomata.

Genus Batostoma Ulrich. Genotype: Monticulipora (Heterotrypa) implication Nicholson. Bastosma Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, p. 154. Foord, Contr. Micro-Pal. Cambro-Sil., 1883, p. 17. Miller, N. A. Geol. Pal., 1889, p. 294. Ulrich, Geol. Surv. Illinois, 8, 1890, pp. 379, 459; Geol. Minnesota, 3, 1893, p. 288; Zittel's Textb. Pal. (Engl. ed.), 1897, p. 275. Simpson, 14th Ann. Rept. State Geol. New York for 1894, 1897, p. 588. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 35. Grabau and Shimer, N. A. Index Fossils, 1, 1907, p. 136. Cumings, 32d Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 740. Bassler, Bull. U. S. Nat. Mus., 77, 1911, p. 272; Zittel-Eastman Textb. Pal., 1913, p. 338.

The zoarium is ramose, branching irregularly from an expanded base. The zooecial walls in the immature region are thin and irregularly flexuous.

In the mature region they are much thickened, ring-like, and seldom in contact. Diaphragms are few or wanting in the axial portion, but more abundant in the peripheral zone. Mesopores are numerous or few, of irregular shapes and sizes, and closed at the surface. Acanthopores are mostly large and abundant with a conspicuous lumen.

Batostoma libana (Safford). Plate VIII, Figs. 5-7. *Stenopora libana* Safford, Geol. Tenn. 1869, p. 285. This species was described by Safford as "like (S.) fibrosa, but with cell-tubes much larger." The following notes are based on specimens and photographs furnished by the U. S. Nat Mus. and sections of several specimens personally collected in Rutherford County, Tennessee.

The zoarium consists of smooth, strong, irregularly arranged branches, 8 to 12 mm. in diameter. Maculae are present, 7 to 8 in one sq. mm., distinguished by the larger size of the zooecia.

In tangential sections the zooecia appear angular, thin-walled, nearly everywhere in contact and 4 to 5 in 2 mm. A definite dark line separates the walls of adjacent zooecia. Mesopores are few, and those present have the appearance of young zooecia. Acanthopores are small, located at the junction angles, and less numerous than the zooecia.

In the longitudinal section the most striking features are the scarcity of diaphragms in the immature region, the narrow mature zone, and the acute angle of approach of the zooecia to the surface following a decided and short bend of the tubes from the immature to the mature region. Diaphragms are few in the peripheral zone, separated from one another by one-half to one tube diameter, and located near the abrupt bend of the zooecial tubes. They are rare or absent in the axial region.

The less number of mesopores, the smooth zoarium, and the acute angle of approach of the zooecial tubes to the surface following the short bend from the immature to the mature region distinguish this species from B. magnopora in which the tubes proceed towards the surface in a very gentle curve until they enter the peripheral region.

Occurrence: Lebanon limestone of Central Tennessee.

Holotype: 44693 U. S. Nat. Mus.

Paratypes: 247-2, 3, 4; 242-1. Indiana University.

Batostoma subcrassum n. sp. Plate IX, Figs. 1-3. Zoarium is ramose, subcylindrical or a little compressed, 5 to 10 mm. in the greater diameter. The surface is smooth with maculae (10 to 12 in one sq. mm.) distinguished by clusters of large zoecia about an apparently solid area which consists of mesopores, as shown in tangential sections.

The zoecia in the surface sections are subangular, thick-walled, in contact at nearly all sides and 4 to 5 in 2 mm. Mesopores are small, few, situated mostly at the angles of contact of the macular zoecia. Acanthopores are few, inconspicuous, and at the junction angles. The walls of contiguous zoecia are separated by a distinct dark line in perfectly preserved surfaces.

In the axial region at the proximal tapering ends of the young zoecia the walls are wavy, constricted at the diaphragms. In the completely developed zoecia of the axial region the diaphragms are from 2 to 5 tube-diameters apart with no constriction of the walls. The zoecia proceed forward in a broad curve and approach the surface at an acute angle. Diaphragms are more numerous in the mature zone than elsewhere, 2 to 3 in one tube-diameter with occasionally 1 or 2 incomplete ones in some of the zoecial tubes; the free portion is supported by the next diaphragm below. Mesopores are few, beaded, of irregular shapes and sizes, present in the submature and mature region.

Batostoma subcrassum is distinguished from *B. magnopora* in the singular approach of the zooecia to the surface, the thicker walls, more numerous diaphragms in the axial region and the absence of monticules.

Occurrence: This species is abundant in the Pierce limestone, one and three-fourths miles north of Eagleville, Rutherford County, Tenn.

Holotype: U. S. Nat. Mus.

Paratype: 242-7. Indiana University.

Batostoma dendroidea n. sp. Plate IX, Figs. 4-5. Zoarium has an even surface (spinulose in well preserved specimens), short branches, irregularly arranged, varying from 3 to 10 mm. in diameter, but in most specimens 5 to 8 mm. The numerous short branches give a knotty appearance to the zoarial mass.

The zoecia are angular, thick-walled, nearly everywhere in contact, and 7 to 8 in 2 mm. The apertures are subangular to circular. Mesopores are few, 1 to 2 among 10 zoecia. Acanthopores are numerous, 4 to 6 about each aperture, located at nearly all junction angles and occasionally between contiguous zoecia, inflecting the walls.

In the axial region the diaphragms are numerous in the attenuated end of the zoecial tubes and very few or absent in the zoecia that have attained full size. The tubes pass into the mature zone with a symmetrical curve and proceed to the surface nearly perpendicularly.

The mature zone is narrow, with 2 to 3 diaphragms crossing the zoecia in the distance of a single tube diameter. A few of the diaphragms are incomplete and coalesced with one another. The walls are greatly thickened, separated by a conspicuous median dark line. Acanthopores in the vertical section are distinct, many originating in the early mature region and do not reach the surface. In the mesopores, some of which develop into zoecia, five diaphragms occur in the distance of the diameter of a zoecial tube.

This species possesses several characters similar to *B. winchelli*, from which it can be distinguished by scarcity or lack of diaphragms in the full sized zoecia of the axial region.

Occurrence: Common in the Pierce limestone: Murfreesboro, Walter Hill, Wards Mill, Lascasses, Rutherford County, Tennessee.

Holotype: 44731 U. S. Nat. Mus.

Paratypes: 241—14, 15; 246—1. Indiana University.

Batostoma ramosa n. sp. Plate IX, Figs. 6-7. Zoarium is smooth, ramose, dividing every 10 mm. into subcylindrical solid branches, 4 to 6 mm. in diameter. Maculae of clusters of large zoecia are rather numerous, 6 in one-fourth of 1 sq. mm.

Zoecia are subangular, 8 to 8½ in 2 mm., contiguous on the sides only and separated at most angles by intercellular spaces (mesopores) of irregular shapes and sizes, in surficial sections of mature specimens. In tangential sections of the submature region or of young specimens the zoecia are angular and thin-walled; mesopores are few.

Acanthopores are distinct, located at the junction angles and between contact zoecia, occasionally inflecting the walls; 4 to 5 among 10 zoecia.

In the longitudinal section the zoecia of the axial region are thin-walled, crossed by diaphragms, few in number, and arranged in zones, convex upward, which probably bears a relation to periods of less rapid growth. The zoecial tubes turn outward in a slight curve to the initial portion of the thin mature region where the bending is short, angular and sufficient to permit the zoecia to approach the surface perpendicularly. The walls of the zoecia on the mature zone thicken slightly and are separated by a distinct median dark line. A single diaphragm (absent in some zoecia) is present near the turn of the zoecia from the submature to the mature zone.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Holotype: 44707 U. S. Nat. Mus.

Batostoma conferta n. sp. Plate X, Figs. 1-3. Zoarium consists of ramose subcylindrical solid stems 5 to 6 mm. in diameter. Maculae and monticules are absent. Acanthopores are large, sharply defined and irregularly distributed about the zoecia. Four to eight usually surround a single zoecium and inflect one or all of the walls of contiguous tubes.

In the tangential section the zoecia are thick-walled, polygonal, six to six and one-half in 2 mm., with an occasional mesopore. There is a distinct median dark line separating the walls. In the axial region the zoaeial tubes are thin-walled. Diaphragms are rare or absent in immature region, but numerous in the late submature region and in the mature zone; 3 to 5 occur in the space of one tube diameter. Incomplete and coalesced diaphragms are rather abundant in each zoecial tube.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Holotype: 44736 U. S. Nat. Mus.

Paratype: 249-9. Indiana University.

Batostoma inutilis n. sp. Plate X, Figs. 4-5. Zoarium is smooth ramose dividing dichotomously every 6 to 8 mm. into compressed branches 4 to 5 mm. in greatest diameter.

Zoercia are polygonal to circular, 7½ to 8 in 2 mm. Mesopores are abundant in some parts of the mature zone, separating the zoecia completely, and in other area, they occupy the angular spaces only. The acanthopores are of medium size, distinct and few, one among ten zoecia. They occasionally inflect the zoecial walls.

In the axial region, the walls of the zoecia are thin and wavy. Mesopores are absent and diaphragms are very rare. The tubes proceed to the mature region in an undulating curve. A decided increase of curvature, the slight thickening of the walls, and the origination of an abundance of beaded mesopores mark the initial periphery zone. A few thin diaphragms occur in some of the zoecial tubes in the mature region and in others they are absent. A distinct median lamina separates the zoecial walls.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Holotype: 44708, U. S. Nat. Mus.

Genus Diplotrypa Nicholson. Genotype: Favosites petropolitanus Pander. Diplotrypa Nicholson, Pal. Tab. Corals, 1879, pp. 101, 155. Ulrich, Jour, Cincinnati Soc. Nat. Hist., 5, 1882, p. 153. Foord, Contr. Micro-Pal. Cambro-Sil., 1883, p. 13. Roemer, Leth. geog., 1, Leth. Pal., 1883, p. 472. Miller, N. A., Geol. Pal., 1889, p. 187. Ulrich, Geol. Surv. Illinois, 8, 1890, pp. 378, 457. Rominger, Amer. Geol., 6, 1890, pp. 116-119. Ulrich, Geol. Minnesota, 3, 1893, p. 285; Zittel's Textb. Pal. (Engl. ed.), 1896, p. 275; also (not Ulrich) p. 104 (in part). Nickles and Bassler, Bull. U. S. Geol. Surv., 173, p. 36. Bassler, Bull. U. S. Geol. Surv., 292, 1906, p. 47; Zittel-Eastman Textb. Pal., 1913, p. 338; Bull. U. S. Nat. Mus., 77, 1911, pp. 312, 313. Callopora (not Hall) Dybouski, Du Chaetetiden d, Ostb. Silur.-Form., 1877, p. 106.

The zoarium of Diplotrypa is massive, or discoid and generally free, consisting of large prismatic zoecial tubes with thin walls. Mesopores are always present, but variable in number and size. Complete, horizontal diaphragms are present in both the zoecia and mesopores. Acanthopores are wanting.

Diplotrypa catenulata n. sp. Plate X, Figs. 6-7. Zoarium massive, discoid, 2½ to 4 cm. in diameter and ½ to 2½ cm. in thickness. The base is circular, covered with thin concentrically wrinkled epithelium. The zoecial apertures are large and polygonal: 4 to 4½ in 2 mm. Mesopores are few and of various shapes and sizes.

In the longitudinal section the tube-walls are thin and beautifully crenulated. The mesopores originate as catenated chambers, enlarging and developing into tubes similar to zoecia as they approach the periphery. The diaphragms of the zoecia are spaced from 2 to 4 tube diameters apart in the immature region and about one tube diameter apart in the mature zone. In the mesopores diaphragms are present at the constrictions.

The form of the zoarium, the large zoecia, crenulated walls and irregularly beaded mesopores are a group of characters that distinguish this species from any other species of the genus.

Holotype: 44658 U. S. Nat. Mus.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Genus Stromatotrypa Ulrich. Genotype: Stromatotrypa ovata Ulrich. Stromatotrypa Ulrich, Geol. Minnesota, 3, 1893, p. 301. Miller, N. A. Geol. Pal., 2d App., 1897, p. 758. Nickles and Bresler, Bull. U. S. Geol. Surv., 173, p. 35. Grabau and Shimer, N. A. Index Fossils, 1, p. 137.

Zoaria consist of laminated expansions growing upon foreign bodies, and of globuler masses in which the zoecial tubes radiate from a small base covered with epitheca. The zoecia have thin walls and are crossed by few diaphragms. Mesoposes are abundant in the basal portion, decreasing in size and numbers in the peripheral region of mature specimens. They are closely tabulated and bead-like. Acanthopores are present, having a distinct lucid center (lumen).

Stromatotrypa lamellata n. sp. Plate XI, Figs. 1-2. The zoarium consist of superimposed layers varying from 1 to 2 mm. in thickness. The base is covered with a wrinkled epitheca. The surfaee is even and without distinct maculae.

The zoecia are large, 4 to 5 in 2 mm., irregular in size and shape. When the mesopores separate the zoecia completely, they are oval or subcircular, and where the mesopores are few or absent the zoecial tubes are elongate polygons as seen in the tangential section.

From 3 to 7 acanthopores surround each zoecia and inflect the walls. They arise in the early mature zone, increase in size rapidly, and then taper gradually to their extremity which projects above the zoöidal cavity in perfectly preserved specimens.

The zooecial tubes are short and slightly inclined in the proximal region. The diaphragms are few, varying from .5 to 1 tube diameter apart. The mesopores are more numerous in the basal zone than in the mature portion and are crossed by relatively few and irregularly spaced diaphragms.

This species differs from the laminated form in the Black River of Minnesota in having less number of mesopores with fewer diaphragms; more angular zoecia and pronounced inflection of the zoecial walls by the well developed and relatively thick-walled acanthopores.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Holotype: 44718, U. S. Nat. Mus.

Stromatotrypa incrustans n. sp. Plate XI, Figs. 3-4. Zarium forms thin incrustations (from .5 to 1 mm. in thickness) upon foreign bodies. The surface is smooth and without maculae.

The zoecia are subangular, relatively thick-walled for the genus; 6 to 7 in 2 mm. Mesopores are few, occurring mostly at the junction angles of the zoecial tubes.

The acanthopores are about as numerous as the zoecia; of large size; thin dark wall, and a large central lucid area. They originate near the base of the zoarium and extend to the surface as well developed structures. In the zoecia there are three to four diaphragms, in the space of one tube diameter, and about twice that many in the mesopores.

The smaller size and thicker walls of the zoecia, the less numbers of mesopores and larger and fewer acanthopores separate this species from *Stromatotrypa lamellata* n. sp.

Occurrence: Pierce limestone, at ford 1¼ mile southeast of Blackman, Rutherford County, Tennessee.

Holotype: 245—14. Indiana University.

Stromatotrypa regularis n. sp. Plate XI, Figs. 5-6. The zoarium consists of thin layers upon foreign bodies, varying in thickness from .8 to 2 mm. The surface is even, and without monticules or maculae.

The zoecia are subpentagonal, thin-walled and completely separated by mesopores; 4 to 5 occur in 2 mm.

The mesopores are only slightly smaller than the zooecia, of more irregular shape, thinner walled and usually six-sided as seen in the tangential section. In the younger stages they are zooecial-like, with few or no diaphragms, becoming smaller in the mature region and crossed by 2 to 3 diaphragms in the distance of their own diameter. The smaller mesopores are distinctly beaded. The zooecia increase in size with age, and have few and irregularly spaced diaphragms; one to two in the primitive portion, and rare or absent in the peripheral zone. The acanthopores are large, thin-walled and have a well developed central lucid area. They occur at the angles of the zoecia and mesopores and are a little more numerous than the zoecia.

The characters of the tangential section separate this species from any described Stromatotrypa.

Occurrence: Pierce limestone, at the ford 1½ mile southeast of Blackman, Rutherford County, Tennessee.

Holotoype: 245-16. Indiana University.

ORDER CRYPTOSTOMATA VINE.

The definition of the order, as given by Ulrich in the English edition of Zittel's Textbook of Paleontology, and again repeated by Bassler in the Zittel-Eastman edition, published in 1913, is as follows:

"Primitive zooecium short, pyriform to oblong, quadrate or hexagonal, sometimes tubular, the aperture anterior. In the mature colony the aperture is concealed, occurring at the bottom of a tubular shaft ("vestibule"), which may be intersected by straight diaphragms or hemisepta, owing to the direct super-imposition of layers of polypides; vestibular shaft surrounded by vesicular tissue, or by a solid calcareous deposit; the external orifice rounded. Marsupia and avicularia wanting."

Family Ptilodictyonidae Ulrich.

Zoarium bifoliate, composed of two layers of zooecia, grown together back to back, forming leaf-like expansions, or compressed branching or inosculating stems, that are usually jointed, at least at the base; mesotheca without median tubuli; zooecia usually have hemisepta and semielliptical orifices; apertures usually ovate, surrounded by a sloping area or a distinct peristome; vestibules separated by thick walls.

Genus Graptodictya Ulrich. Genotype: Ptilodictya perelegans Ulrich. Graptodictya Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, pp. 151, 165. Miller, N. A. Geol. Pal., 1889, p. 307. Ulrich, Geol. Surv. Illinois, 8, 1890, p. 393. Procta, Syst. Sil. Centre Boheme, 8, pt. 1, 1894, p. 14. Simpson, 14th Ann. Rept. New York State Geol. for 1894, 1897, p. 541. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 46. Cumings, 32d Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 747. Bassler, Bull. U. S. Nat. Mus., 77, 1911, p. 121.

The zoarium consists of a narrow, bifoliate, branching frond or cribrose forms, with a pointed base, articulating with a small basal expansion; apertures subcircular, surrounded by a peristome subpolygonal in outline; interspaces depressed, usually with one or two fine tortuous elevated lines.

Graptodictya fruticosa n. sp. Plate XII, Figs. 1-2. Zoarium consists of bifoliate branching frond, 1 to 1.5 mm. wide. The branches rise perpendicularly from the margins and are irregularly spaced from one another. On the type specimen the distance between the branches varies from .1 mm. to 1.5 mm. and portions of the zoarium can be selected in which 4 stipes spring from one margin and one from the opposite margin in the space of 5 mm. Some of the branches develop and bifurcate similar to the principal stipe and others form short lateral extensions 1 to 3 mm. in length. The bushy effect resulting from the irregular branching was observed in a number of specimens, with similar internal characters, and is here considered of specific value.

Sections show that the apertures are oval, arranged in longitudinal series and separated by two fine tortuous lines. Fine zooecia occur in 2 mm. within the series. At the bifurcation, the striated appearance is increased by the presence of narrower apertures; the serial arrangement is less definite, and the fine tortuous lines occasionally wind diagonally among the zooecia.

The primitive tubes are thin-walled and lie upon the median laminae from the proximal end to the hemiseptum, where the outward turn is short and sufficient to permit the tube to approach the surface perpendicularly.

Diaphragms, mesopores and median tubuli are wanting.

The hemisepta is short, blunt, and projects directly towards the mesotheca.

The form of the zoarium distinguishes this species from others of the genus.

Occurrence: Pierce limestone, Walter Hill, Rutherford County, Tennessee.

Holotype: 237-12. Indiana University.

Graptodictya dendroidea n. sp. Plate XII, Figs. 3-4. The zoarium forms a narrow bifoliate frond, 1.5 to 2 mm. wide. The first, 10 to 15 mm. above the articulated base, is an unbranched stipe above which dichotomous branching occurs every 2.5 to 3 mm.

The zooecia are oval, arranged in longitudinal rows, 8 to 9 in 2 mm. Two fine lines separate the rows in the middle of the lateral surface, but near the border where the long axes of the apertures are obliquely directed the tortuous lines pass between the apertures in the series. The walls of the zooecia in *G. fruticosa* are thinner, the apertures larger and the longitudinal rows (14 to 14.5 in 2 mm.) more closely crowded than in *G. dendroidea* (13 to 13.5 in 2 mm.).

The form of the zoarium of *G dendroidea* is characteristically different from all other described species.

Occurrence: Pierce limestone; Walter Hill, Rutherford County, Tennessee.

Holotype: 237—13, 14. Indiana University.

Family, Rhinidictyonidae Ulrich.

Genotype: Rhinidictya nicholsoni Ulrich. Stictopora (part) Hall, Pal. New York, 1, 1847, p. 73. Ulrich, Geol. Surv. Illinois, 8, 1890, p. 388.

Rhinidictya Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, p. 152. Hall and Simpson, Pal. New York, 6, 1887, p. 20. Miller, N. A. Geol. Pal., 1889, p. 320. Ulrich, Geol. Minnesota, 3, 1893, p. 124. Procta. Syst. Sil. Centre Boheme, 8 pt. 1, 1894, p. 15. Ulrich, Zittel's Textb. Pal. (Engl. ed.), 1896, p. 279. Simpson, 14th Ann. Rept. State Geol. New York for 1894, 1897, p. 605. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 48. Grabau and Shimer, N. A. Index Fossils, 1, 1907, p. 158. Cumings, 32d Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 755. Bassler, Bull. U. S. Nat. Mus., 77, 1911, pp. 131, 132; Zittel-Eastman Textb. Pal., 1913, p. 345.

Zoarium bifoliate, continuous or jointed, consisting of compressed branches or leaf-like expansions; occasionally trifoliate; zooecia subgraduate, arranged longitudinally; orifices and apertures elliptical or subcircular, sometimes a little truncated posteriorly; median tubuli between the median laminae and between the longitudinal rows of zooecia; mesopores wanting, but vesicular tissue often developed; inferior and superior hemiseptum sometimes present. The family has been redefined to include the new genus Hemidictya which has both inferior and superior hemiseptum.

Genus Rhinidictya Ulrich. Genotype: Rhinidictya nicholsoni Ulrich. Stictopora (part) Hall, Pal. New York, 1, 1847, p. 73. Ulrich, Geol. Surv. Illinois, 8, 1890, p. 388.

Rhinidictya Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, p. 152. Hall and Simpson, Pal. New York, 6, 1887, p. 20. Miller, N. A. Geol. Pal., 1889, p. 320. Ulrich, Geol. Minnesota, 3, 1893, p. 124. Procta, Syst. Sil. Centre Boheme, 8, pt. 1, 1894, p. 15. Ulrich, Zittel's Textb. Pal. (Engl. ed.), 1896, p. 279. Simpson, 14th Ann. Rept. State Geol. New York for 1894, 1897, p. 605. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 48. Grabau and Shimer, N. A. Index Fossils, 1, 1907, p. 158. Cumings, 32d Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 755. Bassler, Bull. U. S. Nat. Mus., 77, 1911, pp. 131, 132; Zittel-Eastman Textb. Pal., 1913, p. 345.

"Zoaria composed of narrow, compressed, dichotomously divided branches, with the margins sharp, straight and essentially parallel; attached to foreign bodies by a continuous expanded base. Zooecial apertures subcircular or elliptical, arranged alternately in longitudinal series between slightly elevated, straight or flexuous ridges, carrying a crowded row of small, blunt spines. Space immediately surrounding apertures sloping up to summits of ridges." (Ulrich.)

Rhinidictya tabulata n. sp. Plate XII, Figs. 5-6. Zoarium consists of bifoliated branching form, the branches rising from the margins; the type specimen is 3 mm. wide, .8 to 1.7 mm. in thickness midway between the margins. The surface is even with an occasional subsolid area, formed by the thickening of the zooecial interspaces of mature specimens. The margins are thin, celluliferous, approximately parallel, except near the bifurcations.

The zooecia are elliptical. In the central portion of the lateral surface they are arranged in longitudinal and diagonal rows (7 to 11 in the type specimen), with the longer diameters of the apertures parallel to the margins. Between the longitudinal series and the edges of the branch occur short, less definite series, each consisting of 4 or 5 zooecia that extend upward and outward. The longer diameters of these zooecia are parallel to the longitudinal series of apertures in the proximate branches rising from the corresponding margin.

Close set, wavy rows of tubuli are present upon the crest of the ridge separating the series of zooecia, and in a few cases a single one is found between the zooecia within the series. In the subsolid areas their distribution shows much less systematic arrangement.

The longitudinal section shows clearly the bifoliate character of the zoarium and the presence of median tubuli. The primitive zooecial tube is .3 mm. long, lies inclined upon the median lamina, extends upward, increases in size with age and ends abruptly by a short turn into the long (.7 to .8 mm.) vestibule. No superior septum is developed. From one to four diaphragms cross some of the vestibular tubes. The intercellular space in the vestibule zone consists of solid tissue except in a few cases near the junction of the vestibule and the primitive zooecia, where diaphragm-like structures occur.

This species resembles *Rhinidictya mutabilis* in many of its characters, but differs in the presence of diaphragms in the vestibular tubes.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Holotype: (98) U. S. Nat. Mus.

Rhinidictya salemensis n. sp. Plate XIII, Figs. 4-5. The zoarium consists of bifoliate branches 2 mm. thick and from 5 to 10 mm. wide. The surface is even with small, solid, unequally distributed maculae, composed of compact sclerenchyma and radiating rows of vertical tubuli.

The zoocial apertures are small, oval, and separated from one another by walls that are greater than twice the short diameter of the opening in thickness and traversed by a single row or an irregular band of vertical tubuli. The zooecia are not arranged in definite longitudinal series as in many Rhinidictya; 7 to 8 occur in 2 mm.

Median tubuli are shown in the longitudinal section. The zooecial tubes lie along the median laminae for only .1 to .2 mm. and then turn outward with a short bend and proceed nearly direct to the periphery. The interspaces in the vestibular zone are filled with solid tissue traversed with numerous tubuli. No diaphragms occur in the zoocial tubes.

Occurrence: Ridley limestone, 2½ miles northwest of Salem, Rutherford County, Tennessee.

Holotype: 245-7. Indiana University.

Rhinidictya lebanonensis n. sp. Plate XIII, Figs. 6-7. The zoarium branches dichotomously. The branches are small, 2 to 2.2 mm. wide and .5 mm. thick. The margins are celluliferous; the zooecia in the rows nearest the margin are more widely spaced than in the other series. Nine to ten rows of zooecia are present on the lateral surfaces.

The zooecia are oval; 7 in 2 mm. measured along the rows. Each longitudinal series is separated by a wavy line of close-set tubuli.

In the longitudinal section the median laminae are distinct, and in a portion of the section the median tabuli are shown. The primitive zooecia lie along the median laminae, terminating at the entrance of the vestibule where the posterior wall extends forward and constricts the aperture by forming a superior hemiseptum. Beyond the septum the tube lies along the posterior wall of the upper primitive zooecia for a distance of about .2 mm. It then turns sufficiently to permit the zooecia to open perpendicularly at the surface. The tube in the vestibular zone is constricted notably by the thickening of the walls.

This species resembles *R. fidelis* and *R. minima* in having a well developed superior hemiseptum. It can be distinguished from *R. fidelis* by the smaller zoarium, the decided construction of the zooecial tubes in the vestibule and the direct apertures.

The zoarium of *R. minima* is smaller and has less number of rows of zooecia than *R. lebanonensis*.

Occurrence: Lebanon limestone, ½ mile south of Milesford, Rutherford County, Tennessee.

Holotype: 247-9. Indiana University.

Genus Pachydictya Ulrich. Genotype: Pachydictya robusta Ulrich. Pachydictya Ulrich, Jour., Cincinnati Soc. Nat. Hist., 5, 1882, p. 152. Foerste, Bull. Sci. Lab. Denison Univ., 2, 1887, p. 152. Miller, N. A. Geol. Pal., 1889, p. 313. Ulrich, Geol. Surv. Illinois, 8, 1890, pp. 390, 522; Geol. Minnesota, 3, 1893, p. 145. Procta, Syst. Sil. Centre Boheme, 8, pt. 1, 1894, p. 15. Simpson, 14th Ann. Rept. State Geol. New York for 1894, 1897, p. 530. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 48. Hennig, Archiv. fur Zool., K Sven. Vet.-ckad. Stockhalm, 2, No. 10, 1905, p. 25. Bassler, Bull. U. S. Geol. Surv., 292, 1906, p. 57. Graban and Shimer, N. A. Index Fossils, 1, 1907, p. 159. Cumings, 32d Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 751. Bassler, Bull. U. S. Nat. Mus., 77, 1911, pp. 137, 138.

The zooecial apertures of Pachydictya are oval and have well developed, ring-like walls; no hemisepta. The character distinguishes the genus from any other of the family Rhinidictyonidae.

Pachydictya senilis n. sp. Plate XIII, Figs. 1-3. Zoarium is ramose, branches vary from 1 to 1.2 mm. in thickness and 6 to 10 mm. in width. The margin is non-poriferous and variable in width, ranging from .2 to .6 mm. Maculae of mesopores and raised clusters of zooecia occur irregularly distributed over the surface.

The zooecia are oval or circular, with well developed peristome, arranged in indefinite longitudinal series; and separated by irregular rows of minute vertical tubuli in the peripheral zone. Deeper tangential sections show an increased number and larger mesopores which in some places separate the zooecia.

The vertical section shows median tubuli traversing the median laminae longitudinally. The zooecial tubes are recumbent only a very short distance, then turn outward and approach the surface almost direct. Two to six diaphragms cross the tubes in the vestibular zone.

The mesopores are crowded with diaphragms in their earlier part, but closed at the surface by the thickened walls of the zooecial tubes.

Pachydictya robusta is closely allied to this species, but the larger zoarium, and large zooecia of *P. robusta* serves to differentiate it.

Occurrence: Pierce limestone, Murfreesboro, Tennessee.

Holotype: 55140 U. S. Nat. Mus.

Genus Trigonodictya Ulrich. Genotype: Pachydictya conciliatrix Ulrich. Tigonodictya Ulrich. Geol. Minnesota, 3. 1893. p. 160. Nickles and Bassler,* Bull. U. S. Geol. Surv., 173, 1900. p. 49.

"Zoarium of triangular branches, constructed upon the plan of Prismopora, but with zooecia and all minute details of structure as in Pachydictya."

Trigonodictya irregularis n. sp. Plate XIII, Figs. The zoarium consists of irregular, triangular branches with unequal poriferous faces. The edges are noncelluliferous.

The zooecial apertures are oval, 7 to 8 in 2 mm. counted diagonally. The peristome, the structure of the interzooecial spaces, and the arrangement of the zooecia, show great similarity to *Pachydictya foliata* Ulrich.

Straight and coalesced diaphragms occur in the zooecial tubes, varying in number from one to eight.

The small tubuli, present in the interspaces of *Trigonodictya conciliatrix* and the longitudinal arrangement of the zooecia, serve to distinguish it from this species.

Occurrence: Lebanon limestone; 2 miles southwest of Christiana, Rutherford County, Tennessee.

Holotype: 245-11. Indiana University.

New Genus Hemidictya. Zoarium bifoliate fronds or irregularly ramose forms with nonporiferous margins; surface with maculae; zooecia with thin walls, elliptical or subcircular; vestibule nearly direct, walls thicken and form peristomes; diaphragms appear in some of the vestibular tubes: inferior and superior hemiseptum present; spaces between the vestibule traversed by one or more series of minute tubuli. The presence of a peristome shows the close relation of this genus to Pachydictya, from which it is distinguished by the occurrence of hemisepta.

Genotype: Hemidictya lebanonensis, n. sp.

Hemidictya lebanonensis n. sp. Plate XIV, Figs. 1-3. Zoarium consists of thin fronds, 5 to 10 mm. across and one mm. thick, from the edge of which rise several compressed short branches 2.5 to 3 mm. wide and .3 to .5 mm. thick. The margin is conspicuously non-poriferous in the angle of bifurcation, where it is .5 mm. wide in the type specimen, and becomes narrower rapidly farther along the branch.

The surface is even, upon which is distributed small subsolid macules,

*Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 49.

2 to 3 mm. apart in which the vestibular are greatly thickened and the zooecia less numerous than in the intermacular area.

The zooecia are arranged into more or less definite longitudinal rows (13 to 14 in 2 mm.) separated by one or more rows of minute tubuli. The apertures at the surface are mostly elliptical (6 to 7 in 2 mm. measured longitudinally) with the longer diameter parallel to the direction of the series. In the maculae and near the non-poriferous margin the apertures are rounded.

The cross-section shows a single row of median tubuli traversing the median laminae lengthwise.

The zooecia in the primitive area lie inclined upward along the median laminae to the inferior hemiseptum. After passing the septa the zooecial tube turns abruptly outward, enters the vestibular area and proceeds almost directly to the surface. An occasional diaphragm, either straight or curved, occurs in some of the zooecia.

Occurrence: Lebanon limestone; Big Springs, Rutherford County, Tennessee.

Holotype: 248—25. Indiana University.

Family Stictoporellidae, Nickles and Bassler.

This family differs from Ptylodictyonidae mainly in that the zoarium is not articulated, but grows upward from, and is continuous with, a spreading base.

Genus Stictoporella Ulrich. Genotype: Stictoporella interstincta Ulrich.

Stictoporella Ulrich, Jour. Cincinnati Soc. Nat. Hist., 5, 1882, pp. 152, 169. Miller, N. A. Geol. Pal., 1889, p. 325. Ulrich, Geol. Surv. Illinois, 8, 1890, p. 394; Geol. Minnesota, 3, 1893, p. 179. Pocta, Syst. Sil. Centre Boheme, 8, pt. 1, 1894, p. 14. Ulrich, Zittel's Textb. Pal. (Engl. ed.), 1896, p. 279. Simpson, 14th Ann. Rept. State Geol. New York for 1894, 1997, p. 535. Nickles and Bassler, Bull. U. S. Geol. Surv., 173, 1900, p. 46. Graban and Shimer, N. A. Index Fossils, 1, 1907, p. 157. Cumings, 32d Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 756. Bassler, Bull. U. S. Nat. Mus., 77, 1911, p. 127; Zittel-Eastman Textb. Pal., 1913, p. 345.

Micropora Eichwald (not Gray, 1848), Bull. Soc. Nat. Moscow, No. 4, 1855, p. 457; Lethaea Rossica, 1, 1860, p. 393.

Zoarium, branching, cribose, or leaflike, from an expanded base. Zooecia with primitive portion tubular, usually long, generally without hemisepta, the inferior one only occasionally present. Apertures at the bottom of a wide, sloping vestibule. Thick-walled mesopores, with true diaphragms wanting occur between the apertures and line the margin of the zoarium.

Stictoporella cribrilina n. sp. Plate XIV, Figs. 4-7. Zoarium consists of a cribrose, bifoliate expansion from an extended base. The anastomosing branches average .7 mm. in thickness and .5 to 1 mm. in width. The fenestrules are small oval openings .75 to 1.5 mm. in greatest diameter and irregularly distributed.

Zoecial apertures are small, separated completely by mesopores, and occur in diagonal and longitudinal rows; 10 zoecia in 2 mm. diagonally and 7 in 2 mm. longitudinally. The vestibular walls of the zooecia and mesopores are distinctly granular along the contact, forming an encircling dark band. The orifices of the zooecia lie at the base of sloping vestibules which are composed of homogenous tissue forming a ring about the opening.

As shown in the longitudinal section the zooecial tubes are thin-walled in the primitive region and lie prostrate upward on the median lamina, then turning outward, opening into the vestibules acutely. The walls of the vestibules terminate almost perpendicularly at the periphery. A single diaphragm crosses many of the zooecial tubes usually shortly preceding the turn from the reclining position towards the vestibule.

The mesopores are short, rising in the late primitive zone. True diaphragms are absent, but in some thick irregularly arranged tabulae occur.

This species differs from *Stictoporella cribrosa*, in having smaller fenestrules, a granular band surrounding the apertures of the mesopores and zooecia, more numerous mesopores and diaphragms crossing the zooecia. The zoaria of the other species is so different from *S. cribilina* that no other differentiating characters are necessary.

Occurrence: Pierce limestone. Murfreesboro, Tennessee, and 1 mile north of McFadden Ford, Rutherford County, Tennessee.

Holotype: 56162 U. S. Nat. Mus.

Paratype: 238, 20, 21; 242-13. Indiana University.

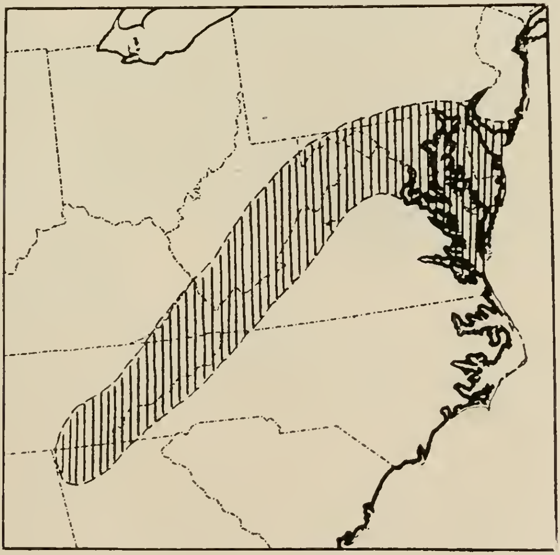

FIG. 1.

Fig. 1.—A portion of the eastern part of the United States showing the probable boundary of the Early Stones River (Mosheim) Sea.

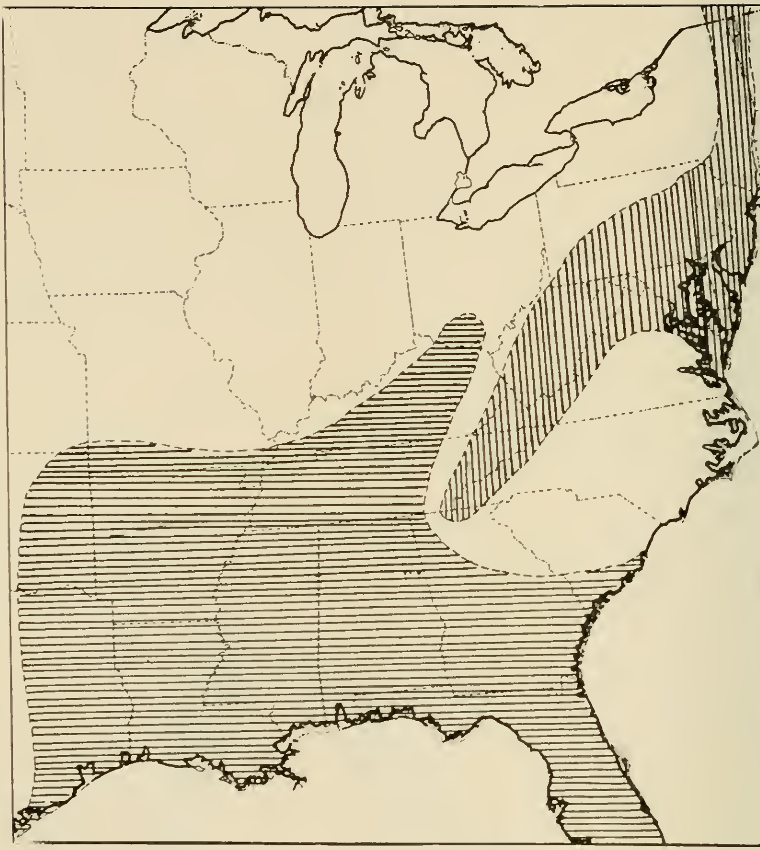

FIG. 2.

Fig. 2.—Map showing the extent of the Gulf of Mexico Embayment (horizoatal-lined area) during Middle Stones River time and the Appalachian-Champlain sea (vertical-lined area).

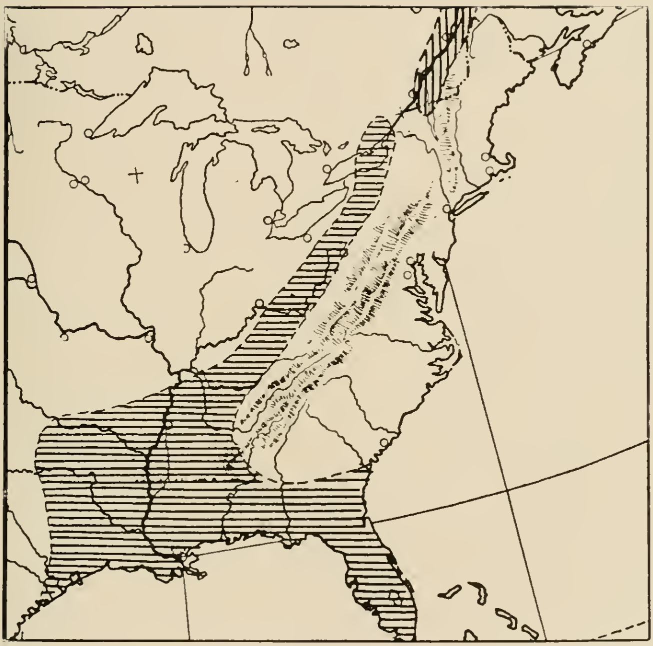

FIG. 3.

Fig. 3.—Map of eastern North America showing the greatest extent of the Gulf of Mexican embayment (Lebanon-Pamelia time) and the probable restricted conditions of the Appalachian and Champlain troughs.

RANGE AND DISTRIBUTION OF THE BRYOZOAN SPECIES OF THE CENTRAL BASIN OF TENNESSEE

TABLE 2. SHOWING RANGE AND DISTRIBUTION OF STONES RIVER BRYOZOA.

(aa = very abundant, a = abundant, c = common r = rare, cf = compare to species of horizon.

SPECIES	Central Tennessee				Upper Valley of Mississippi		Ontario Canada	New York	Russia	Other Horizons
	Murfreesboro	Pierce	Ridley	Lebanon	Black River	Richmond	Chazy	Chazy	Middle Ordovician	
Cyclostomata										
Anolotchia explanata, new species		c	c							
Ceramoporella grandis, new species		c		c						
Ceramoporella ingenua, new species		c								
Coeloclema consimile, new species		c								
Coeloclema inflatum, new species		c								
Coeloclema pierceanum, new species		c								
Corynotrypa delicatula (James)		c		c	c	c			c	
Corynotrypa tennesseensis Bassler		c		c						
Mitoclema cinctosum Ulrich			c							High Bridge Is., Kentucky.
Trepostomata										
Batostoma conferta, new species		c								
Batostoma dendroidea, new species		c								
Batostoma inutilis, new species		c								
Batostoma libana (Safford, name only)				c						
Batostoma ramosa, new species		c								
Batostoma suberasum, new species		c						c		
Constellaria lamellosa, new species		c	r							
Dekayella ridleyana, new species			c							Middle Ordovician of Upper Valley of Mississippi; Ontario.
Dianulites cf. petropolitanus			c						cf.	
Diplotrypa catenulata, new species		c								
Hallopora florencia, new species		a								
Hallopora spissata, new species		aa	a							
Hemiphragma irrasum (Ulrich)		a	c		a					
Heterotrypa patera, new species		r								
Heterotrypa stonensis, new species		r								

Mesotrypa crustulata, new species		c								
Mesotrypa dubia, new species		c								
Monticulipora compacta, new species		c								
Monticulipora discula, new species		c	c	c						
Monticulipora intersita, new species		c								
Nicholsonella frondifera, new species	a	aa	a	a				c		
Nicholsonella pulchra Ulrich	a	a		a						
Orbignyella multltabulata, new species		c								
Orbignyekla nodosa, new species				aa						
Orbignyella sublamellosa Ulrich and Bassler		c	c							
Stromatotrypa incrustans, new species		c								
Stromatotrypa lamellata, new species		c	r	c				c		
Stromatotrypa regularis, new species		c								
Cryptostomata										
Arthroclema stratum Ulrich				c	c					
Chasmatopora sublaxa (Ulrich)		c	a	c	c		c			
Escharopora angularis Ulrich		c			c					
Escharopora briareus (Ulrich)				c						Highbridge Is. Kentucky
Escharopora confluens Ulrich		c			c					
Escharopora libana (Safford)				c						
Escharopora ramosa (Ulrich)				c						
Escharopora suberecta (Ulrich)			r		c		r			
Graptodictya dendroidea, new species		c								
Graptodictya fruticosa, new species		c								
Helopora spiniformis (Ulrich)		c	r	c						
Hemidictya lebanonensis, new species				r						
Bachdictya cf. fimbriata		r			cf.					
Pachydictya cf. foliata		c	c	c	cf.					
Pachydictya senilis, new species		c								
Rhinidictya basalis (Ulrich)				c						
Rhinidictya lebanonensis, new species				c						
Rhinidictya nashvillensis (Miller)		c	c							
Rhinidictya, tabulata, new species		c	c	c						
Rhinidictya trentonensis (Ulrich)				c	c					
Sctoporella cribrilina, new species		c	r							
Trigonidictya irregularis, new species				r						

TABLE 3. SHOWING THE RANGE AND DISTRIBUTION OF OTHER SPECIES FROM THE STONES RIVER OF CENTRAL TENNESEE

Abbreviations: M = Murfreesboro, P = Pierce, R = Ridley; L = Lebanon, BR = Black River, SR = Stones River; C = Chazy, Pa = Pamelia, Ri = Richmond; T = Trenton, X = present

SPECIES	Central Tennessee					Kentucky		E. Tennessee	Virginia	Maryland	Pennsylvania	New York			New Jersey	Canada			Baffin Land	Upper Mississippi Valley		
	M	P	R	L	BR	SR	BR	SR	SR	SR	SR	C	Pa	BR	BR	C	BR	RI	BR	BR	T	Ri
Camarella varians Billings			X					X				X				X						
Camarotoechia orientalis (Billings)				X								X				X						
Ceraurinus scofieldi (Clarke)				X										X						X		
Cleiocrinus tessellatus (Troost)				X																		
Columnaria alveolata Goldfuss	X	X	X	X	X		X							X			X			X	X	
Ctenobolbina subcrassa Ulrich			X			X																
Ctenodonta gibberula Salter	X																					
Cyclonema praeciptum Ulrich	X																					
Cyrtoceras? stonense Safford	X																					
Cyrtospira tortillis Ulrich	X																					
Dinorthis deflecta (Conrad)	X	X	X	X	X		X													X		
Drepanella ampla Ulrich			X			X																
Drepanella elongata Ulrich				X		X																
Drepanella macra Ulrich				X																		
Eccyliomphalus contiguus Ulrich	X	X	X	X																		
Ectomaria prisca extenuata Ulrich	X																					
Eotomaria canalifera Ulrich	X																					
Eotomaria labiosa Ulrich	X																					
Eurychilina aequalis Ulrich			X			X																
Eurychilina subradiata Ulrich		X		X										X						X		
Fletcheria incerta (Billings)				X												X						
Gonioceras anceps Hall			X											X						X		
Gonioceras occidentale Hall	X																			X		
Hebertella bellarugosa (Conrad)		X	X				X					X							X	X		
Hebertella borealis (Billings)				X				X				X				X						
Helicotoma declivis Ulrich	X																					
Helicotoma subquadrata Ulrich	X																					

Helicotoma tennesseensis U. and S.	X																					
Hudsonaster narrawayi (Hudson)				X												X				X		
Leperditia fabulites (Conrad)	X	X	X	X									X				X			X		
Liospira abrupta U. and S.	X					X														X		
Liospira americana (Billings)	X	X	X	X	X								X					X			X	
Liospira convexa U. and S.			X																			
Liospira dicipiens Ulrich	X																					
Liospira progne (Billings)	X	X	X	X	X								X									
Liospira subconcava Ulrich	X																					
Lophospira bicincta (Hall)	X	X	X	X			X						X									X
Lophospira centralis Ulrich	X																					
Lophospira perangulata (Hall)	X										X											
Lophospira procera Ulrich	X																					
Lophospira (?) trochonemoides Ulrich	X																					
Maclurites magnus Lesueur	X	X	X	X				X	X	X	X	X	X									
Maclurites nitidus Ulrich and Scofield	X																			X		
Modiolopsis (?) consimilis Ulrich	X																					
Ophiletina sublaxa depressa U. and S.	X																					
Orthis tricenaria Conrad	X	X	X	X	X		X						X				X			X		
Palaeocrinus sulcatus Safford		X																				
Phragmolites grandis (Ulrich)				X																		
Pianodema stonensis (Safford)		X																				
Pianodema subaequata (Conrad)	X	X	X	X			X						X		X		X			X	X	
Plectoceras bondi (Safford)	X																					
Primitiella limbata Ulrich				X																X		
Protorhyncha ridleyana (Safford)		X	X																			
Pterotheca saffordi (Hall)				X																		
Pterygometopus troosti (Safford)	X	X	X	X									X									
Rafinesquina incrassata (Hall)		X	X	X				X				X										
Raphistomina modesta Ulrich	X																					
Salterella billingsi Safford	X																					
Scenidium anthonense Sardeson				X											X					X		
Schmidtella subrotunda Ulrich				X																X		
Solenopora compacta (Billings)				X										X						X		
Streptelasma (?) parasiticum Ulrich				X																X		
Stromatocerium rugosum Hall			X		X		X										X			X		
Strophomena incuravta (Shephard)	X	X	X	X									X				X			X		
Tetradium syringoporoides Ulrich		X	X	X				X	X	X	X		X									
Tetronota bidorsata (Hall)	X	X	X	X																X		
Tetranota sexcarinata U. and S.				X																	X	
Trochonema bellulum Ulrich	X																					
Trochonema eccentricum Ulrich				X													X					
Trochonema umbilicatum latum Ulrich				X																		
Whiteavesia saffordi (Ulrich)	X																					
Zittelella varians (Billings)	X		X					X								X						
Zygospira saffordi Winchell and Schuchert		X	X	X																		

PLATE I

Ceramoporella ingenus Ulrich and Bassler.
1. Vertical section x 20.
2. A portion of the surface x 10.
3. Tangential section x 20.
Pierce limestone, Murfreesboro, Tenn.

Ceramoporella grandis Ulrich and Bassler.
4 and 5. Tangential sections x 20, showing the proiminent lunaria'
6. A portion of the surface x 10.
Pierce limestone, Murfreesboro, Tenn.

PLATE I.

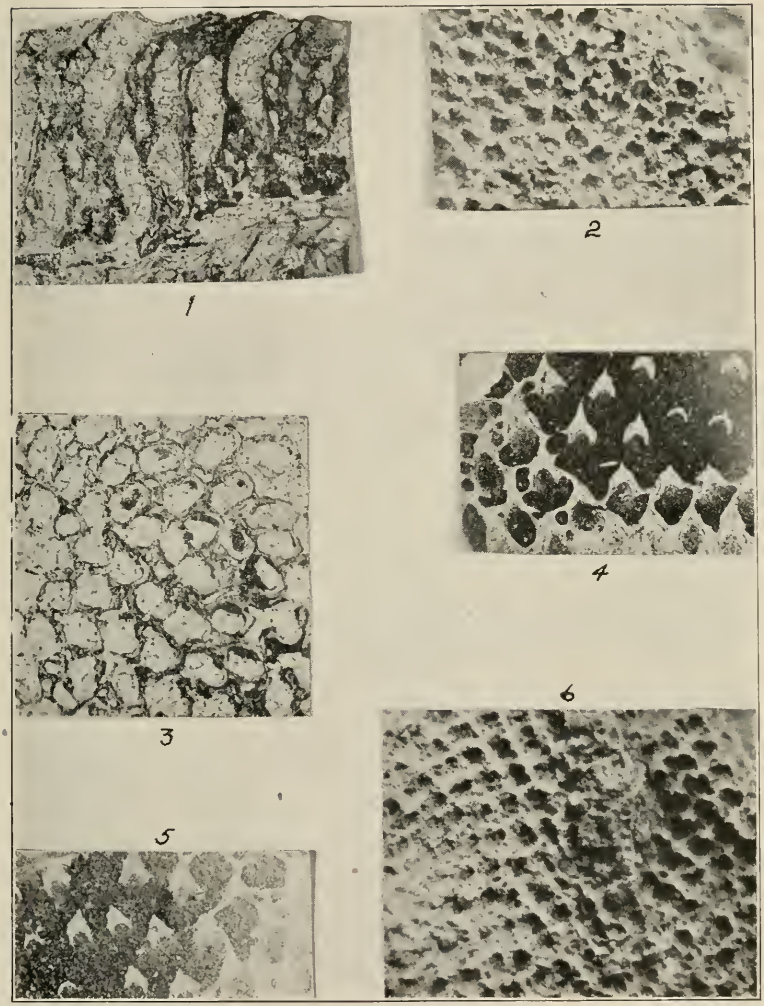

PLATE II

Coeloclema pierceanum n. sp.

1. Tangential section x 18, showing the circular shaped lunaria.
2. Longitudinal section x 18, showing the irregular opening within the stem
   Pierce limestone, Walter Hill, Rutherford Co., Tenn.

Coeloclema inflatum n. sp.

3. Cross-section x 18, showing the hollow stem.
4. Longitudinal section x 18.
5. Tangential section x 18, showing the lunaria with inflated, outward curved ends.
   Pierce limestone, Florence, Rutherford Co., Tenn.

Coeloclema consimile n. sp.

6. Longitudinal section x 18, showing the long zooecocial tubes.
7. Tangential section x 18, showing crescent shape lunarium.
   Pierce limestone. Lascassas, Rutherford Co., Tenn.

PLATE II.

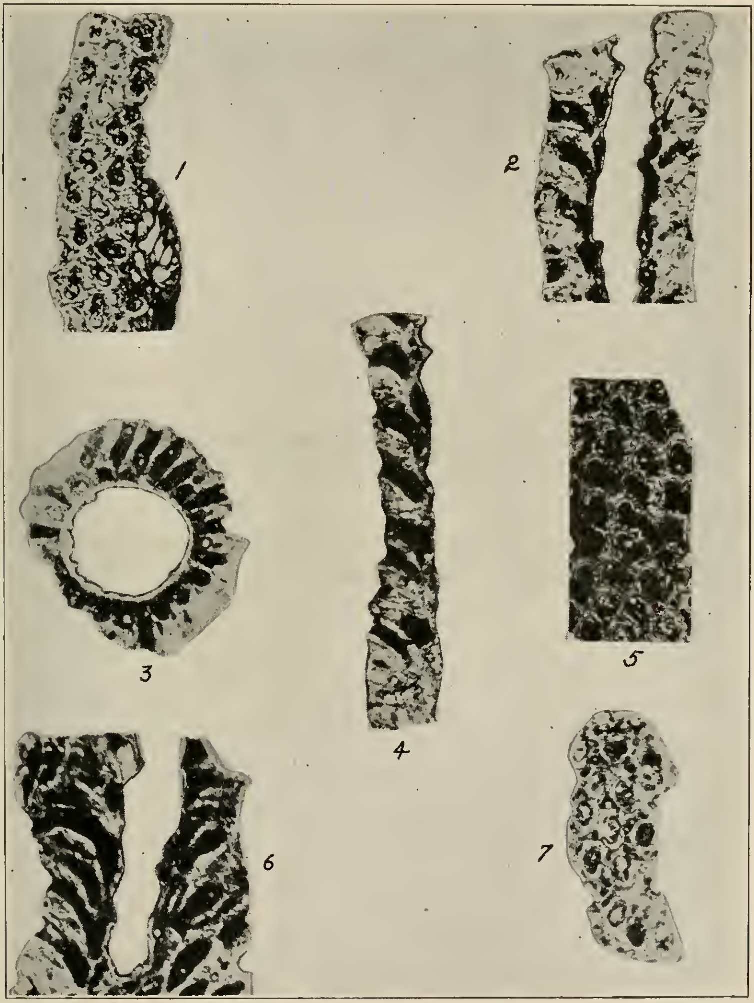

PLATE III

Anolotichia explanata n. sp.

1. Longitudinal section x 20, showing superposed layers.
2, 3, and 4. Tangential sections x 20.
Pierce and Ridley limestones, Murfreesboro and Sulphur Springs, Rutherford Co., Tenn.

Trigonidictya irregularis, n. sp.

5. Cross-section x 18, showing the three divisions of the laminae.
6. Longitudinal section x 18.
Lebanon Limestone, Christiana, Tenn.
(See Plate XIII)

PLATE III.

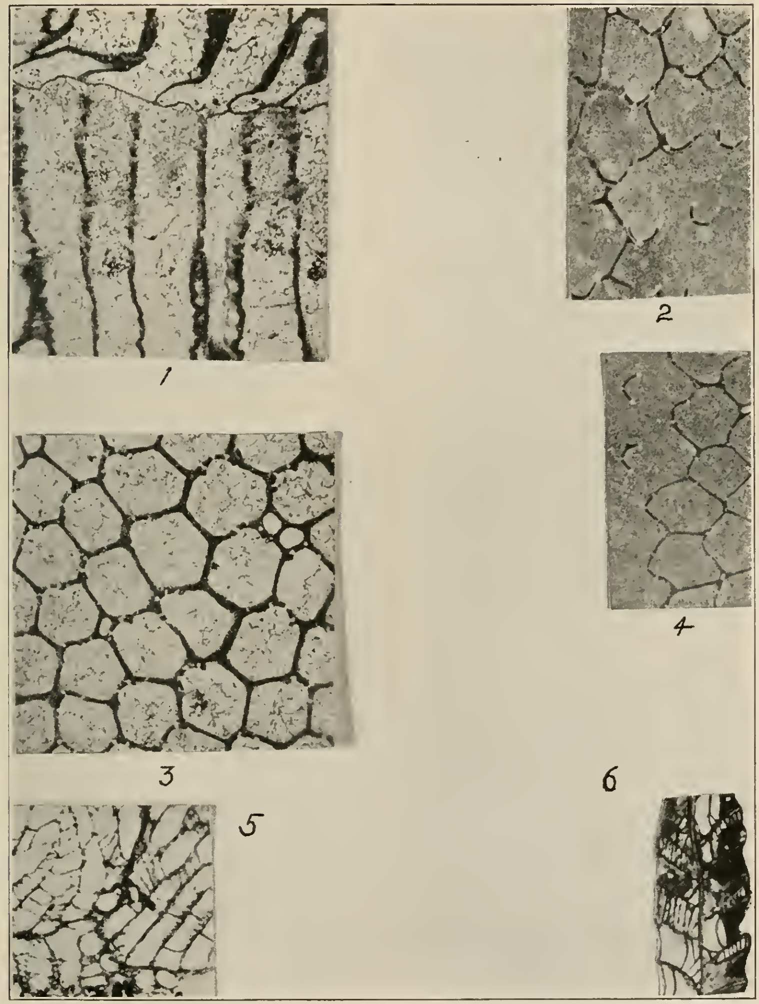

PLATE IV

Monticulipora intersita Ulrich and Bassler.

1. Tangential section x 20.
2. Longitudinal section x 20.
Pierce limestone, Murfreesboro, Tenn.

Monticulipora discula Ulrich and Bassler.

3. Tangential section x 20.
4. Longitudinal section x 20.
Pierce limestone, Murfreesboro, Tenn.

Monticulioora compacta Ulrich and Bassler.

5. Tangential section x 20.
6. Longitudinal section x 20.
Pierce limestone. Murfreesboro, Tenn.

PATE IV.

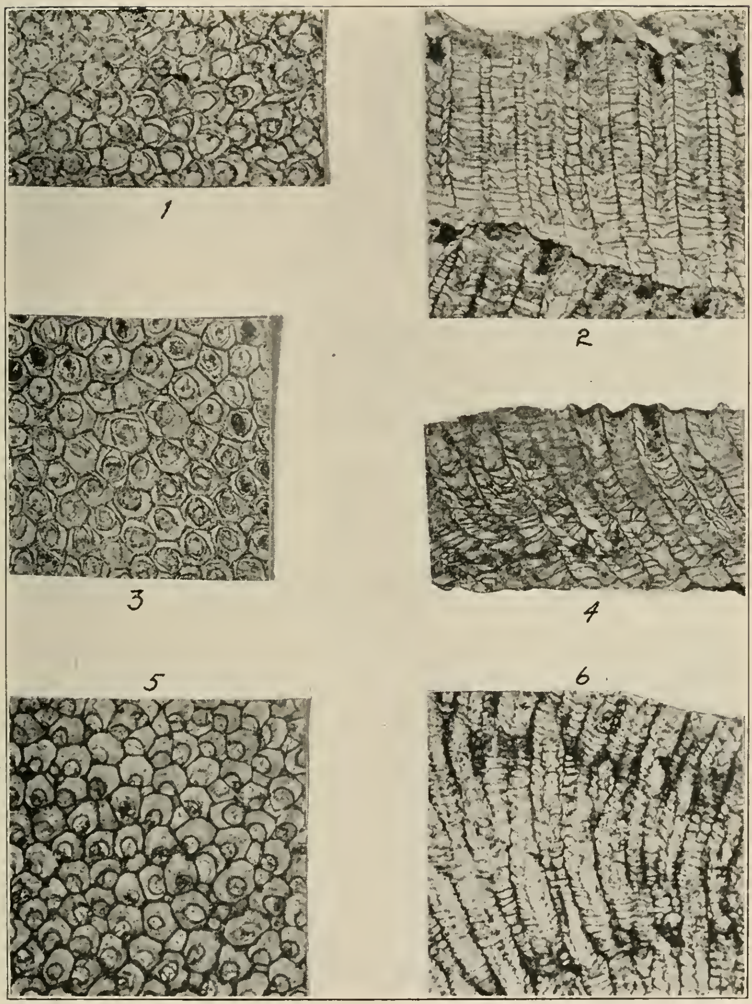

PLATE V

Orbignyella nodosa n. sp.

1. Tangential section x 18.
2. Longitudinal section x 18.
   Lebanon limestone. Big Springs, Rutherford Co., Tenn.

Orbignyella multitabulata n. sp.

3. Longitudinal section x 18.
4. Tangential section x 18.
   Pierce limestone. Almaville, Tenn.

Mesotrypa crustulata n. sp.

5. Tangential section x 20.
6. Longitudinal section x 20.
   Pierce limestone. Murfreesboro, Tenn.

PLATE V.

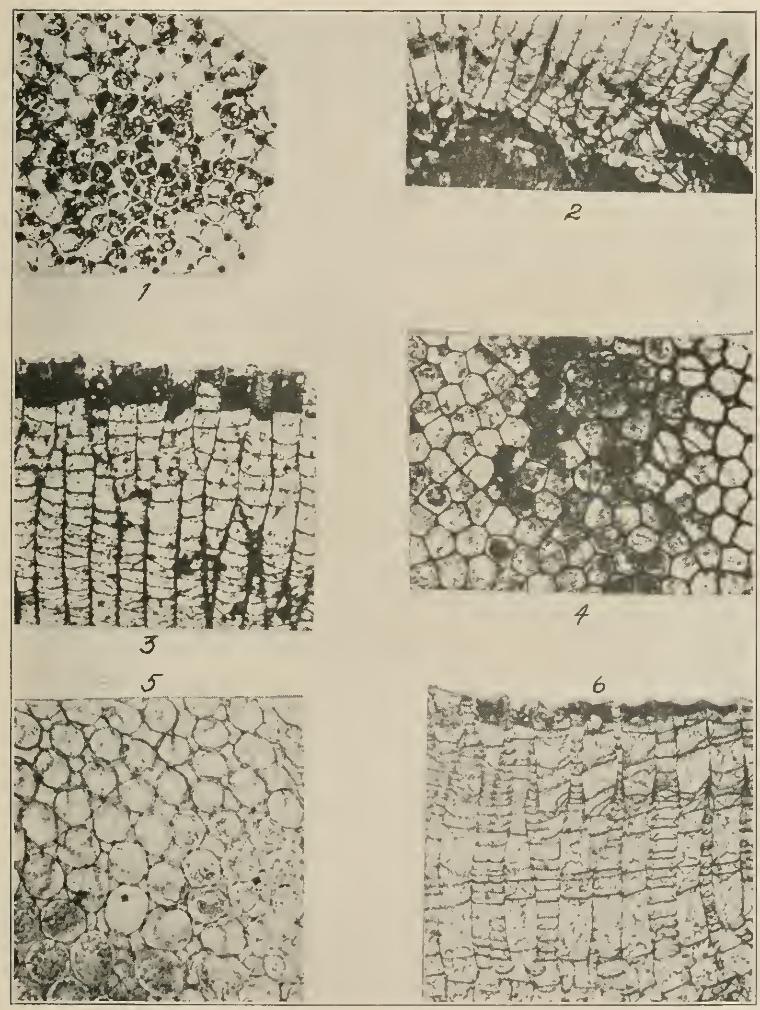

PLATE VI

Mesotrypa dubia n. sp.

1. Tangential section x 20.
2. Longitudinal section x 20.
   Pierce limestone. Murfreesboro, Tenn.

Dekayella ridleyana n. sp.

3. Longitudinal section x 18.
4. Tangential section x 18.
   Ridley limestone. Salem, Tenn.

Heterotrypa patera n. sp.

5. Longitudinal section x 18.
6. Tangential section x 18.
   Pierce limestone. Stokes Gannon Ford, 2 miles northwest of Murfreesboro, Tenn.

PLATE IV.

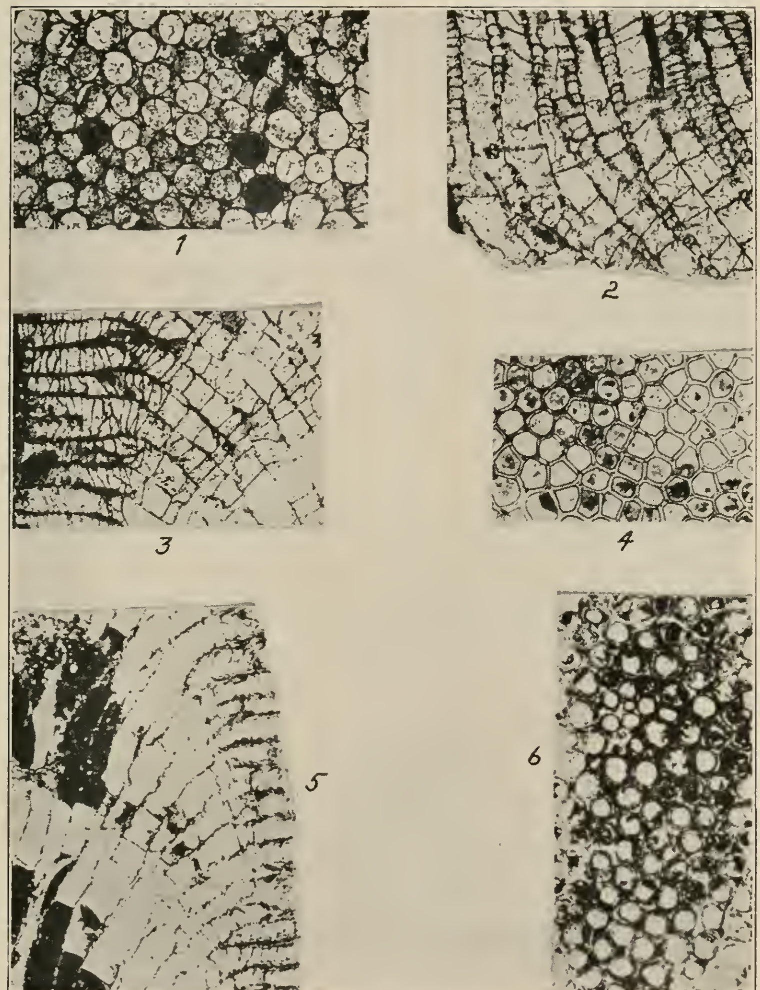

PLATE VII

Heterotrypa stonensis n. sp.

1. Longitudinal section x 18.
2. Tangential section x 18.
   Pierce limestone. Stokes Gannon Ford, 2 miles northwest of Murfreesboro, Tenn.

Constellaria lamelosa n. sp.

3 and 4. Tangential sections x 20.
5. Longitudinal section x 20.
   Pierce limestone. Murfreesboro, Tenn.; Lascassas, Tenn.

Nicholsonella frondifera n. sp.

6. Longitudinal section x 20.
7. Tangential section x 20.
   Pierce, Ridley and Lebanon limestone. Murfreesboro, Atmanville, Marshall Knob, Salem, Rutherford Co., Tenn.

PLATE VII.

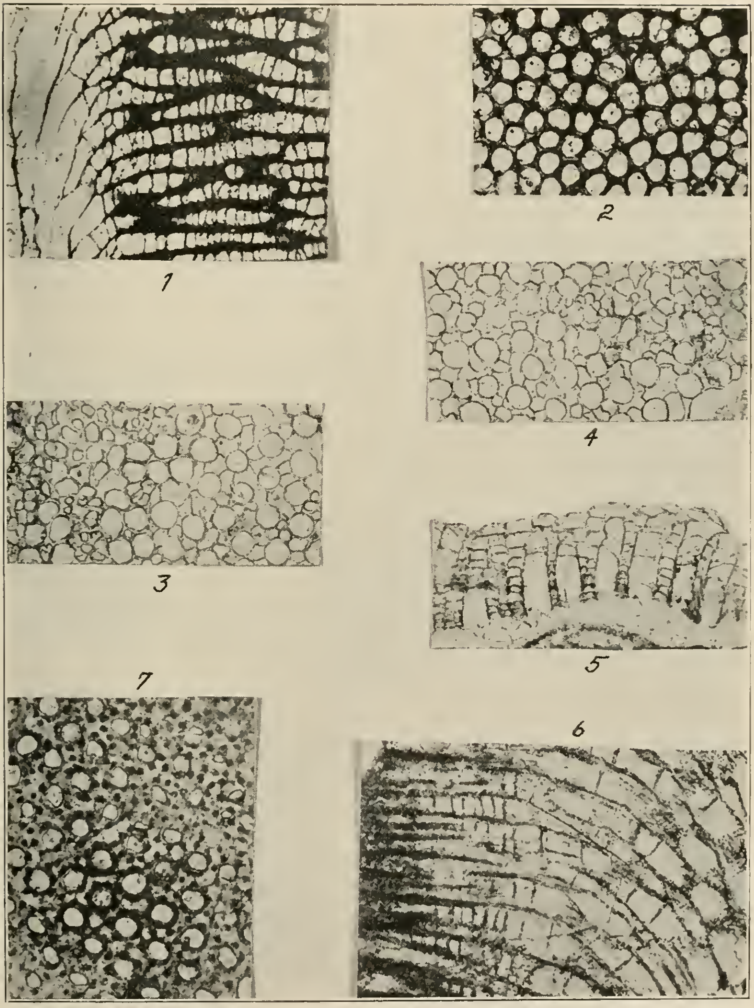

PLATE VIII

Hallopora spissata n. sp.

1. Longitudinal section x 20.
2. Tangential section x 20.
   Pierce limestone. Murfreesboro, Ward's Mill, Almaville, Tenn.

Hallopora florencia n. sp.

3. Longitudinal section x 18.
4. Tangential section x 18.
   Pierce limestone. Florence, Tenn.

Batostoma libana (Safford).

5. Portion of zoarium, natural size.
6. Longitudinal section x 20.
7. Tangential section x 20.
   Lebanon limestone, of Central Tennessee.

PLATE VIII.

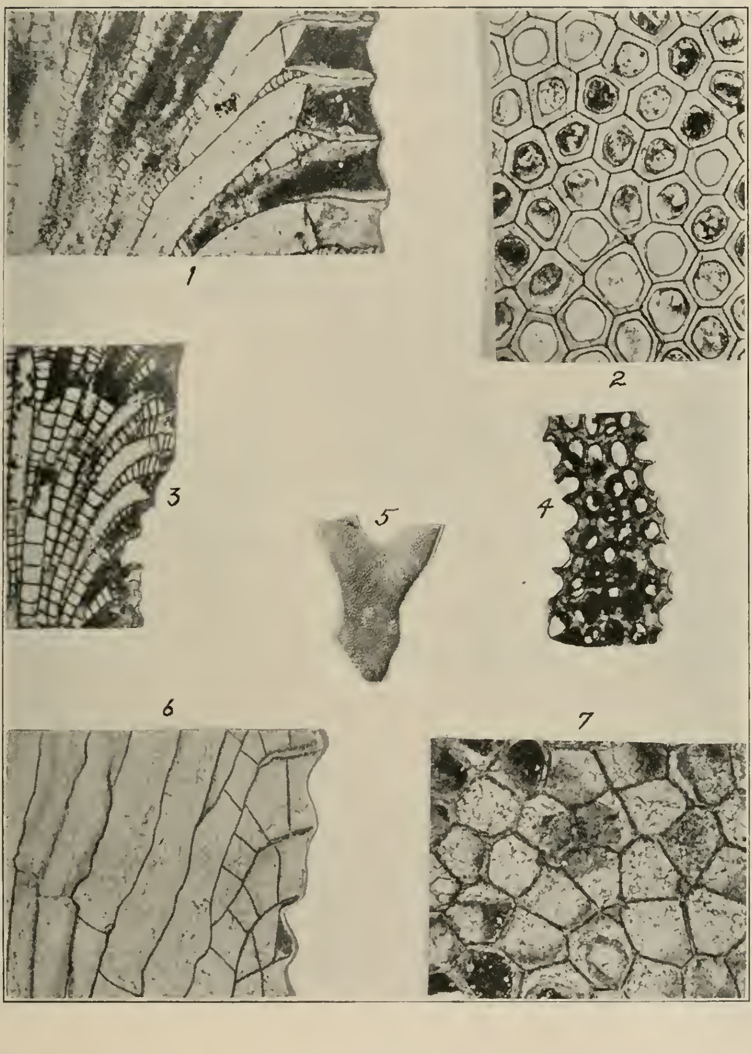

PLATE IX

Batostoma subcrassum n. sp.

1. Longitudinal section x 20.
2. Tangential section x 20.
3. A portion of zoarium, natural size.
   Pierce limestone. Murfreesboro and Eagleville, Tenn.

Batostoma dendroidea n. sp.

4. Tangential section x 18.
5. Longitudinal section x 18.
   Pierce limestone. Murfreesboro, Walter Hill, Wards Mills, and Lascassas, Tenn.

Batostoma ramosa n. sp.

6. Longitudinal section x 20.
7. Tangential section x 20.
   Pierce limestone. Murfreesboro, Tenn.

PLATE IX.

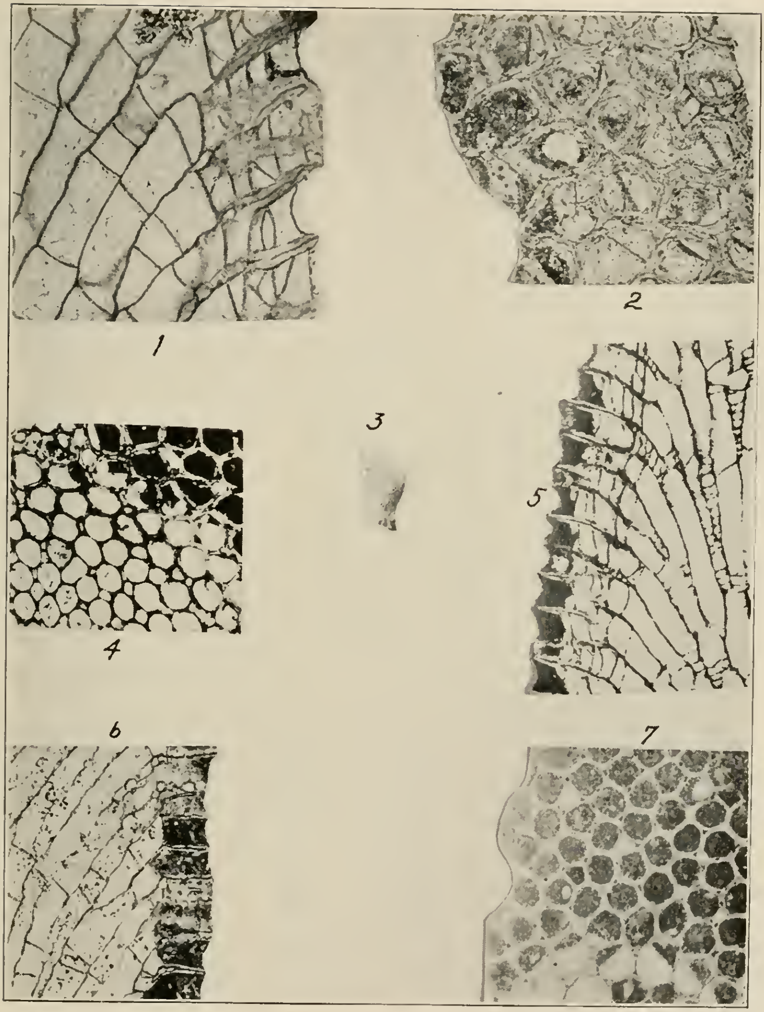

PLATE X

Batostoma conferta n. sp.

1 and 3. Longitudinal section x 18.
2. Tangential section x 18.
Pierce limestone. Murfreesboro, Tenn.

Batostoma inutilis n. sp.

4. Longitudinal section x 18.
5. Tangential section x 18.
Pierce limestone. Murfreesboro, Tenn.

Diplotrypa catenulata n. sp.

6. Longitudinal section x 20.
7. Tangential section x 20.
Pierce limestone. Murfreesboro, Tenn.

PLATE X.

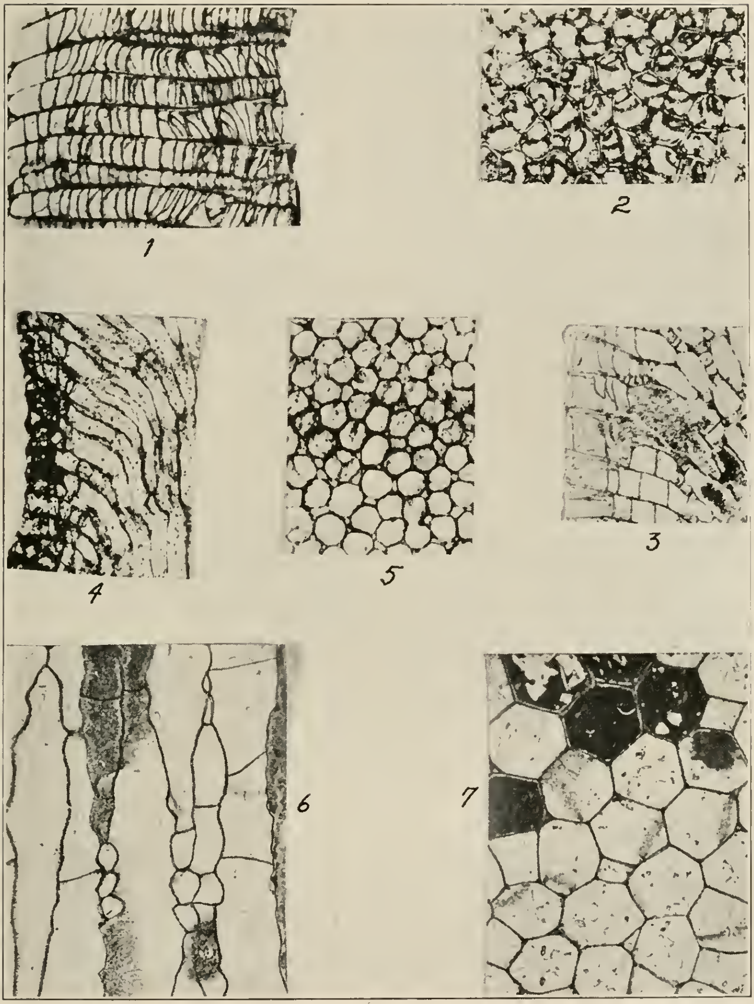

PLATE XI

Stromatotrypa lamellata n. sp.

1. Vertical section x 20, showing supposed layers.
2. Tangential section x 20.
   Pierce limestone. Murfreesboro, Tenn.

Stromatotrypa incrustans n. sp.

3. Vertical section x 18.
4. Tangential section x 18.
   Pierce limestone. Blackman, Tenn.

Stromatotrypa regularis n. sp.

5. Tangential section x 18, showing pentagonal-like zooecia.
6. Longitudinal section x 18.
   Pierce limestone. Blackman, Tenn.

PLATE XI.

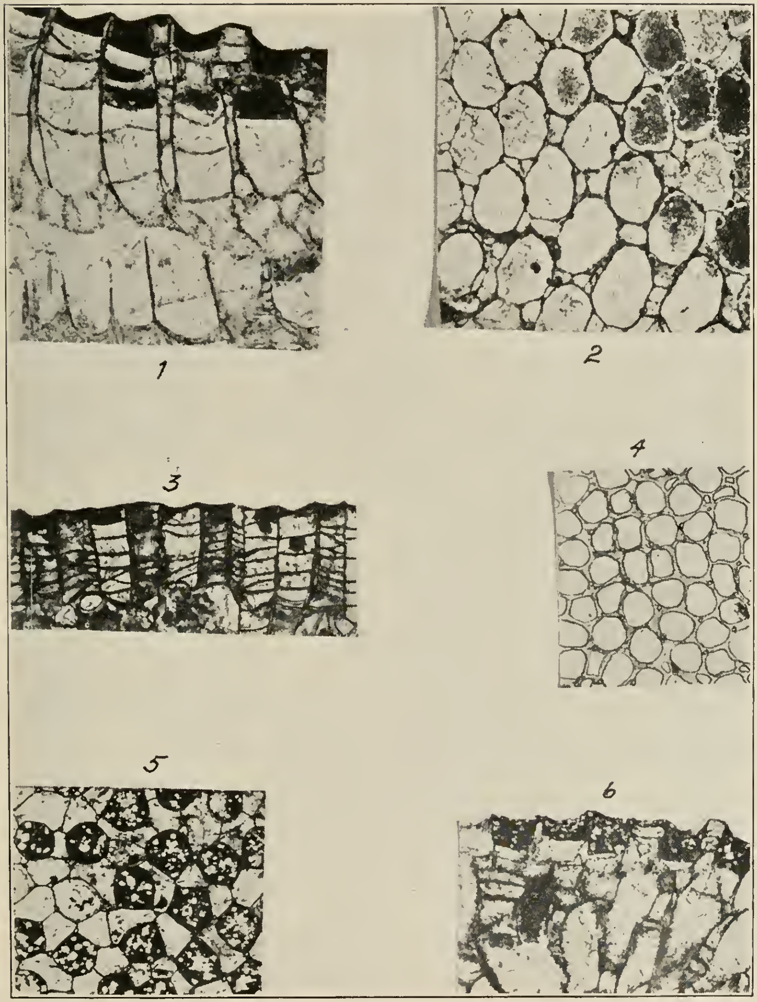

PLATE XII

Graptodictya fruiticosa n. sp.

1. Longitudinal section x 18.
2. Tangential section x 18.

Pierce limestone. Walter Hill, Tenn.

Graptodictya dendroidea n. sp.

3. Tangential section x 18.
4. Longitudinal section x 18.

Pierce limestone. Walter Hill, Tenn.

Rhinidictya tabulata n. sp.

5. Longitudinal section x 20.
6. Tangential section x 18.

Pierce limestone. Murfreesboro, Tenn.

PLATE XII.

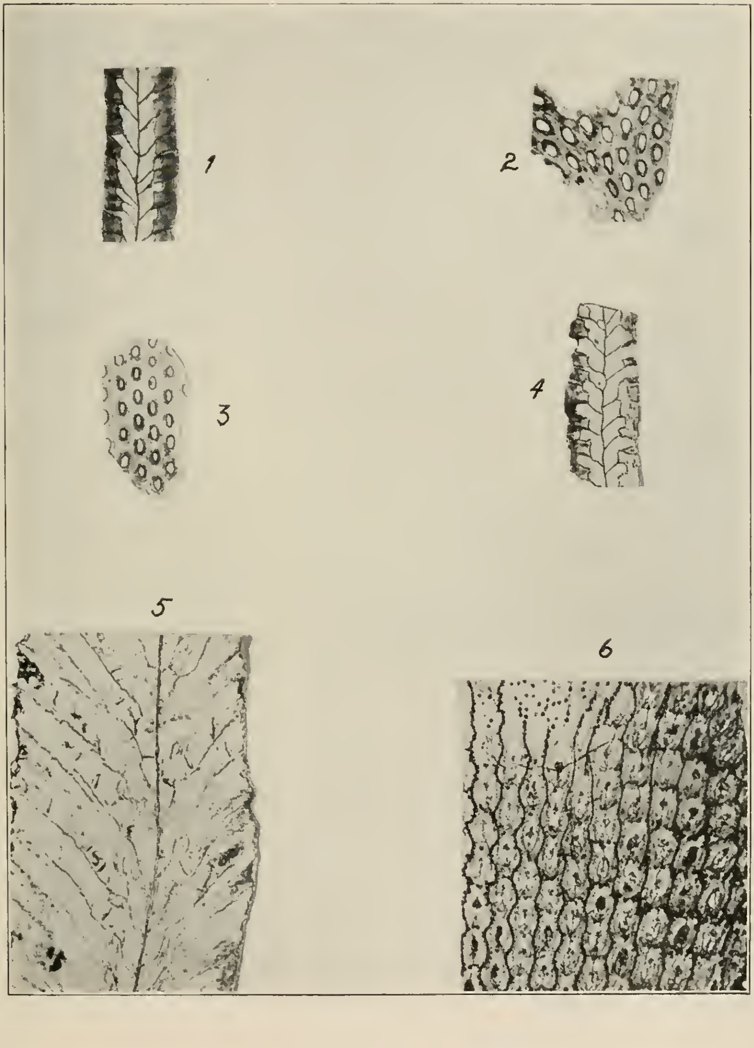

PLATE XIII

Pachydictya senilis n. sp.

1. Tangential section x 20.
2. Tangential section x 20, near the surface, showing tubuli.
3. Longitudinal section x 20.
   Pierce limestone. Murfreesboro, Tenn.

Rhinidictya salemensis n. sp.

4. Longitudinal section x 18.
5. Tangential section x 18.
   Ridley limestone. Salem, Tenn.

Rhinidictya lebanonensis n. sp.

6. Longitudinal section x 18, showing superior septum.
7. Tangential section x 18.
   Lebanon limestone. Miles Ford, Rutherford Co., Tenn.

Trigonidictya irregularis n. sp.

8. Longitudinal section x 18.
9. Tangential section x 18.
   Lebanon limestone. Christiana, Tenn.
   (See Plate III)

PLATE XIII.

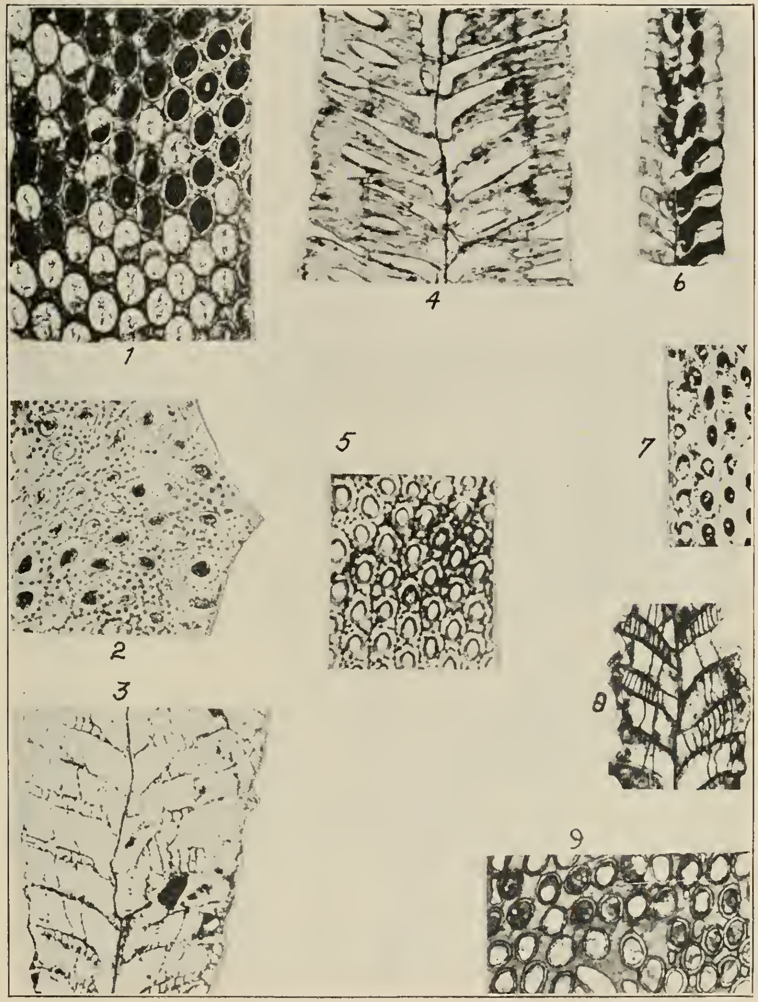

PLATE XIV

Hemidictya lebanonensis n. sp.

1. Cross-section x 18, showing median tubuli.
2. Tangential section x 18.
3. Longitudinal section x 18.
   Lebanon limestone. Big Springs, Rutherford Co., Tenn.

Stictoporella cribilina n. sp.

4. Tangential section x 20.
5. Longitudinal section x 20.
6. Portion of the surface x 10.
7. Photograph of a slab from the Pierce limestone showing a portion of a zoarium.
   Pierce limestone. Murfreesboro and McFadden Ford, Rutherford Co., Tenn.

PLATE XIV.

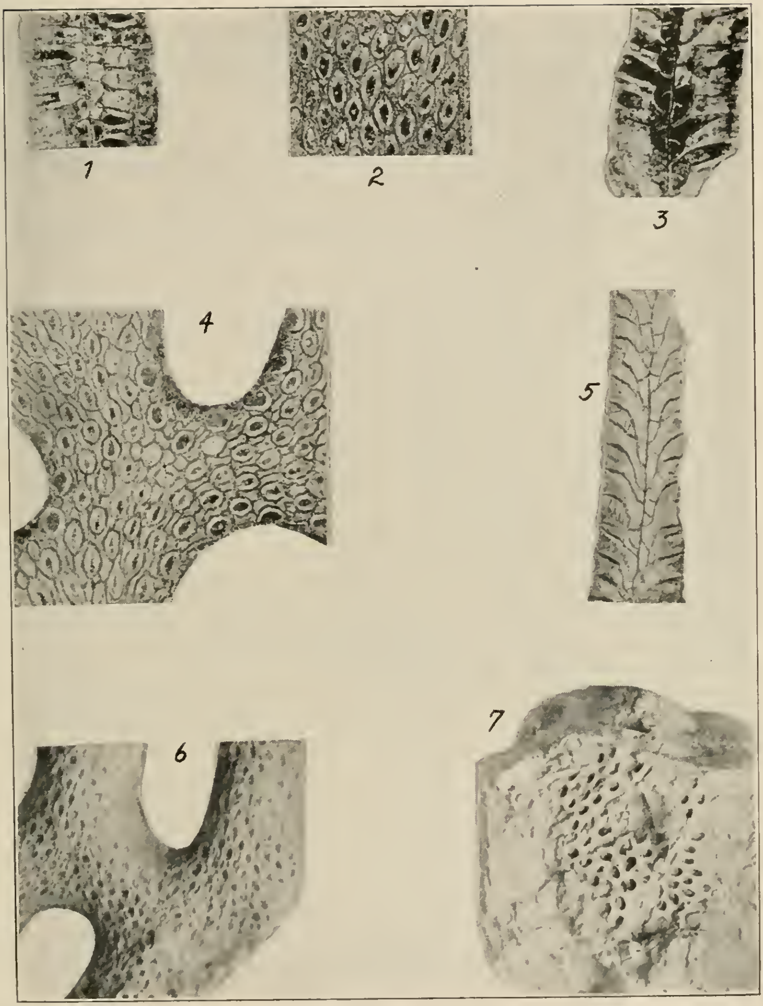

TABLE 1. CORRELATION TABLE OF THE STONES RIVER DEPOSITS OF NORTH AMERICA

		Gulf of Mexico Embayment							Appalachian and Champlain Trough				
	Group	Central Basin Tennessee	Alabama	Oklahoma	Kentucky	Central Pennsylvania and Central New York	Bellefont Pennsylvania	Eastern Canada	Eastern Tennessee	Western Virginia	West Virginia and Maryland	South Central Pennsyl-vania	Eastern New York and Western Vermont
Lower Chazyan	Stones River Group	Lebanon ls.	Stones River ls.	Simpson formation	Camp Nelson ls. Base not exposed High Bridge ls.	Pamelia ls.	Lebanon ls.	Rideau SS.		Stones River ls.	Stones River ls.	Pamelia ls.	
						?			?			?	?
		Ridley ls.	Attala Cong.				Ridley ls.		Lenoir ls.			Stones River ls.	Crown Point ls.
		Pierce ls.					?						Day Point ls. ?
		Murfreesboro ls. Base not exposed					?		? absent				
									?	?	?		
			?	?					Mosheim			?	