THE UNIVERSITY OF CHICAGO

BRYOZOA FROM THE ORDOVICIAN BROMIDE FORMATION, OKLAHOMA

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INTRODUCTION

Since the original definition of the Bromide formation, a number of writers have discussed it, with little agreement as to its age in comparison with the type section, as to local correlation within limited areas, and even as to its upper and lower limits. Various criteria have been used in discussion of the above questions, among them general lithology, heavy mineral analysis, and a few fossil zones. Although correlation by means of fossils is almost universally accepted as the most reliable method, almost no detailed faunal studies on this formation have been published.

Bryozoa are possibly the best group of organisms for close stratigraphic work in the middle and upper Ordovician, because of their widespread geographic and limited stratigraphic range and also because accurate specific identification can be made from small fragments. Yet, because of the fact that bryozoa must be thin-sectioned, they are generally not studied and often not even collected by stratigraphers and when mentioned are frequently listed merely as "bryozoans."

Although it is impossible to study the bryozoa of the Bromide formation without some reference to the stratigraphic problems involved, the purpose of the present paper is primarily to describe some of the more unusual species and to discuss their structural features. No attempt has been made to describe here all of the bryozoa, as in the Bromide formation, where it crops out in Oklahoma, this group comprises a large percentage of the fauna and in some beds the bryozoa are almost the only megascopic organisms represented.

CHAPTER I

PREVIOUS STRATIGRAPHIC WORK

The Bromide is the uppermost formation of the Simpson group of Ordovician age, cropping out in the Arbuckle and Wichita Mountains and in the Criner Hills of southern Oklahoma. As originally defined by Ulrich (1911, pl. 27) this formation included beds from Blount to Decorah inclusive in age, or from the upper Chazyan through the majority of the Black River. This original definition consisted merely of placing the name Bromide in a table of formations, and no lithologic description, type section, thickness nor characteristic fossils were given. The Bromide was not considered as a formation of the Simpson group, but all the underlying formations of this group, as now understood, were included in the Simpson formation.

Dake (1921, p. 59) considered the upper three hundred feet of the Simpson group, thus including the Bromide formation, as equivalent to beds as late as Lowville and early Black River in age, and closely related to the Platteville.

Later, Ulrich (1927, p. 29 and fig. 2) divided the Simpson into three faunal divisions, the lower division having been deposited in a sea of Pacific origin and lower Chazyan age; the second division, or typical Bromide, containing an Atlantic fauna, and the third division consisting of beds provisionally referred to the Bromide formation, being northern in origin as it possessed representatives of the Decorah and Prosser faunas of Minnesota.

Edson (1927, fig. 1) correlated the Bromide with the entire Blount and part of the Lowville and Black River and considered the lower part of the overlying Viola formation equivalent to the upper Black River. Later (1929, fig. 1), however, she considered the Bromide as equivalent to the entire Blount - Black River sequence.

Decker (1930, p. 1495) gave a table, credited to Ulrich, in which the Simpson was divided, in ascending order, into Oil Creek, Bromide, and West Spring Creek formations, the latter having a member termed Criner, and in which the lower two formations

were correlated with the Chazyan and the upper with the upper Black River and lower Trenton. A second table credited to Ulrich for the same year, 1928, but evidently slightly later, was given by Decker, in which the Simpson was subdivided into seven formations. The term West Spring Creek was dropped and its former member, the Criner, was raised to the rank of a formation, but its position reversed so that it was here placed below the Bromide formation. The seven formations given at this time were, in ascending order, Joins Ranch, Nebo, Falls, McLish, Tulip Creek, Criner, and Bromide.

Later Ulrich (1929, pp. 76-77) correlated the Bromide with approximately the upper two-thirds of the Black River group and the lower two-thirds of the Prosser, and considered it northern in origin. The underlying Criner was said to be separated from the Bromide by a stratigraphic break and on the basis of genetically comparable fossils, not occurring elsewhere, was correlated with the Blount and Chambersburg formations to the east. The Viola, overlying the Bromide, was considered as later than Trenton in age, falling somewhere in the Cincinnatian or in the hiatus which elsewhere separates that series from the Richmond, according to Ulrich. Thus, at this time, no Trenton equivalents were considered to be present in the Arbuckle area.

Decker (1930, p. 1497) dropped the term Criner of Ulrich, including those beds in the Bromide, which he correlated with the Trenton and Black River. Later Decker, in Decker and Merritt (1931, p. 44), further stated that the Bromide is closely related to the Plattin and Platteville of Wisconsin and Illinois and contains many of the species of the Black River of Minnesota. Some species which are more characteristically Trenton were said to occur in the upper part with those of Black River age.

Bridge, in Reeside (1933, pl. 2), put forth a tentative correlation of Ordovician formations, in which he stated that certain exact equivalents of the Bromide were known, including the following: Lowville of New York and the northern Appalachian mountains; Bays (type)=Moccasin type, of the southern Appalachians; Carters limestone of Tennessee; Tyrone of the Cincinnati Arch area; Platteville of the upper Mississippi Valley and the Plattin of the Ozark region. It is to be realized that in a publication of this type no details can be given as to the evidence supporting the various correlations. In view of the "exact equivalents"

listed, however, the present writer regrets that the basis for these conclusions has as yet not been published elsewhere. Bridge considered the Bromide, including the Criner and Cool Creek of Ulrich, to be lower Black River in age and recognized only five formations in the Simpson group, the Joins, Oil Creek, McLish, Tulip Creek, and Bromide.

Ulrich (1933, p. 105) divided the Simpson into eight formations, adding the Cool Creek to those previously listed. His classification at this time contained the Joins, Oil Creek, Falls, McLish, Tulip Creek, Cool Creek, Criner, and Bromide, in ascending order. He stated that the typical Bromide correlated with the Platteville and Plattin limestone of Wisconsin and Missouri and the Lowville of New York, all of which are of lower Black River age, and that the Cool Creek and Criner formations have no direct counterparts in the Ordovician sections east of Oklahoma. It should be noted at this time that both the Cool Creek and Criner of Ulrich are included in the Bromide by Decker.

Later in the same year, Decker (1933, pp. 55-57), in a lecture before the Tulsa Geological Society, the digest of which was prepared for publication by Mr. Glen S. Dille, divided the Simpson group into the Joins, Oil Creek, McLish, Tulip Creek, and Bromide. These were listed in a table with three subdivisions of the underlying Arbuckle group. The latter were, in descending order, West Spring Creek formation, Alden limestone (Ceratopea bed), and Cool Creek limestone. The term West Spring Creek had already been used by Ulrich (1933, p. 105) for a Simpson formation. Wilmarth (1938, p. 2312) erroneously stated that Decker (1933, pp. 56-57) divided the Simpson group of the Arbuckle and Wichita Mountains into Bromide, Tulip Creek, McLish, Oil Creek, Joins, West Spring Creek, Alden, and Cool Creek, in descending order. The table given by Decker (1933, p. 55) is somewhat confusing as the boundary between the Simpson and Arbuckle groups is not definitely shown, which undoubtedly led Wilmarth to her mistake. However, it is clearly stated (pp. 56-57) in the text that only five formations were included in the Simpson. In two later papers concerning the Arbuckle group, Decker (1939a, table 1; 1939b, pp. 25-26) again used the terms West Spring Creek and Cool Creek for formations in the Arbuckle group, changing the name of the preoccupied Alden to Kindblade, although he made no further provision for the also preoccupied terms West Spring Creek and Cool Creek.

Ulrich in Ulrich and Cooper (1938, pp. 23-24) also used Cool Creek for an Arbuckle formation of Middle Canadian age, citing it with Decker in parentheses, evidently crediting the formational name to him, and the name West Spring Creek for an Upper Canadian formation of the Arbuckle group, although both of these terms had originally been used by Ulrich for formations of the Simpson group.

Bassler and Kellett (1934, p. 48) used the eight formations of Ulrich, but the upper three formations, Bromide, Criner, and Cool Creek, were all placed in the Black River.

Edson (1935a, fig. 4), in a stratigraphic column, used only four formations for the Simpson group, the Joins, Oil Creek, McLish, and Bromide, in ascending order, and used the term Webster for beds immediately overlying the Bromide. She (1935b, p. 1123) credited Ulrich for the term Webster, a formation of late Black River and early Trenton age. Ulrich was said to have correlated the Webster with the Decorah formation of the Upper Mississippi Valley and with the lower Viola of Taff (1903, pp. 3-4).

Summary

Although all of the formational names of the Simpson group were originally used by Ulrich, none of them were defined nor were type localities designated. Decker, in Decker and Merritt (1931, pp. 13-49), later defined five of these, the remainder, as well as the overlying Webster formation of Ulrich, having not yet been well defined. However, Decker's conception of two of these, the McLish and Bromide, is not the same as that of Ulrich.

It is also regrettable that two of the formational names of the Simpson have also been used for formations of the Arbuckle group. These two, which have not been completely defined as divisions of the Simpson, have been well defined with type localities designated as formations of the Arbuckle group. The writer questions the validity of such double usage of formational names. If one formation of the Arbuckle group was changed due to its prior use elsewhere, to be consistent the other two Arbuckle names originally used for Simpson formations should also be changed.

Throughout past years, the number of formations recognized in the Simpson group by different writers, and at various times by a single writer, has varied from one to two, three, four, five, seven, and eight. If workers in the past, in naming new formations, had also given a clear definition and exact upper and

lower limits, designated a type locality and given at least some of the characteristic fossils, many of the problems in nomenclature, extent of formations and their correlation, would never have arisen.

CHAPTER II

THE BROMIDE FORMATION

The Bromide formation of the Arbuckle and Wichita Mountains, as herein used, is the same as that defined and mapped by Decker, in Decker and Merritt (1931, p. 40), and thus includes the typical Bromide, Criner, and Cool Creek formations of Ulrich.

The type locality of the Bromide formation is along an old road on a hill northwest of the old Galbraith Hotel in the town of Bromide, in Section 32, Township 1 South, Range 8 East, Johnston County, Oklahoma, but no measured section has previously been published. The following section at the type locality was measured during the summer of 1938 by Dr. C. E. Decker and the writer.

TYPE SECTION OF THE BROMIDE FORMATION

Bed	Thickness	Total Thickness	Description
			Viola Limestone
1	5.5	5.5	Thin bedded limestone in beds 4 to 8 inches thick
2	7.0	12.5	Thin bedded limestones
3	11.2	23.7	Buff and gray thin bedded limestones, 1 to 2 inches thick
4	7.0	30.7	Yellow and gray limestone, beds 5 to 9 inches thick
5	3.9	34.6	Thin bedded limestones alternating with green shales
6	16.0	50.6	Upper part of buff to brown shales, lower portion greenish gray to buff shale including a 2.5 foot limestone bed near base
7	6.5	57.1	Upper four feet of yellow clay shales with numerous lime nodules, lower 2.5 feet of olive green shale
8	3.5	60.6	Yellow brown limestones in beds 4 to 9 inches thick
9	2.5	63.1	Yellowish brown limestones alternating with shale

TYPE SECTION OF THE BROMIDE FORMATION--Continued

Bed	Thickness	Total Thickness	Description
			Viola Limestone
10	2.5	65.6	Lense of thin sandy limestone and green shale extending laterally approximately 30 feet and grading into limestone
11	4.0	69.6	Yellow brown thin bedded limestone
12	5.0	74.6	Yellow green clay shales with a 5 inch bed of fossiliferous limestone at the base
13	3.0	77.6	Light green clay shale, containing calcareous nodules
14	10.0	87.6	Yellow and green fossiliferous shales
15	40.0	127.6	Yellow brown limestones exposed on the slope to the north down to the base of a short valley

Remainder of section covered.

CHAPTER III

THE BROMIDE BRYOZOA

Methods of Study

The method used in thin-sectioning bryozoan specimens in preparation for study is that described by the writer (1940, p. 378). The thin sections were examined under a monocular microscope at magnifications ranging from x 20 to x 300. The writer has found that minute wall structure is best studied under magnifications from x 100 to x 300, as at these comparatively high magnifications structures are clearly and definitely shown that under low powers are easily overlooked. In preparing the illustrations the sections were photographed by means of time exposures at a magnification of x 20, on 2-1/4 by 3-1/4 in. cut film and enlargements were printed at x 30 and x 75. The prints were retouched with pencils, with constant reference to the thin-sections. While most of the structures are apparent in an unretouched photograph, crystallization features and mud fillings in the zooecial tubes often obscure important structures. In the opinion of the writer, careful retouching minimizes the unnecessary portions without the loss of scientific accuracy. The plates were assembled at one and one-half times their present size and the consequent reduction gives the present magnifications of x 20 and x 50.

Conclusions

The following bryozoa have been listed by Decker, in Decker and Merritt (1931, p. 48), as occurring in the Bromide formation. The writer has added after each specific name the occurrence as given by Bassler (1915).

Chasmatopora reticulata	Black River - Trenton (Decorah)
Corynotrypa delicatula	Stones River - Richmond
Diastoporina flabellata	Trenton (Prosser)
Homotrypella cf. ovata	Trenton (Prosser)
Monotrypa magna	Black River (Platteville)
Pachydictya occidentalis	Decorah
Prasopora simulatrix	Black River - Trenton

Rhinidictya exigua	Decorah
Rhinidictya mutabilis	Decorah and Prosser
Rhinidictya mutabilis major	Decorah
Rhinidictya cf. neglecta	Trenton (Wilmore)
Stictopora elegantula	Trenton (Trenton Falls)
Stictoporella cribrosa	Decorah

Neglecting the long-lived Corynotrypa and Monotrypa magna, the bryozoa are indicative of Trenton age; that is, if the Decorah is considered to be Trenton, as it has been by Kay (1937, p. 294). While Decker, in Decker and Merritt (1931, p. 44), stated that he considered the Bromide to be closely related to the Plattin of Missouri and the Platteville of Wisconsin and Illinois, the species listed above are predominantly Trenton. Monotrypa magna Ulrich has a limited range in the Platteville formation and it would not be expected to occur in the assemblage listed above. Furthermore, the writer has collected and sectioned numerous specimens of large-pored, massive bryozoa from the so-called Monotrypa magna zone, occurring near the middle of the Bromide formation, from many of the localities from which it has been recorded, and has found that specimens commonly referred to Monotrypa magna are in reality species of several genera of the family Prasoporidae, a species of a probable new genus that is closely allied to Diplotrypa, and in addition, several species of Anolotichia. No specimens have been encountered by the writer as yet that belong to Monotrypa magna Ulrich, or even to that genus. It is probable that the listing of this species in this case is due to misidentification.

In addition to the above listed species, the writer has added the following which are indicative of Trenton age: Batostoma winchelli Ulrich, Dekayella praenuntia echinata Ulrich, Nicholsonella laminata Ulrich, Hemiphragma irrasum (Ulrich), and Anolotichia impolita (Ulrich). The new species described are also more closely related to the Trenton forms of Minnesota than to any other faunal group. The evidence presented by the bryozoa suggests a lower Trenton age, and the fauna is closely allied to the Decorah of Minnesota.

Systematic Descriptions

Order CYCLOSTOMATA Busk, 1852

Suborder CERAMOPOROIDEA Bassler, 1913

Family CERAMOPORIDAE Ulrich, 1882

Genus ANOLOTICHIA Ulrich, 1890

ANOLOTICHIA DECKERI Loeblich, n. sp.

Plate I, Figs. 1-2

Zoarium massive, sub-hemispherical, over 6 cm. in height, 10 cm. in length, and 7 cm. in width. Zooecia polygonal, with small lunaria, indistinct on the surface, occupying one of the angles. Mesopores small, angular, and few in number.

Zooecia averaging four in 2 mm., possessing fairly thin, granular amalgamate walls, in very thin sections appearing constructed of alternating light and dark tissue. Lunarium occupying one corner of the zooecium, pierced by three circular tubuli which may project into the zooecial cavity.

Zooecial tubes with slightly crenulated walls, crossed by thin straight diaphragms, which become indistinct as sections are ground very thin, spaced from less than one up to three or more tube diameters apart. Diaphragms irregularly spaced in a single tube, being close together in one portion, then absent for a long distance. Lunarial tubuli appear in longitudinal section as long clear streaks in the walls, which appear constructed of alternating layers of light and dark tissue. Occasionally in longitudinal section the walls are broken by circular clear pores. Mesopores irregular in width, occasionally appearing beaded and often not reaching the surface.

Remarks and comparisons.--Anolotichia deckeri differs from A. impolita (Ulrich) in the massive zoarial form, in having slightly larger zooecia, possessing fewer mesopores, and in lacking the small aggregates of these.

Locality.--Bromide formation, 35 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48559; portion of holotype in U. S. National Museum.

ANALOTICHIA IMPOLITA (Ulrich)

Plate I, Figs. 3-4

Zoarium palmate, terminal marginal indentations giving a digitate appearance, zoarium up to 4 cm. in width and one cm. in thickness; surface smooth. Small aggregates of four or five mesopores occur scattered over the surface, with a few isolated ones between the zooecia.

About five zooecia occur in 2 mm., possessing granular, amalgamated walls and appearing polygonal in outline, with a small crescentic lunarium occupying one of the corners. Lunaria generally perforated by three pores, appearing as clear spots in section. Small, polygonal mesopores are irregular in size and shape.

Zooecial tubes of irregular width in the axial region, with thin crenulated walls and diaphragms spaced as close as 1.5 to 2.0 tube diameters apart. Tubes bend gently toward the surface and in the more mature region have thicker walls, in section appearing constructed of alternating lighter and darker layers of granular material, and are crossed by more numerous, thin diaphragms that disappear as sections are ground very thin, spaced as close as one-third tube diameter apart. Lunarial pores easily seen as clear tubes along the zooecial wall. Mesopores occasionally appear beaded in the more mature regions.

Remarks and comparisons.--The Bromide specimens have a frondescent zoarium, more numerous diaphragms in the mature region, and a somewhat greater number of mesopores than do the forms from Minnesota, but otherwise they are very similar.

Locality.--Bromide formation, 26 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Hypotypes U. C. 48557, also in U. S. National Museum.

ANOLOTICHIA SPINULIFERA Loeblich, n. sp.
Plate I, Figs. 5-6

Zoarium of encrusting layers, forming an irregular lobed mass, often around other bryozoa, the holotype being 4 cm. in height and 3.5 cm. in greatest width. Surface exhibits prominent small lunaria in the angles of zooecia, projecting into the zooecial cavity. Lunarial tubuli project above surface of lunaria as prominent spines.

Five polygonal zooecia occur in 2 mm. and possess granular amalgamated walls. Lunaria with three lunarial pores, appearing as clear spots in tangential section.

Zooecial tubes prostrate for a very short distance, then turned abruptly toward the vertical, are crossed by straight diaphragms, varying from less than one up to 2 tube diameters apart. Walls crenulated, composed of alternating layers of dark and light granular material.

Remarks and comparisons.--Anolotichia spinulifera differs from the associated A. impolita (Ulrich) in its encrusting mode of growth and in having fewer mesopores and a more prominent lunarium, with the lunarial tubuli projecting as short spines.

Locality.--Bromide formation, 140 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48558; portion of holotype in U. S. National Museum.

Family FISTULIPORIDAE Ulrich, 1882

Genus FISTULIPORA McCoy, 1850

FISTULIPORA (?) BASSLERI Loeblich, n. sp.

Plate I, Figs. 7-12

Zoarium ramose to encrusting, in the holotype of anastomosing, round to flattened branches, 0.3 to 1.0 cm. in diameter, arising from a wide basal expansion attached to rocks or other bryozoa, older parts of zoarium completely closing the fenestrules. Zooecia show small but prominent arched lunaria on the surface. Numerous elevated, at times depressed or level, substellate maculae occur on the surface, spaced 1.8 to 2.4 mm. apart, from center to center.

Zooecial apertures adjacent to maculae are 0.2 to 0.25 mm. in long dimension, being larger and more elongated than the more nearly circular intermacular zooecia, which are 0.12 to 0.16 mm. in diameter. The zooecia adjacent to maculae are elongate in the direction of the macular centers and possess a well developed lunarium on that side, occupying almost half of the zooecial circumference, but not observed to project into the zooecial cavity. Centers of lunaria possess a small clear spot, much as in Anolotichia. Zooecia rarely in contact, being separated by vesicular interstitial tissue. Macular areas appear solid in section.

Zooecial tubes passing in a gentle curve from the axial region to the periphery, are crossed by bent or curved diaphragms, spaced one-half to one tube diameter apart in the more mature region, with only an occasional diaphragm in the axial region. The lunarial pores may appear in longitudinal section as a clear tube. Large, loosely arranged vesicles fill the interzooecial space.

Remarks and comparisons.--This species varies somewhat in internal characters. Some specimens lack the characteristic lunarial pores while others, in addition to the lunarial pores,

have numerous pores piercing the macular and interstitial areas. Zooecia vary from 0.12 to 0.52 mm. in greatest diameter and diaphragms are spaced at intervals varying from one-fifth to three or more tube diameters apart. Diaphragms may be curved, arched upward, horizontal, or cup-shaped. It is probable, however, that these differences and also those of zoarial form are growth features.

The vesicular tissue of this species is the type found in primitive species of Fistulipora, and all specimens exhibit a well formed lunarium. The lunaria, however, may be pierced by a single clear pore, recalling features of Anolotichia, but in addition other secondary pores are present in the interzooecial spaces and in the maculae, similar to those found in Fistuliporella and in some species of Ceramoporella. According to Dr. R. S. Bassler, there are similar species in the Chazyan of the Appalachian Valley, that differ from each other in the presence or absence of some of the characters mentioned above. In view of the unstable character of the group of early Fistuliporoids it has been thought best to refer this species questionably to Fistulipora until the group can be studied in detail and the true generic characters determined.

Fistulipora (?) bassleri differs from F. primaeva Bassler in having an encrusting to ramose and anastomosing form, rather than a massive one, and in possessing a lunarial pore in addition to the granular acanthopore-like tubes.

Locality.--Type locality, lower Bromide, in the basal sand series where it forms a solid bed or biostrome, 6 to 8 in. thick, at Rock Crossing of Hickory Creek, in the Criner Hills, Sec. 35, T. 5 S., R. 1 E., Oklahoma; in green shales, 240 ft. below the top of the formation, slightly above the previously mentioned horizon but at the same locality; common in a shaly limestone, 170 ft. below the top of the formation, west of the Nebo Store, Sec. 22, T. 2 S., R. 3 E., Arbuckle Mountains, Murray County, Oklahoma; 260 ft. below the top of the formation on the West Branch of Sycamore Creek, in the northwest one-fourth of Sec. 27, T. 3 S., R. 4 E., Arbuckle Mountains, Johnston County, Oklahoma.

Types.--Holotype U. C. 48551, portion of holotype in U. S. National Museum; paratypes U. C. 48552, 48553, 48554, 48555, 48556; paratypes also in U. S. National Museum.

Order TREPOSTOMATA Ulrich, 1882
Family PRASOPORIDAE Simpson, 1897
Genus ATACTOPORELLA Ulrich, 1883
ATACTOPORELLA BELLULA Loeblich, n. sp.
Plate II, Figs. 1-2

Zoarium a laminar encrustation, up to 1.8 mm. in thickness. Surface with low, broad monticules of somewhat larger zooecia, spaced at intervals of 2.5 to 4.0 mm. Acanthopores project as short blunt spines.

Zooecia polygonal to rounded in cross section, 11 to 13 occurring in 3 mm. Walls thin and inflected by acanthopores, of which 2 to 5 surround each zooecium. Acanthopores 0.01 to 0.03 mm. in diameter, and slightly larger in the walls of the larger zooecia of the monticules, composed of dense tissue with a small lumen. Zooecia occasionally isolated by numerous, large, angular and irregular mesopores, but walls generally in contact.

Tubes originate from a wrinkled basal lamina, are prostrate for a short distance, then rise abruptly to the vertical, crossed by nearly straight diaphragms spaced at intervals varying from one-half to two tube diameters apart, and lined on one side by a row of vesicular cystiphragms with 11 to 13 vesicles occurring in one millimeter of tube length. Acanthopores present in longitudinal section as granular streaks enclosing a clear tube. Mesopores originate early in growth, and are tabulated by 6 to 12 straight diaphragms in 0.5 mm. or are vesicular in nature in their early portion, with as many as 12 vesicles in 0.5 mm., later changing to possess more widely spaced straight diaphragms. Some mesopores in their early portion have the walls inflected at points of diaphragm insertion and some of the mesopores fail to reach the surface.

Remarks and comparisons.--Atactoporella bellula is similar to A. insueta Ulrich, in size of zooecia, but may be distinguished by the smaller number of diaphragms, more regular and smaller vesicle-like cystiphragms, and in the closer tabulation of the mesopores.

Locality.--Bromide formation, 136 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48573; portion of holotype in U. S. National Museum.

Genus HOMOTRYPA Ulrich, 1882

HOMOTRYPA CALLITOECHA Loeblich, n. sp.

Plate II, Figs. 3-5

Zoarium ramose, composed of small branches 2 to 3 mm. in diameter. Surface nearly smooth, groups of three or four zooecia slightly raised into small monticules.

Zooecia polygonal, 13 to 14 in 3 mm., with thick amalgamate walls separated by a light-colored granular band and bordered on each side by a thick laminated secondary deposit. Acanthopores poorly defined, present in the junction angles as dark spots. Mesopores few, confined to the monticules.

Tubes in the axial region thin-walled, crossed by straight or slightly oblique diaphragms, spaced at intervals of one to three tube diameters. Occasionally the early portion of a tube is closely tabulated, having as many as five straight diaphragms in 0.5 mm. of tube length and in rare instances some tubes display a single cystiphragm or a series of two or three of these in the axial region. Zooecial tubes turned in a gentle curve into the mature region, with true cystiphragms arising in the submature zone, 3 to 4 occurring in 0.5 mm. of tube length in that region. Walls of mature region thicken rapidly in a short distance, appearing fusiform in some cases. Cystiphragms thick, of laminar continuations of the walls. Thin, straight or slightly bent diaphragms occur in the mature region, as closely spaced as six in 0.2 mm. of tube length. Walls divided in the mature region by a fine dark crenulated line.

Remarks and comparisons.--Homotrypa callitoecha differs from H. minnesotensis Ulrich in its smaller monticules, thicker walls, non-oblique apertures, and in the presence of diaphragms in the axial region.

Locality.--Bromide formation, 225 ft. below the top of the formation, in a roadside ditch, west of the Nebo Store, Sec. 22, T. 2 S., R. 3 E., Arbuckle Mountains, Murray County, Oklahoma.

Types.--Holotype U. C. 48584; portion of holotype in U. S. National Museum.

HOMOTRYPA MULTITABULATA Loeblich, n. sp.

Plate II, Figs. 6-8

Zoarium irregularly ramose or anastomosing, composed of

circular branches, 0.7 to 1.6 cm. in diameter, or somewhat flattened branches attaining a width of 4 cm. or more. Surface with small clusters of larger zooecia, only slightly elevated, scattered over the surface at intervals averaging 2.8 mm. apart.

Zooecia polygonal, averaging 13 in 3 mm., walls in contact, with a distinct granular line or band down the middle, marking the original amalgamate wall, bordered by very finely laminated tissue. A few small and indistinct acanthopores, situated in the junction angles of the zooecia, are composed of laminated tissue with a very small lumen. Mesopores rare, except for a few small angular ones among the groups of larger zooecia.

Tubes in axial region thin-walled and crossed by straight or slightly oblique diaphragms, spaced at intervals varying from one-half to one or slightly more tube diameters apart. As the tubes pass in a gentle curve from the axial region into the submature region, the diaphragms become more oblique, later changing to cystiphragms in the mature region. Walls thicken gradually from the base of the mature zone, and are separated by a crenulated dark line of granular material; cystiphragms continue as laminar linings of the zooecia. Diaphragms in mature region thin, either straight or bent, with as many as 5 occurring in 0.5 mm. of tube length. Cystiphragms line one or at times both sides of the zooecia, with 9 to 11 vesicles in 0.5 mm. of tube length.

Remarks and comparisons.--Specimens from the Sycamore Creek locality have slightly thinner walls than those of the type locality, with an occasional acanthopore indenting the walls, and slightly larger zooecia in the maculae; otherwise the two are very similar.

In growth and size of aperture H. multitabulata is similar to H. subramosa Ulrich, but it may be distinguished by the small size and almost complete absence of acanthopores, the presence of distinct groups of larger zooecia, and the more regular and closer tabulation in the axial and submature regions.

Locality.--Bromide formation, 200 ft. below the top of the formation, at Rock Crossing of Hickory Creek, Sec. 35, T. 5 S., R. 1 E., Criner Hills, Oklahoma (type locality); 300 ft. below the top of the Bromide formation, on the West Branch of Sycamore Creek, in the northwest one-fourth of Sec. 27, T. 3 S., R. 4 E., Arbuckle Mountains, Johnston County, Oklahoma; 140 feet below the top of the Bromide formation, in road cut on State Highway 99,

Sec. 12, T. 1 N., R. 6 E., Arbuckle Mountains, Pontotoc County, Oklahoma.

Types.--Holotype U. C. 48574, portion of holotype in U. S. National Museum; paratypes U. C. 48575, 48576, 48578; topotypes and paratypes also in U. S. National Museum.

HOMOTRYPA SAGITTATA Loeblich, n. sp.
Plate II, Figs. 9-11

Zoarium ramose, branches one cm. or slightly more or less in diameter. Surface with small elevated monticules, composed of zooecia larger than average, spaced at intervals averaging 2.8 mm.

Zooecia polygonal, 11 to 12 in 3 mm., with walls of medium thickness, amalgamate and separated by a thin granular band, bordered on each side by a laminated secondary deposit. Acanthopores small, composed of laminated dark tissue with a small lumen, one to 5 generally surrounding a zooecium, but not occurring on a great many zooecia. Mesopores few, rare except in the monticules.

Tubes in the axial region thin-walled and crossed by straight or slightly oblique thin diaphragms, spaced at intervals of one to two tube diameters, turned in a very gentle curve into the submature zone where the cystiphragms are developed and diaphragms are slightly more closely spaced. From the submature zone the zooecia turn abruptly to the surface. In some cases a young tube developing in the submature zone may be beaded. Cystiphragms thin in the early mature zone, thickening and continuing as laminar linings of the walls in the more mature areas. Diaphragms thin and straight in the mature zone, 5 to 7 in 0.3 mm. Walls thicken abruptly, longitudinally divided by a strongly crenulated dark granular line.

Remarks and comparisons.--This species is very similar to H. callitoecha but may be distinguished by its thinner walls, more prominent aggregates of larger zooecia, slightly more widely spaced diaphragms, and in having a more irregular mature region. It is separated from H. minnesotensis Ulrich by the presence of diaphragms in the axial region.

Locality.--Bromide formation, 235 ft. below the top of the formation, on Tulip Creek, Sec. 25, T. 2 S., R. 1 E., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48585; portion of holotype in U. S. National Museum.

HOMOTRYPA ULRICHI Loeblich, n. sp.
Plate II, Figs. 12-14

Zoarium ramose, composed of flattened branches, 5 to 8 mm. in width and 3 to 6 mm. in thickness. Surface with prominent monticules spaced at intervals of 2 mm. or slightly less, as measured from center to center.

Zooecia polygonal, 12 to 13 in 3 mm., with thick, amalgamate walls composed of a medial light granular deposit, bordered on either side by irregular laminated secondary tissue. Walls often indent the zooecial cavity, even where acanthopores do not occur, giving the interior a rugose appearance. Acanthopores small, composed of dark tissue with a small lumen, one to three surrounding a zooecium, generally occurring in the junction angles, but not present around all zooecia. Mesopores few and small.

Tubes in the axial region with thin, crenulated walls and crossed by straight, oblique, or cup-shaped diaphragms spaced at intervals of one-half to two tube diameters apart, with an occasional tube being beaded in the early portion. Method of change of direction from the axial region to the mature region varies; may be by a gradual curve or by abruptly turning toward the surface. Tubes may be recurved slightly and even grow downward. Large cystiphragms arise in the submature zone, becoming smaller as the zooecium matures in character; cystiphragms thick, their laminar continuations lining the zooecia, often giving the tubes a vesicular character. Diaphragms straight or slightly bent, as many as 6 occurring in 0.5 mm. of tube length. Walls of mature region varying in width and expanding rapidly, commonly strongly wrinkled in the early part, composed of pinnately arranged laminated tissue separated by an irregular dark granular line.

Remarks and comparisons.--Homotrypa ulrichi differs from H. tuberculata Ulrich in having thicker and more irregular walls and in possessing diaphragms in the axial region.

Locality.--Bromide formation, 26 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R.1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48587; portion of holotype in U. S. National Museum.

Genus MESOTRYPA Ulrich, 1893

MESOTRYPA FAVOSA Loeblich, n. sp.

Plate III, Figs. 5-6

Zoarium of superimposed layers forming a low discoidal mass, 5 cm. or more in width and 1.3 cm. in height. Surface irregular and with low rounded monticules, spaced as closely as 4 mm. from center to center on some parts of the surface, absent on others; low, ridge-like monticules may also occur.

Zooecia varying greatly in size and shape, polygonal to oval in outline, 8 to 9 in 3 mm., with thin, amalgamate walls consisting of an inner clear granular zone and bordered by fine laminar tissue sharply set off from the former by a dark line; numerous clear beads occur in the walls. Mesopores vary in number, absent in some areas and abundant in others, varying greatly in size and shape.

Tubes arise nearly directly from a wrinkled basal lamina, with thin and very slightly crenulated walls, crossed by straight, cupped, funnel-shaped, or oblique thin diaphragms, commonly incomplete, spaced as close as 7 in 0.5 mm. of tube length, although they may be as much as two tube diameters apart, in general more closely spaced in the more mature portions. Mesopores few, crossed by 12 to 14 straight diaphragms, with their walls slightly constricted at points of diaphragm insertion, becoming smaller with age and generally not reaching the surface.

Remarks and comparisons.--Mesotrypa favosa is distinguished from M. quebecensis (Ami) in possessing a more massive zoarium and in having more polygonally-shaped zooecia, which are more closely tabulated throughout.

Locality.--Bromide formation, 275 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48588, portion of holotype in U. S. National Museum.

MESOTRYPA TUBULIFERA Loeblich, n. sp.

Plate III, Figs. 7-8

Zoarium of superimposed layers building an irregular mass, 15 cm. or more in greatest width and 6 cm. or more in greatest thickness, both surfaces irregular and basal one strongly wrinkled, upper surface with small irregular low monticules.

Zooecia generally oval, occasionally polygonal, 8 to 9 in 3 mm., with numerous small, angular mesopores filling the interzooecial space. Walls thin, amalgamate, lined with numerous small clear beads (acanthopores?).

Tubes arise from a basal crenulated lamina directly to the surface, are crossed by straight, oblique, funnel-shaped or incomplete diaphragms, spaced at intervals up to two and one-half tube diameters apart, but generally somewhat less. Mesopores numerous, crossed by 10 to 12 straight diaphragms in one mm. of length, either diminishing in size upward and disappearing, or reaching the surface, with a few mesopores being "vesicular" in nature. Diaphragms in mesopores and zooecia continue as laminar linings of these tubes. Walls of zooecial tubes thicken gradually with growth and may be traversed by a small, clear tube, or small, clear beads may appear.

Remarks and comparisons.--Mesotrypa tubulifera is very similar to M. favosa but may be distinguished by its larger, more irregular zoarium, more ovate zooecia, greater number of mesopores, and more widely spaced diaphragms. This species is distinguished from M. quebecensis (Ami) in having more closely spaced diaphragms and in possessing the peculiar clear beads in the walls.

Locality.--Bromide formation, 235 ft. below the top of the formation, on Tulip Creek, Sec. 25, T. 2 S., R. 1 E., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48589, portion of holotype in U. S. National Museum.

Genus MONTICULIPORELLA Bassler, 1934

MONTICULIPORELLA CRONEISI Loeblich, n. sp.

Plate III, Figs. 1-2

Zoarium composed of round to wide flattened branches, irregular in width and thickness, up to 2 cm. or over in width and one cm. or less in thickness. Surface with small, slightly raised clusters of larger zooecia.

Zooecia polygonal, 12 to 13 in 3 mm., walls thin, amalgamate, composed of granular tissue with a thin border of an irregular, laminated secondary deposit. Acanthopores rarely conspicuous, walls containing numerous darker granular spots. Mesopores few, small, and angular, varying in number over the surface.

Tubes in axial region thin-walled, with a slight tendency towards beading in the early portion, crossed by closely spaced straight or bent diaphragms, 6 to 8 in the early portions of the zooecia. Diaphragms become more widely spaced and irregular in arrangement as the zooecia increase in length, those in the mature region are straight or slightly bent, may vary in spacing between one-fifth and over one tube diameter apart, usually more closely spaced in the earliest portion of the mature zone, then rare or lacking for a space of several tube diameters, followed by one to three in the latest portion of the tube. Cystiphragms in both axial and mature region, 5 to 7 vesicles lining one side or occasionally both sides in the axial region, generally in long series but lacking in some portions of the tubes in the axial region. In the mature region 6 to 8 small vesicles line one side of the walls. Small mesopores with horizontal partitions occur in the submature zone.

Remarks and comparisons.--Monticuliporella croneisi is distinguished from the associated M. shideleri in possessing fewer mesopores, slightly larger zooecia, and in having fewer diaphragms in the mature region. In the latter the diaphragms are more regularly arranged throughout the tubes. This species is separated from M. arborea (Ulrich) in the presence of mesopores and in lacking the more prominent acanthopores of that species, and in having smaller cystiphragms in the axial region. It is distinguished from M. (?) cannonensis (Ulrich) in the presence of mesopores, thicker walls, and smaller cystiphragms.

Locality.--Bromide formation, 25 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48598, portion of holotype in U. S. National Museum.

MONTICULIPORELLA PECULIARIS Loeblich, n. sp.

Plate II, Figs. 18-19

Zoarium irregularly lobate, giving off short round or oval branches which are 6 to 10 mm. in diameter; surface smooth.

Zooecia polygonal, 10 to 12 occurring in 3 mm., with thin amalgamate walls consisting of a narrow cingulum of irregularly laminate tissue and a medial zone of lighter granular material separating walls of adjacent zooecia. One to three large acanthopores, consisting of ring-like laminated tissue having a small

lumen, occur around a zooecium, often indenting the walls; numerous small and indistinct granular acanthopores also occur and do not inflect the walls. Under high magnifications the walls appear rugose. Mesopores numerous, small and angular, varying in number over the surface.

In the axial region the zooecia are thin-walled and crenulated, crossed by straight or bent diaphragms spaced at intervals varying from one to slightly more than three tube diameters apart; large cystiphragms, isolated or in series of two to five, occur in the axial region. Cystiphragms developed more or less in zones, a short series being followed by a long distance in which none occurs. Early portions of tubes more closely tabulated and often walls are inflected at points of diaphragm insertion. Diaphragms thin-walled in mature zone, weakly funnel-shaped, straight, bent, or cupped, spaced at intervals of one-third to one tube diameter apart, continuing as zooecial linings; cystiphragms irregular in occurrence, lining one side of the zooecium. Mesopores seldom reach the surface.

Remarks and comparisons.--This species presents certain peculiarities not considered characteristic of the genus. Mesopores are numerous and in addition, numerous acanthopores with definite laminated tissue and clear centers occur. The latter are best visible under a magnification of x 300.

Monticuliporella peculiaris is distinguished from M. arborea (Ulrich) in possessing fewer diaphragms in the mature zone and in lacking the regularity of the cystiphragms in that species.

Locality.--Bromide formation, 125 ft. below the top of the formation, on Tulip Creek, Sec. 25, T. 2 S., R. 1 E., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48597; portion of holotype in U. S. National Museum.

MONTICULIPORELLA SHIDELERI Loeblich, n. sp.
Plate II, Figs. 15-17

Zoarium ramose, of smooth, round to somewhat oval branches, one cm. in thickness and 1.5 cm. or more in width.

Zooecia polygonal to subcircular in outline, 14 to 15 in 3 mm., walls thin, amalgamate, of granular tissue with a very thin darker zone composing the cingulum, bordering the light medial zone. Acanthopores small, indistinct, and rare. Mesopores

common, small, polygonal, filling the interspaces between zooecia.

Tubes in axial region with straight, cupped, or incomplete diaphragms, spaced as close as 5 to 7 in 0.5 mm. of tube length. Cystiphragms in both immature and mature regions; 5 to 7 vesicles line one side of the wall in the immature zone, arranged in a long series or occasionally isolated, small, and regularly arranged or elongate and irregular in arrangement. A few tubes in the axial region have walls inflected at points of diaphragm insertion, producing a beaded appearance for a short distance. Walls in axial region irregular in width, having the appearance of hollow tubes, the borders of darker lines while the centers are clear with cystiphragms as continuations of the walls. Tubes curve gently from the immature to the mature zones with the boundary between the two zones being indistinct. In the mature zone straight, cupped, funnel-shaped, or incomplete diaphragms occur, spaced as close as 7 to 8 in 0.5 mm. of tube length and in mesopores generally 8 to 12 straight diaphragms occur in the same length. Cystiphragms in the mature region composed of small vesicles lining one side of the walls, 8 to 9 in 0.5 mm. of tube length. Walls in mature zone irregular in width, crenulated and containing numerous clear granules.

Remarks and comparisons.--Monticuliporella shideleri differs from M. arborea (Ulrich) in the presence of a greater number of mesopores, smaller acanthopores, and smaller and more irregular cystiphragms in the axial region. It is distinguished from M. (?) cannonensis (Ulrich) by the more numerous mesopores.

Locality.--Bromide formation, 25 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Oklahoma.

Types.--Holotype U. C. 48591, portion of holotype in U. S. National Museum.

Genus PRASOPORA Nicholson and Etheridge Jr., 1877

PRASOPORA FRITZAE Loeblich, n. sp.

Plate III, Figs. 3-4

Zoarium free, massive, hemispherical in shape, 6 mm. in height and 22 mm. in breadth; surface with small slightly elevated monticules, spaced at intervals of slightly over 3 mm.

Zooecia polygonal, 12 to 14 of the ordinary size in 3.0 mm., those of monticules being somewhat larger; walls thin, amalgamate, composed of light finely laminated tissue bordering a

dark or light granular medial band. One to 2 acanthopores around each zooecium, situated in the junction angles, composed of darker tissue. Walls greatly thickened where acanthopores occur and slightly inflected. Mesopores angular, small, occurring in small aggregates in the monticules, rare elsewhere.

Tubes arise from a wrinkled basal lamina, prostrate for a short distance, then turned abruptly toward the surface. Cystiphragms small, occur throughout the tubes as laminar continuations on both walls, 9 to 10 in 0.5 mm. of tube length, generally in a single series but often overlapping in limited areas. Diaphragms straight, bent, or cupped, with as many as 7 in 0.5 mm. of tube length, then absent for a longer distance in the same tube. Acanthopores in longitudinal sections appear as clear granular tubes bordered by pinnately arranged laminated tissue. Walls crenulated, separated longitudinally by a dark crenulated line bordered by light laminated tissue.

Remarks and comparisons.--*Prasopora fritzae* is separated from *P. conoidea* Ulrich in possessing fewer mesopores, smaller zooecia and more prominent acanthopores.

Locality.--Bromide formation, 125 ft. below the top of the formation, on Tulip Creek, Sec. 25, T. 2 S., R. 1 E., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48592, portion of holotype in U. S. National Museum.

Family HETEROTRYPIDAE Ulrich, 1890
Genus DEKAYELLA Ulrich, 1882
DEKAYELLA PRAENUNTIA var. ECHINATA Ulrich
Plate III, Figs. 15-17

Zoarium frondescent, one cm. or more in width and 0.5 cm. or less in thickness. Surface with small, slightly elevated monticules, spaced at intervals of 2 to 3 mm. over the surface, and composed of zooecia only slightly larger than average.

Zooecia polygonal, 11 to 14 in 3 mm., with thick, amalgamate walls composed of a light granular band, bordered on either side by a laminated secondary deposit. Acanthopores with a clear center surrounded by darker rings of tissue, somewhat variable in size, one or 2 occurring per zooecium, but not present around all zooecia; the largest and most prominent acanthopores, up to 0.06 mm. in diameter, are aggregated in the monticules; two sizes of acanthopores occur in the junction angles of intermonticular

zooecia. In addition, small, dark, and poorly defined granular spots may also occur. Mesopores small, few in number.

Tubes in axial region with thin, crenulated walls, tabulated by thin, straight or slightly oblique diaphragms occurring in zones where they are spaced one to 2 tube diameters apart, then generally absent for a long distance. In some cases a young tube displays walls inflected at points of diaphragm insertion, giving a beaded appearance. Zooecial tubes bend in a gentle curve into the mature zone, with diaphragms becoming more numerous and walls thickening rapidly. Young tubes developing in the submature zone often beaded or a single wall in the early mature zone may have a bead. Diaphragms straight or slightly oblique, occasionally incomplete, spaced at intervals of one-half to one tube diameter apart in the mature region. Light colored granular tubes traverse the walls of the mature zone, and are bordered on each side by pinnately arranged laminated tissue, or divided by a dark granular line. Walls of many of the tubes crenulated in the mature region and of irregular width.

Remarks and comparisons.--The Oklahoma specimens are very similar to the types from Minnesota described by Ulrich, in the spacing of the acanthopores and in the rarity of mesopores, but are slightly more flattened in zoarial form and have slightly thicker walls.

Locality.--Bromide formation, 26 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Hypotype U. C. 48582; portion of hypotype in U. S. National Museum.

Genus HETEROTRYPA Nicholson, 1879

HETEROTRYPA TAFFI Loeblich, n. sp.

Plate IV, Figs. 7-10

Zoarium ramose, composed of large branches which are circular to ovate in cross section, ranging in width from 1.5 to 2.2 cm. or more, and in diameter from 0.7 to 2 cm. or more. Surface with small, low monticules, spaced at an average interval of 2.8 mm.

Zooecial apertures polygonal, an average of 13 zooecia occurring in one mm. in the intermonticular area, slightly larger zooecia in the monticules. Three to 6 ring-like acanthopores, having a small lumen, surround each aperture, those in the monti-

cules being of slightly larger size. Acanthopores situated in the junction angles, inflecting the walls of the zooecia in the monticules, rarely those of the intermonticular zooecia. Walls amalgamate, with a clear or weakly granular band representing the original amalgamate walls and a well defined laminated cingulum set off from the former by a dark line. Small round bodies, free from the walls, composed of laminated tissue enclosing granular material are observed in tangential section, and the edges of the laminated bent diaphragms appear as cystiphragm-like structures. Mesopores small, essentially confined to the monticules, rare or absent elsewhere.

Zooecial tubes possess thin crenulated walls in the axial region, with horizontal diaphragms apparently arranged somewhat in zones, as they are spaced less than one to 2 or slightly more tube diameters apart, then absent for a long distance in the tube. Tubes change in direction from the axial to the submature zone in a gentle curve, thence into the long mature zone by an abrupt change of direction. Diaphragms become more common in the submature zone, spaced one-half to one tube diameter apart, with an occasional beading of the earlier part of new tubes, diaphragms crowded in the mature zone, 7 to 8 occurring in 0.5 mm. of the most closely tabulated tube length, generally straight or cup-shaped, although occasionally they may be V-shaped, sigmoid, or incomplete and projecting downward to touch that last formed.

Diaphragms, under high magnification, are observed to be composed of laminar tissue that continues as laminar zooecial linings. Individual diaphragms vary greatly in thickness, some being exceedingly thin, some much thicker and wedge-shaped, and the diaphragms may split in two, forming two separate entities, or may split and reunite, forming a cyst-like receptacle, which is filled with brown granular material. On one diaphragm observed a long spine arises near the center and passes through the next diaphragm above. From the wall of another tube a clavate projection arises, extending diagonally up into the zooecium. In a few tubes small inward projecting, hemiphragm-like structures occur, and in one a small, pedunculate ball projects from the wall. In many of the tubes small, irregularly rounded masses of laminated tissue are present, with a darker or reddish center, some lying within a split diaphragm, and in a few instances 10 or more of these small structures are entirely enclosed in an amazingly contorted laminar band of tissue from the zooecial wall.

Remarks and comparisons.--Heterotrypa taffi is distinguished from H. patera Coryell in possessing a greater number of acanthopores and diaphragms in the mature region, and from H. stonensis Coryell by the presence of monticules, greater number of acanthopores and diaphragms in the mature region.

The identity and function of the small bodies included in the zooecia and the small pedunculate balls on the tube walls is not known. They appear in specimens from two different localities and seem to be composed of tissue similar to that of the parent zoarium. In some cases they appear to be restricted to certain growth levels in the zoarium. Whether they represent parasites upon the bryozoa or whether they may represent some sort of "statoblast" is not known. They are certainly in some way intimately connected with the zooecia, as the diaphragms are modified to enclose them.

This species is named for Mr. Joseph A. Taff, whose pioneer work in the Arbuckle and Wichita Mountains on the early Paleozoic sediments has laid the foundation for all later studies.

Locality.--Bromide formation, 105 ft. below the top of the formation, on Tulip Creek, Sec. 25, T. 2 S., R. 1 E., Arbuckle Mountains, Carter County, Oklahoma (type locality and horizon); 145 ft. below the top of the Bromide formation at the same locality as the preceding; 136 ft. below the top of the Bromide formation on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48570, portion of holotype in U. S. National Museum; paratypes U. C. 48571, 48572, portions of paratypes also in U. S. National Museum.

Family CONSTELLARIIDAE Ulrich, 1890

Genus NICHOLSONELLA Ulrich, 1889

NICHOLSONELLA IRREGULARIS Loeblich, n. sp.

Plate IV, Figs. 13-15

Zoarium ramose, composed of small, round to slightly flattened branches, 3 to 4 mm. in diameter, occasionally irregular in growth. Surface granulose, studded with small blunt spines around the apertures. Macular areas small and indistinct.

Zooecial apertures with ring-like peristomes of laminated tissue, circular to ovate or irregular in outline, 11 to 13 occurring in 3 mm. Irregularity of apertural outline results from indentation by the 5 to 6 acanthopore-like tubes surrounding each

zooecium; acanthopores 0.04 to 0.06 mm. in diameter, composed of laminated rings of tissue filled with dark material.

Tubes with thin, slightly crenulated walls in the axial region, occasionally beaded in the early part, with diaphragms rare or absent; zooecial tubes curve gently from the axial into the submature zone; tubes crossed by only a rare complete diaphragm in the mature region, but with small outpushings or "hemiphragms" commonly projecting inward from the sides, but occasionally pushing outwards. Numerous dark granular streaks bordered by clear bands of tissue traverse the mature region in longitudinal sections. Mesopores originate in the submature zone as beaded structures which occasionally do not reach the surface. Four to 5 partitions occur in the early mature area of the mesopores, with the rest of their length obscured by a granular filling.

Remarks and comparisons.--Nicholsonella irregularis is similar to N. moniliformis but may be distinguished by its less crenulated walls in the axial region, in having both larger acanthopores and the peculiar "hemiphragm-like" projections from the walls; in addition, the zoaria are much smaller and more irregular than those of N. moniliformis. This species is distinguished from N. pulchra Ulrich in possessing fewer diaphragms in the axial region, beaded mesopores, and in the character of the tabulation of the mature region.

Locality.--Type locality of the Bromide formation, 40 ft. below the top of the formation, Sec. 32, T. 1 S., R. 8 E., at the northwest edge of the town of Bromide, Arbuckle Mountains, Johnston County, Oklahoma.

Types.--Holotype U. C. 48569, portion of holotype in U. S. National Museum.

NICHOLSONELLA LAMINATA Ulrich

Plate IV, Figs. 11-12

Zoarium low and massive, 2 cm. in thickness and 5 cm. in diameter, composed of laminae varying from one to 1.5 mm. in thickness. Basal surface strongly wrinkled concentrically.

Zooecia subcircular in outline, 0.44 to 0.64 mm. in diameter, with 4 to 5 occurring in 3 mm., and isolated by angular mesopores. In sections cut near the surface the interzooecial space is filled with a granular-like deposit and perforated by numerous granular acanthopore-like pores. Walls of zooecia and the pores piercing them both granular, the pores may attain a

diameter of 0.04 to 0.06 mm. and occasionally indent the zooecial cavity.

Tubes arise from an irregular basal lamella, are prostrate for a short distance, then turned abruptly to the vertical. Tubes crossed by straight diaphragms spaced at intervals varying from one-half to 3 tube diameters apart. Mesopores originate early in growth and are crossed by an average of 8 straight partitions in one mm.

Remarks and comparisons.--The Bromide forms agree closely with those from the Decorah of Minnesota in mode of growth, and they are similar internally. However, zoaria from Oklahoma are generally more robust than those from the Decorah.

Locality.--Bromide formation, in thin limestones, 280 ft. below the top of the formation, on the West Branch of Sycamore Creek, in the northwest our-fourth of Sec. 27, T. 3 S., R. 4 E., Arbuckle Mountains, Johnston County, Oklahoma.

Types.--Hypotype U. C. 48563, portion of hypotype in U. S. National Museum.

NICHOLSONELLA MONILIFORMIS Loeblich, n. sp.
Plate IV, Figs. 16-17

Zoarium ramose, of dichotomously dividing, round or very slightly flattened branches, varying from 2 to 8 mm. in diameter, according to the maturity of the branches. Surface smooth, the small acanthopore-like spines giving a minutely granulose appearance; small, indistinct maculae also occur.

Zooecial apertures circular to slightly ovate in outline, 11 to 12 occurring in 3 mm., with distinct, thick, ring-like peristomes of irregularly laminated tissue. Zooecia isolated by wide granular interspaces which are perforated by numerous clear acanthopore-like tubes, attaining a diameter of 0.03 mm. In sections, small maculae of granular tissue are also perforated by the numerous small acanthopores.

Tubes in axial region with thin and strongly crenulated walls, early portion commonly beaded, rarely crossed by straight diaphragms, turning in a very gentle curve into the mature region, with beaded mesopores developing in the submature zone and proceeding to the surface. Tubes in early part of mature zone crossed by thin diaphragms spaced at intervals of from two-thirds to one tube diameter apart, with the mesopores crossed by as many as 6 much thicker partitions in 0.5 mm. Outer mature region

obscured by granular deposit; mature region in longitudinal sections traversed by clear or granular streaks, representing the clear acanthopores seen in tangential sections.

Remarks and comparisons.--Nicholsonella moniliformis is distinguished from N. pulchra Ulrich by its smooth surface, the absence of diaphragms in the axial region, and in its characteristic crenulation and beading of the walls. It is distinguished from N. frondifera Coryell by zoarial habit, the almost total absence of diaphragms in the axial region, and in its beaded crenulate walls.

Locality.--Bromide formation, 330 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma (type locality); 165 ft. below the top of the Bromide formation in a roadside ditch, west of the Nebo Store, Sec. 22, T. 2 S., R. 3 E., Arbuckle Mountains, Murray County, Oklahoma; 53 ft. below the top of the exposed section of the Bromide formation, in a road cut on State Highway 18, Sec. 11, T. 1 S., R. 3 E., southwest of Sulphur, Arbuckle Mountains, Murray County, Oklahoma.

Types.--Holotype U. C. 48568, portion of holotype in U. S. National Museum; paratype U. C. 48567; topotypes U. C. 48566 and in the U. S. National Museum.

Family BATOSTOMELLIDAE Ulrich, 1890

Genus ERIDOTRYPA Ulrich, 1893

ERIDOTRYPA ABRUPTA Loeblich, n. sp.

Plate III, Figs. 13-14

Zoarium ramose, branches 3 to 5 mm. in diameter. Surface with low monticules, spaced at intervals of approximately 2 mm., as measured from center to center.

Zooecia oval to subangular in outline, 6 to 9 in 2 mm. Walls thick, ring-like, composed of finely laminated tissue, that of adjoining zooecia separated by a light granular zone. Mesopores common, angular, filling the spaces between the oval zooecia.

Zooecial tubes crossed by remote straight diaphragms, walls thin in the axial region, expanding slowly in width. Zooecia have an abrupt change of direction from the axial region to the mature, as in the submature zone they are nearly vertical. In the short mature region tubes are crossed by one to 4 thick diaphragms that continue as linings of the zooecia. Diaphragms occasionally incomplete and cystiphragm-like in nature. Walls

thicken gradually from the submature zone to the surface and longitudinally are divided by an irregular crenulated dark granular line bordered on either side by laminated tissue. Mesopores originate in the submature zone and are crossed by as many as 7 thick laminated partitions in 0.25 mm. of length.

Remarks and comparisons.--*Eridotrypa abrupta* is distinguished from *E. aedilis* (Eichwald) in lacking the crenulated walls in the axial region and in having diaphragms more widely spaced in that area, in having thicker diaphragms in the mature zone, and in lacking the granular structures as seen in tangential section.

Locality.--Bromide formation, 135 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48595, portion of holotype in U. S. National Museum.

Family HALLOPORIDAE Bassler, 1911

Genus HALLOPORA Bassler, 1911

HALLOPORA DUBIA Loeblich, n. sp.

Plate III, Figs. 9-12

Zoarium ramose, composed of round to slightly flattened branches, 4 to 6 mm. in diameter; surface smooth.

Zooecia polygonal, 11 to 13 occurring in 3 mm., walls thick, under low power appearing vaguely integrate, under high magnification observed to be composed of fine laminated tissue separated by a light-colored granular zone. Small indistinct acanthopores, lacking a lumen, occur in almost every junction angle, with darker granular lines radiating from them. Mesopores few, small and angular.

Tubes with thin crenulated walls in the axial region, attain their full diameter slowly. Diaphragms more closely spaced in the early part, 4 to 5 in 0.5 mm. of tube length, then more widely spaced. In the early part the zooecial walls are slightly inflected at points of diaphragm insertion. Zooecia curve gently from the axial into the mature region, with mesopores developing in the submature zone. In the mature region the diaphragms of zooecia are spaced from less than one-half to one tube diameter apart. Mesopores crossed by straight partitions at the rate of 6 in 0.5 mm. of length, often slightly beaded in the early portion. Walls in mature region separated by a light or dark granu-

lar zone, in a few walls having the appearance of an indistinct crenulated tube, and bordered by pinnately laminated tissue. Diaphragms often incomplete, thick, continuing as laminar linings of the zooecia and of the mesopores.

Remarks and comparisons.--This species possesses numerous acanthopores and has an amalgamate wall, both features which are not characteristic of the genus Hallopora. This species differs from H. angularis (Ulrich) in having acanthopores, smaller zooecia, and the different wall character.

Locality.--Bromide formation, 25 ft. below the top, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48596, portion of holotype in U. S. National Museum.

HALLOPORA MACROSTOMA Loeblich, n. sp.
Plate IV, Figs. 4-6

Zoarium ramose, of rounded branches, 3 to 4 mm. in diameter, to flattened branches, 12 mm. or less in width and 6 mm. in thickness, arising from a basal expansion which is attached to foreign objects.

Zooecia polygonal to subangular, 7 to 8 in 3 mm., walls thick with ring-like cingulum of finely laminated tissue separated from adjoining zooecial walls by a prominent dark granular line. Occasionally acanthopores occur, composed of dark laminae with an obscure lumen. Mesopores small, angular, filling the interzooecial spaces and never isolating the zooecia.

Tubes in axial region with weakly crenulate walls and straight or slightly bent diaphragms spaced at intervals of one-half to 2 tube diameters apart in mature tubes. In the early part of a tube 5 or 6 diaphragms occur in 0.5 mm. of tube length, followed by a gap, then the diaphragms are more widely spaced. Zooecia are curved gently into the short mature zone with the walls thickening rapidly from the base of the mature zone, becoming clavate in sectional view, separated by a dark crenulated line and bordered by pinnately laminated tissue, with diaphragms continuing as laminar linings of the zooecia. Diaphragms are spaced from one-third to one tube diameter apart in the mature zone, this region possessing a total of only one to 3 diaphragms. Mesopores develop in the submature zone and are tabulated by straight diaphragms, rarely incomplete and vesicular in na-

ture, with 7 to 11 partitions in 0.5 mm. of mesopore length.

Remarks and comparisons.--Hallopora macrostoma is separated from H. dumalis (Ulrich) by its larger zooecia, thicker walls and more diaphragms in the axial region.

Locality.--Bromide formation, 25 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48593, portion of holotype in U. S. National Museum.

HALLOPORA PACHYMURA Loeblich, n. sp.
Plate IV, Figs. 1-3

Zoarium ramose, of round branches, 3 to 6 mm. in diameter; surface smooth.

Zooecia polygonal, 7 to 9 occurring in 3 mm., walls thick, composed of finely laminated tissue separated by a prominent dark granular line. At the junction angles of the dark separating line occur small triangular clear spots. Mesopores rare, small and angular.

Tubes thin-walled in the axial region, expanding slowly to full width, in early portion closely tabulated, as many as 6 thin diaphragms in 0.5 mm. of tube length. Diaphragms, thickened in mature region and bent or incomplete, are laminar continuations of the walls. Walls of mature region thicken abruptly and are separated longitudinally by a wrinkled dark line, bordered on either side by pinnately laminated tissue.

Remarks and comparisons.--This species is similar in size of tubes to H. angularis (Ulrich), but mesopores are fewer and the walls much thicker.

Locality.--Bromide formation, 235 ft. below the top of the formation, on Tulip Creek, Sec. 25, T. 2 S., R. 1 E., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48594, portion of holotype in U. S. National Museum.

Family TREMATOPORIDAE Ulrich, 1890

Genus BATOSTOMA Ulrich, 1882

BATOSTOMA CHAPPARSI Loeblich, n. sp.
Plate V, Figs. 7-9

Zoarium ramose, composed of round to oval branches, 4 to 5 mm. in diameter; surface smooth.

Zooecia polygonal, 12 to 13 in 3 mm., walls thin, under low magnification observed to be separated by a dark division line which under high power is seen to be a light or dark granular line separating the finely laminated walls. Acanthopores numerous, 2 to 5 surrounding a zooceium, generally occurring in the junction angles, rarely inflecting the walls, composed of darker tissue with an obscure lumen. Mesopores few, small and angular.

Tubes in axial region with thin crenulated walls and straight or slightly bent diaphragms spaced as close as one tube diameter apart, or absent for long distances in a single tube. Early portions of zooecia more closely tabulated with diaphragms often inflecting the walls. Zooecia curve gently from the axial region into the short mature region. Walls thicken rapidly in mature region and diaphragms, cupped, straight, bent, or as is more usual, incomplete, are closely spaced, as many as 8 in 0.5 mm. of tube length. Walls in mature region separated by a crenulated dark granular line and bordered by light, pinnately laminated tissue. Thick laminated diaphragms of darker material continue as laminar linings of the zooecia, adding to the thickness of the walls.

Remarks and comparisons.--This species differs from B. winchelli Ulrich in having fewer diaphragms in the axial and submature zones; otherwise the two are very similar.

Locality.--Bromide formation, 25 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48599, portion of holotype in U. S. National Museum.

BATOSTOMA CUMINGSI Loeblich, n. sp.

Plate V, Figs. 4-6

Zoarium ramose, commonly with a series of overgrowths, forming an irregular mass which obscures the branching. Corners of zooecia studded with small blunt acanthopore spines on the surface.

Zooecia polygonal, ovate to nearly circular in shallow tangential sections, 8 to 10 occurring in 3 mm., with thick heavy walls, in sections cut fairly deep the tubes are thin-walled and strongly polygonal in section. Walls thick, amalgamate, separated by a band of light-colored granular tissue and bordered by laminate tissue distinct from the granular zone. Acanthopores large,

up to 0.13 mm. in diameter, with a central lumen surrounded by rings of laminated tissue and dark irregular lines radiating from the center. About 3 to 4 acanthopores surround each zooecium, strongly bulging the walls and constricting the zooecial apertures. Mesopores obscured by a granular deposit in the thick-walled portion of tangential sections but in deeper regions thin-walled and angular, varying in size and shape.

Tubes in axial region constricted at points of diaphragm insertion in their early part, giving a beaded appearance, with 6 to 7 diaphragms in one mm. of the beaded portion, the thin and slightly crenulate walls expanding gradually in width and crossed by thin, straight, bent, or cup-shaped diaphragms, spaced at intervals of one-half to 2 tube diameters apart. Zooecial tubes bent in a gentle curve into the mature region, with walls thickening and diaphragms becoming more closely spaced, at intervals of approximately one-half tube diameter, most abundant in the early and medial portions of the mature region, varying in arrangement from weakly sigmoid to cupped, bent, or incomplete and resting on that previously formed; diaphragms continue as laminar linings of the zooecia. In longitudinal section, long tubes filled with a light-colored granular material and bordered by a sharp dark line traverse the mature region. Beaded mesopores arise in the submature zone, being tabulated by as many as 7 diaphragms in 0.5 mm. and may not reach the surface, commonly being obscured by a granular deposit.

Remarks and comparisons.--This species is somewhat similar to Batostoma winchelli spinulosum Ulrich in the appearance of the acanthopores in tangential sections, but differs in possessing beaded tubes; it is similar to B. granulosum Bassler in the beading of the tube walls, but is easily distinguished from the latter by having fewer acanthopores, more diaphragms in the axial and and mature regions, and in possessing an amalgamate wall, which is not characteristic of the genus Batostoma.

Locality.--Bromide formation, 26 ft. below the top, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48581, portion of holotype in U. S. National Museum.

BATOSTOMA WINCHELLI Ulrich

Plate V, Figs. 1-3

Zoarium of ramose, occasionally anastomosing, slightly

flattened branches, 5 to 7 mm. in diameter, being over one cm. wide at points of anastomosing. Very low and scarcely noticeable monticules, with apertures slightly larger than average, are scattered over the surface. On unweathered surfaces corners of zooecial walls are studded with small spines.

Zooecia polygonal to slightly rounded, 10 to 12 occur in 3 mm., possessing walls of finely laminated tissue, the walls of adjacent zooecia separated by a prominent dark division line, junction angles occupied by a small acanthopore which may be clear or more commonly of darker material; acanthopores rarely inflect the walls. In tangential sections which are cut fairly deep, curved cystiphragm-like structures are often seen. Mesopores few and of small size.

Tubes in axial region with thin crenulated walls and crossed by diaphragms varying from less than one up to 4 tube diameters apart, with young tubes frequently beaded in their early portion. Zooecial tubes change in direction from the axial to mature regions in a gentle curve, walls become thicker and are crossed by more closely spaced diaphragms, 5 to 7 occurring in 0.5 mm. of mature length. Diaphragms straight, slightly bent, or commonly incomplete, projecting downward to touch that previously formed. Walls with tissue arranged pinnately are split by a dark crenulated fine line. Mesopores originate in the submature zone.

Remarks and comparisons.--The Bromide specimens compare in size and internal characters closely to the forms described by Ulrich from the Decorah of Minnesota.

Locality.--Bromide formation, 25 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Hypotype U. C. 48565, portion of hypotype in U. S. National Museum.

Genus HEMIPHRAGMA Ulrich, 1893

HEMIPHRAGMA IRRASUM (Ulrich)

Plate V, Fig. 10

Remarks and comparisons.--This species is extremely rare in the collections studied from the Bromide, being represented by a single fragmentary zoarium. Five hemiphragms occur in 0.5 mm. of tube length in the more closely tabulated portions. An average of 10 zooecia occur in 4 mm. of distance in the tangential section.

Locality.--Upper Bromide formation, northwest edge of

the Wichita Mountains, in the northwest one-fourth of Sec. 14, T. 6 N., R. 16 W., Oklahoma.

Types.--Hypotype U. C. 48562, portion of hypotype in U. S. National Museum.

HEMIPHRAGMA PULCHRA Loeblich, n. sp.
Plate V, Figs. 11-14

Zoarium ramose, with subcylindrical branches one cm. or less in diameter, arising from a basal expansion which is generally attached to other bryozoa.

Zooecial apertures sub-circular to elongate-oval in outline, 0.28 to 0.40 mm. in long diameter, including the thick, ring-like walls, which are composed of laminated tissue appearing darker on the inner margins in section. Four to 5 distinct acanthopores, 0.03 to 0.04 mm. in diameter and constructed of darker laminated tissue with a clear center, surround each zooecium. Mesopores not observed in tangential section, the interspaces and maculae appear as granular fillings between the laminated walls. The small maculae, containing numerous acanthopores, occur at intervals of 2.8 to 3.6 mm. over the surface, as measured from center to center.

Zooecial tubes in the axial region with crenulated walls which are thin and crossed by few diaphragms or hemiphragms, turning in a gentle curve into the submature zone where prominent hemiphragms or slight outpushings of the walls become more abundant. Mesopores originate in the submature zone, tabulated by straight diaphragms in their early part but becoming filled and obscured in the more mature portion of the zoarium. Walls thicken rapidly from base of mature zone to surface, gradually constricting the apertures. As many as 5 hemiphragms occur in 0.5 mm. but generally the number is somewhat less as the spacing is varied. Hemiphragms and complete partitions are of laminar continuations of the walls. Clear acanthopores traverse the center of the walls in longitudinal sections, with their borders marked by a somewhat darker line, laminar tissue occurring on either side, the downward projecting laminae giving a pinnate appearance.

Remarks and comparisons.--Hemiphragma pulchra differs from H. irrasum (Ulrich) in possessing fewer hemiphragms in the axial region, thicker walls and consequently smaller apertures and in having fewer diaphragms in the more mature region; in tangential section the acanthopores of H. irrasum (Ulrich) are of

larger size than those of H. pulchra and occasionally indent the zooecia. Otherwise the two species are very similar.

Locality.--Bromide formation, 26 ft. below the top of the formation, on Spring Creek, Sec. 17, T. 2 S., R. 1 W., Arbuckle Mountains, Carter County, Oklahoma.

Types.--Holotype U. C. 48560, portion of holotype in U. S. National Museum; paratypes U. C. 48561 and in the U. S. National Museum.

Genus STROMATOTRYPA Ulrich, 1893

STROMATOTRYPA FRONDOSA Loeblich, n. sp.

Plate V, Figs. 15-17

Zoarium of ramose to wide frondescent branches that often anastomose, leaving small fenestrules. Frondescent branches one to 7 cm. or more in width and 2 cm. or over in thickness. Surface with small slightly elevated monticules spaced at intervals of 4 to 5 mm. Acanthopores on the surface project as short spines.

Zooecia subcircular to circular in outline, 9 to 10 in 3 mm., separated from the adjoining zooecia by small angular mesopores, nearly always isolated but may be in contact at numerous points, surrounded by 3 to 5 prominent acanthopores that occasionally indent the walls. Acanthopores, 0.04 to 0.1 mm. in diameter, thick, ring-like, of finely laminated tissue, with darker tissue surrounding the prominent lumen. Zooecial walls thin, of laminated tissue, and where in contact appear separated by a light zone of structureless material. Walls of mesopores thin, indistinct under low magnification.

Tubes im the axial region thin-walled, crossed by straight diaphragms spaced as close as one tube diameter apart, with diaphragms in the early part generally inflecting the walls, resulting in a beaded appearance. Tubes turn in a gentle curve into the submature zone where the mesopores and acanthopores originate and diaphragms gradually become more closely spaced. Diaphragms thin and in the mature zone vary greatly in shape, being cupped, straight, incomplete or even funnel-shaped, 4 to 5 in 0.5 mm. of tube length. Mesopores become slightly smaller as surface is reached, tabulated by thicker straight diaphragms that slightly inflect the walls, 6 to 7 occurring in 0.5 mm. of length. Diaphragms of mesopores and tubes appear as laminar continuations of the walls. Acanthopores present in longitudinal sections as long clear tubes, bordered by pinnately arranged laminated tissue.

Remarks and comparisons.--The wall structure of this species as seen in tangential section seems to be of an amalgamate nature, which is not characteristic of the family Trematoporidae. Stromatotrypa frondosa differs from all described species of the genus in its ramose-frondescent growth. It differs from S. ovata Ulrich in possessing smaller zooecia, definite large acanthopores, and more numerous diaphragms in the zooecial tubes; from S. globularis Ulrich and Bassler, it is distinguished internally by the more numerous acanthopores and by having a greater number of diaphragms that are variable in shape.

Locality.--Bromide formation, 140 ft. below the top of the formation, on State Highway 99, Sec. 12, T. 1 N., R. 6 E., Arbuckle Mountains, Pontotoc County, Oklahoma (type locality); lower Bromide formation on the McLish Ranch, Sec. 24, T. 1 S., R. 7 E., Arbuckle Mountains, Johnston County, Oklahoma.

Types.--Holotype U. C. 48590, portion of holotype in U. S. National Museum; paratypes U. S. National Museum 99443, and in the collection of the writer.

Order CRYPTOSTOMATA Vine, 1883

Family RHINIDICTYONIDAE Ulrich, 1893

Genus PACHYDICTYA Ulrich, 1882

PACHYDICTYA BROMIDENSIS Loeblich, n. sp.

Plate V, Figs. 18-19

Zoarium consisting of bifoliate frondescent branches, undulating and of irregular width, width varying up to more than 4 cm., branches 2 to 3 mm. in thickness, with rounded margins; surface with slightly elevated maculae.

Zooecial apertures oval, those adjacent to maculae somewhat more rounded and slightly larger than intermacular zooecia, about 0.4 by 0.3 mm. in diameter. Walls thick and ring-like and composed of laminated tissue, those of adjacent zooecia generally in contact, boundaries distinguished by a prominent dark line of granular material. Interstitial space filled by small angular vesicles. Irregular to substellate maculae, appearing solid in sections, occur at intervals of 3 to 3.5 mm., as measured from center to center.

Zooecial tubes arise from a median lamina, diverging at an angle of 71 degrees toward the surface; occasionally a young tube is prostrate for a very short distance. Tubes crossed by 7 or 8 bent diaphragms, varying from one to less than one-third tube

diameter apart; diaphragms occasionally incomplete, projecting downward to touch the previously formed one, giving a vesicular appearance. Walls composed of very finely laminated tissue and are separated by an irregular dark line of granular tissue.

Interstitial tissue develops early in growth, narrow areas being tabulated by straight diaphragms at the rate of 12 to 16 per mm., and wider zones are generally vesicular in character. The double nature of the median lamina is clearly shown in longitudinal section, transverse sections exhibiting the small tubuli, approximately 0.02 mm. in diameter between the laminae.

Remarks and comparisons.--This species is similar to Pachydictya foliata Ulrich, but may be distinguished by the more closely spaced and bent diaphragms, the absence of the clearly marked tubular character of the zooecial walls, by the more distinct interstitial tissue shown in tangential sections, and in possessing a lesser amount of vesicular tissue as shown in longitudinal section.

Locality.--Upper Bromide formation, northwest edge of the Wichita Mountains, in the northeast one-fourth of Sec. 14, T. 6 N., R. 16 W., Oklahoma.

Types.--Holotype U. C. 48550, portion of holotype in U. S. National Museum.

Explanation of Plate I

Figs. 1, 2---Anolotichia deckeri Loeblich, n. sp. Holotype, U. C. 48559, from the Bromide formation on Spring Creek. 1, Longitudinal view, x 20; 2, tangential view, x 20.

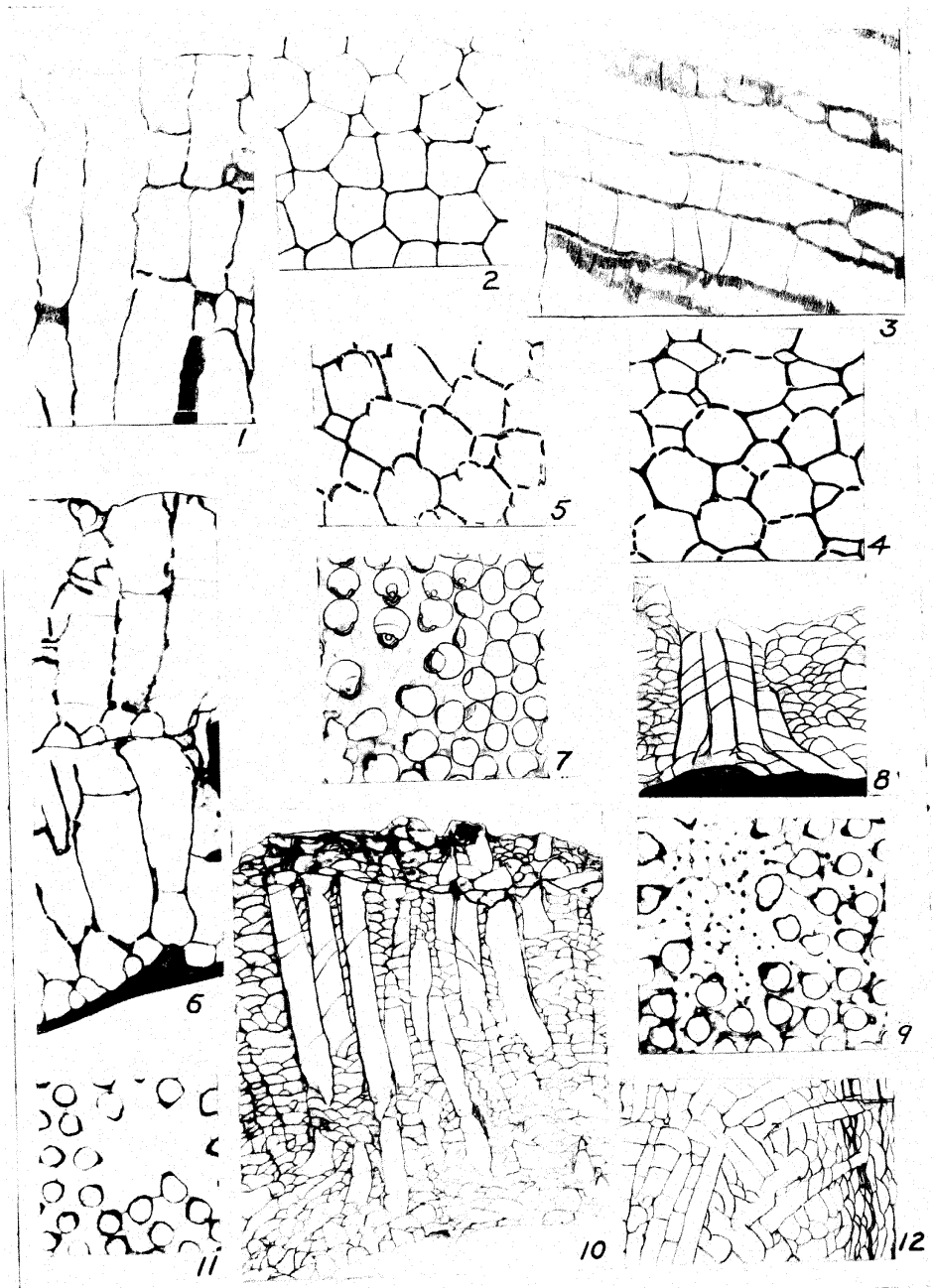
3, 4---Anolotichia impolita (Ulrich). Hypotype, U. C. 48557, from the Bromide formation on Spring Creek. 3, Longitudinal view, x 20; 4, tangential view, x 20.

5, 6---Anolotichia spinulifera Loeblich, n. sp. Holotype, U. C. 48558, from the Bromide formation on Spring Creek. 5, Tangential view, x 20; 6, longitudinal view, x 20.

7-12---Fistulipora (?) bassleri Loeblich, n. sp. 7, Tangential view of paratype, U. C. 48556, from the Bromide formation on the West Branch of Sycamore Creek, showing small lunarial pore. 8, Longitudinal section of same, showing encrusting form of this specimen, and vesicular tissue characteristic of the species. 9, Tangential section of paratype, U. C. 48553, from the Bromide formation at Rock Crossing, showing small inconspicuous lunarial pores and the interstitial pores. 10, Longitudinal view of paratype, U. C. 48554, from Bromide formation west of Nebo Store. 11, Tangential view of holotype, an anastomosing erect form, U. C. 48551, from the Bromide formation at Rock Crossing, showing a macula with surrounding zooecia. 12, Longitudinal view of same. All figures x 20.

PLATE I

CYCLOSTOMATA FROM THE BROMIDE FORMATION



Explanation of Plate II

Figs. 1, 2---*Atactoporella bellula* Loeblich, n. sp. Holotype U. C. 48573, from the Bromide formation on Spring Creek. 1, Longitudinal view, x 20. 2, Tangential view, x 20.

3-5 ---*Homotrypa callitoecha* Loeblich, n. sp. Holotype U. C. 48584, from the Bromide formation west of Nebo Store. 3, Longitudinal view, x 20. 4, Tangential view, x 20. 5, Tangential view, x 50.

6-8 ---*Homotrypa multitabulata* Loeblich, n. sp. 6, Holotype, U. C. 48574, from the Bromide formation at Rock Crossing, longitudinal view, x 20. 7, Paratype, U. C. 48576, from the Bromide formation on the West Branch of Sycamore Creek, tangential view, x 20. 8, Tangential view of same paratype, x 50.

9-11---*Homotrypa sagittata* Loeblich, n. sp. Holotype, U. C. 48585, from the Bromide formation on Tulip Creek. 9, Longitudinal view, x 20. 10, Longitudinal view, x 50, showing laminated wall structure and cystiphragms that continue as laminar linings of the zooecia. 11, Tangential view, x 50.

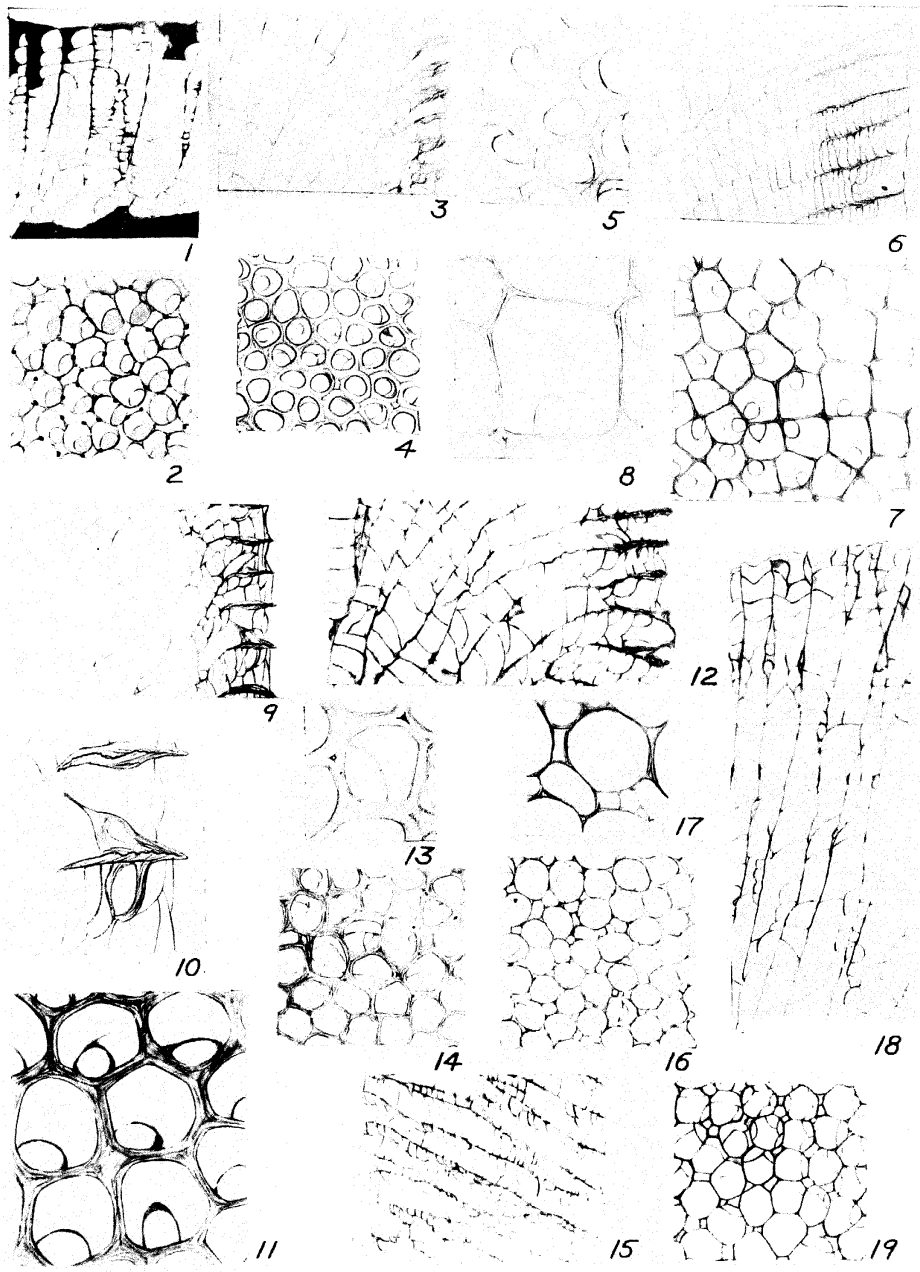
12-14---*Homotrypa ulrichi* Loeblich, n. sp. Holotype, U. C. 48587, from the Bromide formation on Spring Creek. 12, Longitudinal view, x 20. 13, Tangential view, x 50. 14, Tangential view, x 20.

15-17---*Monticuliporella shideleri* Loeblich, n. sp. Holotype, U. C. 48591, from the Bromide formation on Spring Creek. 15, Longitudinal view, x 20. 16, Tangential view, x 20. 17, Tangential view, x 50.

18,19---*Monticuliporella peculiaris* Loeblich, n. sp. Holotype, U. C. 48597, from the Bromide formation on Tulip Creek. 18, Longitudinal view, x 20. 19, Tangential view, x 20.

PLATE II

TREPOSTOMATA FROM THE BROMIDE FORMATION



Explanation of Plate III

Figs. 1, 2---*Monticuliporella croneisi* Loeblich, n. sp. Holotype, U. C. 48598, from the Bromide formation on Spring Creek. 1, Longitudinal view, x 20. 2, Tangential view, x 20.

3, 4---*Prasopora fritzae* Loeblich, n.sp. Holotype, U. C. 48592, from the Bromide formation on Tulip Creek. 3, Longitudinal view, x 20. 4, Tangential view, x 20.

5, 6---*Mesotrypa favosa* Loeblich, n. sp. Holotype, U. C. 48588, from the Bromide formation on Spring Creek. 5, Longitudinal view, x 20. 6, Tangential view, x 20.

7, 8---*Mesotrypa tubulifera* Loeblich, n. sp. Holotype, U. C. 48589, from the Bromide formation on Tulip Creek. 7, Longitudinal view, x 20. 8, Tangential view, x 20.

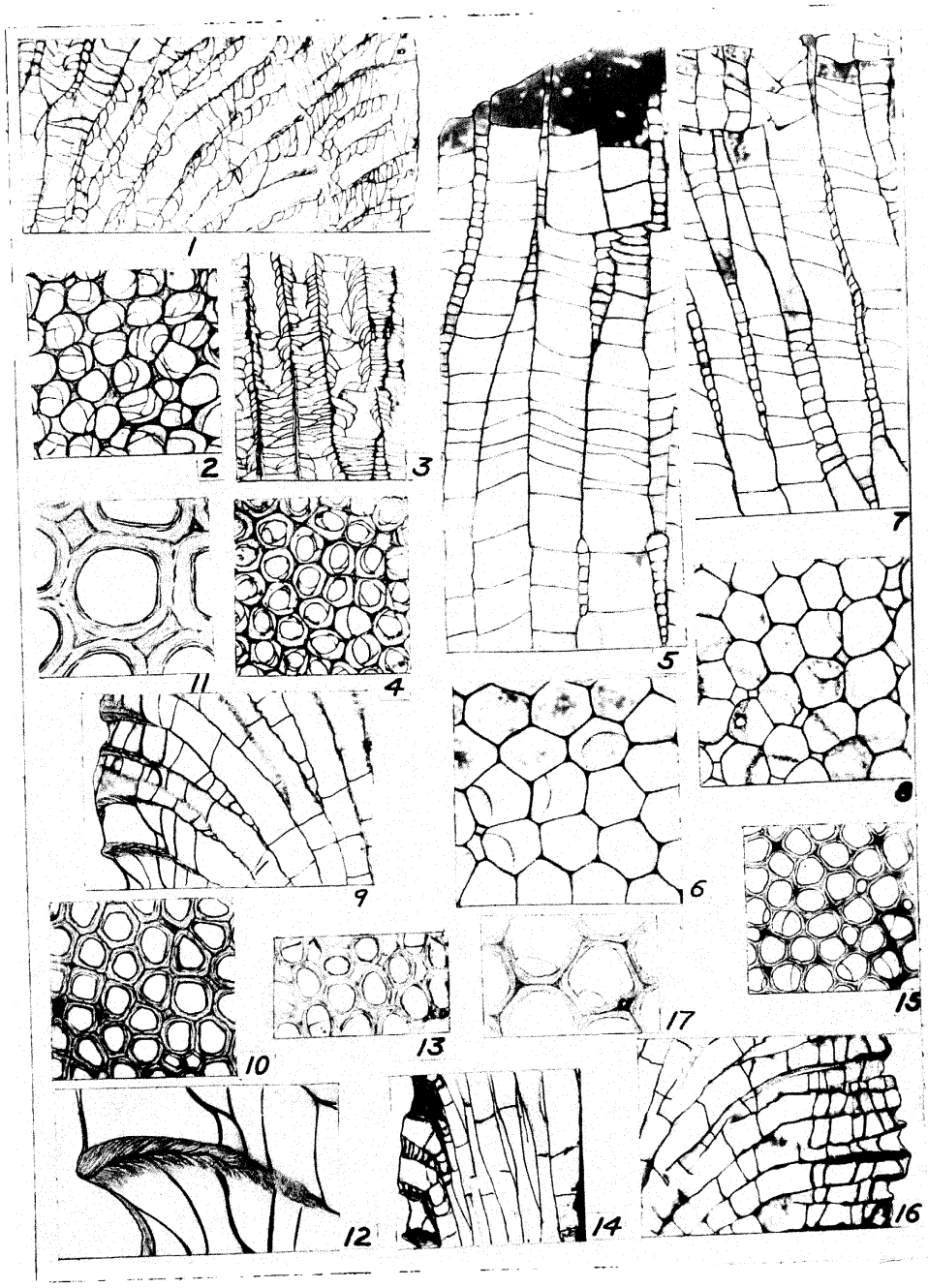
9-12---*Hallopora dubia* Loeblich, n. sp. Holotype, U. C. 48596, from the Bromide formation on Spring Creek. 9, Longitudinal view, x 20. 10, Tangential view, x 20. 11, Tangential view, x 50. 12, Longitudinal view, x 50.

13,14---*Eridotrypa abrupta* Loeblich, n. sp. Holotype, U. C. 48595, from the Bromide formation on Spring Creek. 13, Tangential view, x 20. 14, Longitudinal view, x 20.

15-17---*Dekayella praenuntia* var. *echinata* Ulrich. Hypotype, U. C. 48582, from the Bromide formation on Spring Creek. 15, Tangential view, x 20. 16, Longitudinal view, x 20. 17, Tangential view, x 50.

PLATE III

TREPOSTOMATA FROM THE BROMIDE FORMATION



Explanation of Plate IV

Figs. 1-3 ---Hallopora pachymura Loeblich, n. sp. Holotype, U. C. 48594, from the Bromide formation on Tulip Creek. 1, Longitudinal view, x 20. 2, Tangential view, x 20. 3, Tangential view, x 50.

4-6 ---Hallopora macrostoma Loeblich, n. sp. Holotype, U. C. 48593, from the Bromide formation on Spring Creek. 4, Longitudinal view, x 20. 5, Tangential view, x 20. 6, Tangential view, x 50.

7-10---Heterotrypa taffi Loeblich, n. sp. 7, Tangential view of holotype, U. C. 48570, from the Bromide formation on Tulip Creek, x 20. 8, Longitudinal view of holotype, showing small irregular balls of laminated tissue in the zooecial tubes, x 20. 9, Longitudinal view of paratype, U. C. 48571, from the Bromide formation on Spring Creek, showing diaphragms continuing as laminar linings of the zooecia, x 50. 10, Tangential view of holotype, x 50.

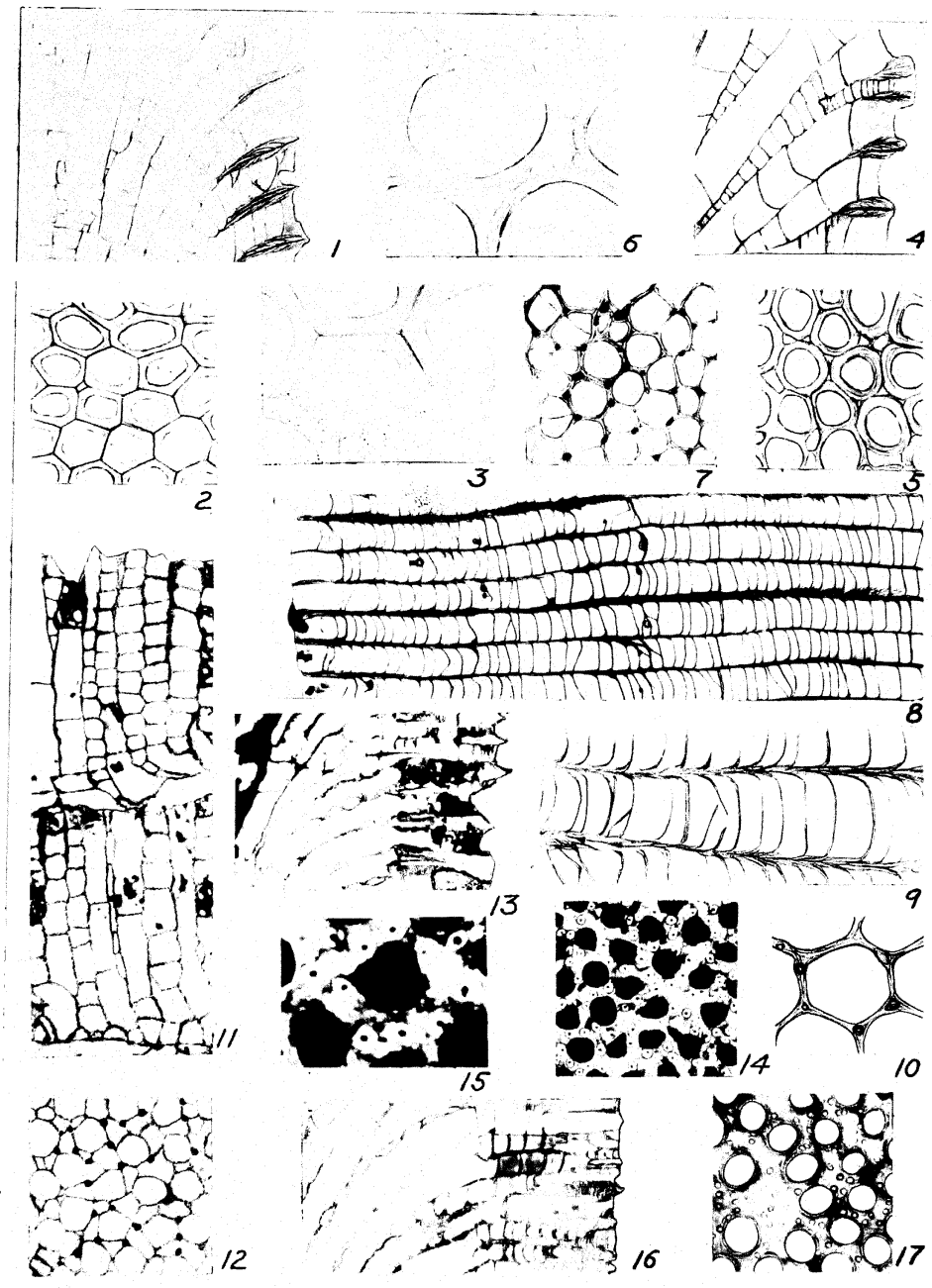
11,12---Nicholsonella laminata Ulrich. Hypotype, U. C. 48563, from the Bromide formation on the West Branch of Sycamore Creek. 11, Longitudinal view, x 20. 12, Tangential view, x 20.

13-15---Nicholsonella irregularis Loeblich, n. sp. Holotype, U. C. 48569, from the Bromide formation at the type locality. 13, Longitudinal view, x 20. 14, Tangential view, x 20. 15, Tangential view, x 50.

16,17---Nicholsonella moniliformis Loeblich, n. sp. 16, Longitudinal view of holotype, U. C. 48568, from the Bromide formation on Spring Creek, x 20. 17, Tangential view of paratype, U. C. 48567, from the Bromide formation on Spring Creek, x 20.

PLATE IV

TREPOSTOMATA FROM THE BROMIDE FORMATION



Explanation of Plate V

Figs. 1-3---*Batostoma winchelli* Ulrich. Hypotype, U. C. 48565, from the Bromide formation on Spring Creek. 1, Tangential view, x 20. 2, Longitudinal view, x 20. 3, Tangential view, x 50.

4-6---*Batostoma cumingsi* Loeblich, n. sp. Holotype, U. C. 48581, from the Bromide formation on Spring Creek. 4, Tangential view, x 20. 5, Tangential view, showing amalgamate wall in one side of the zooecium, and obscurely integrate wall on adjacent side, also large acanthopores, x 50. 6, Longitudinal view, x 20.

7-9---*Batostoma chapparsi* Loeblich, n. sp. Holotype, U. C. 48599, from the Bromide formation on Spring Creek. 7, Longitudinal view, x 20. 8, Tangential view, x 20. 9, Tangential view, x 50.

10 ---*Hemiphragma irrasum* (Ulrich). Hypotype, U. C. 48562, from the Bromide formation in the Wichita Mountains. Longitudinal view, x 20.

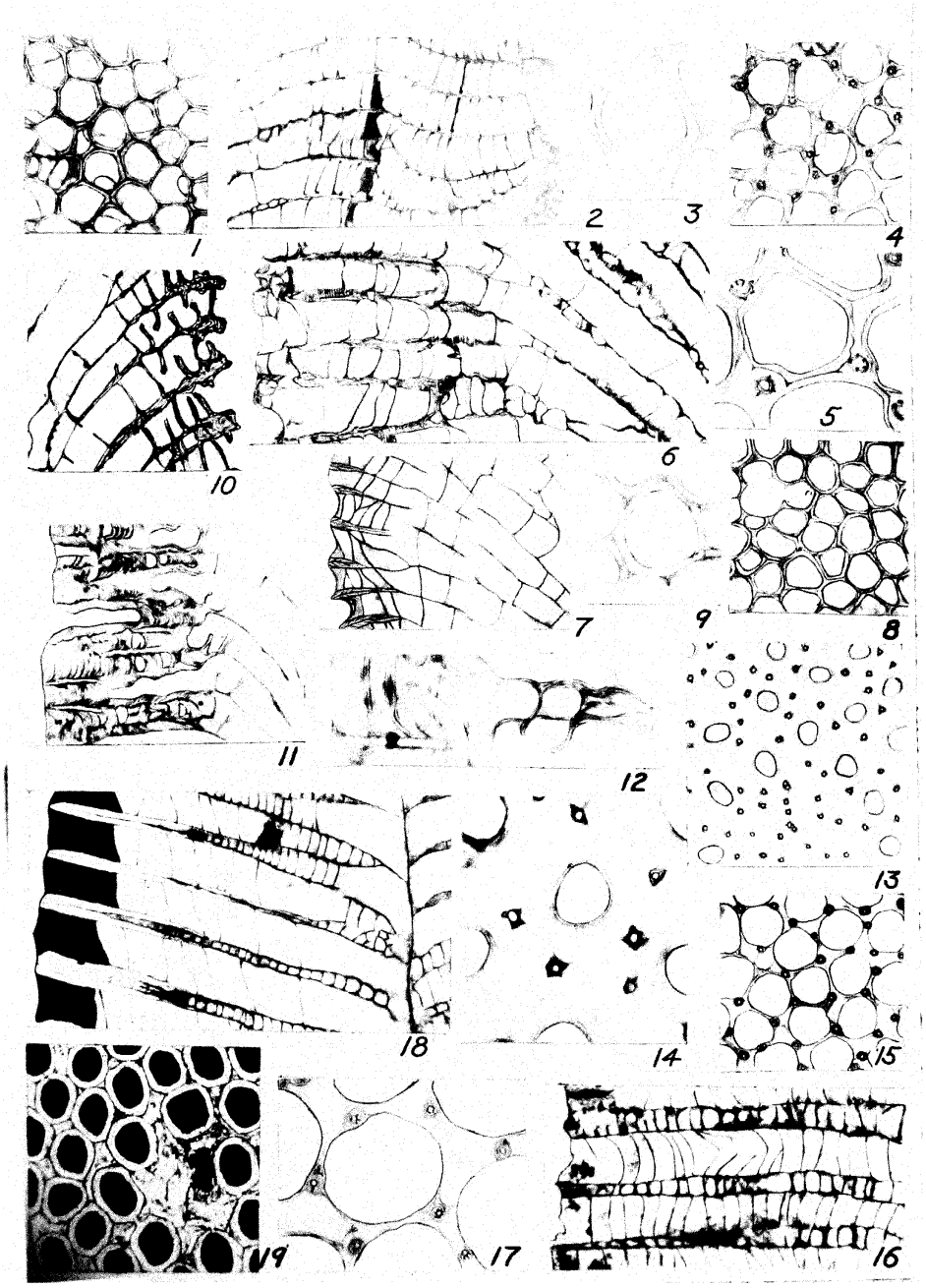
11-14--*Hemiphragma pulchra* Loeblich, n. sp. 11, Longitudinal view of holotype, U. C. 48560, from the Bromide formation on Spring Creek, x 20. 12, Longitudinal view of paratype, U. C. 48561, from the Bromide formation on Spring Creek, showing character of hemiphragms and tubuli piercing the mature region, x 50. 13, Tangential view of holotype, x 20. 14, Tangential view of holotype, x 50.

15-17--*Stromatotrypa frondosa* Loeblich, n. sp. Holotype, U. C. 48590, from the Bromide formation on Oklahoma State Highway 99. 15, Tangential view, x 20. 16, Longitudinal view, x 20. 17, Tangential view, x 50.

18,19--*Pachydictya bromidensis* Loeblich, n. sp. Holotype, U. C. 48550, from the Bromide formation in the Wichita Mountains. 18, Longitudinal view, x 20. 19, Tangential view, x 20.

PLATE V

TREPOSTOMATA AND CRYPTOSTOMATA FROM THE BROMIDE FORMATION



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