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CHEILOTRYPID BRYOZOANS FROM PENNSYLVANIAN AND PERMIAN ROCKS OF THE MIDCONTINENT REGION

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ILLUSTRATIONS

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ABSTRACT

This paper reports part of the results of a comprehensive study of Pennsylvanian and Permian bryozoans of the type that generally has been called "fistuliporoid," because of resemblance to the genus widely known as *Fistulipora* McCoy (1849). Attention is called to the fact that *Fistulipora* Rafinesque (1831) considerably antedates McCoy's use of this name for Paleozoic bryozoans and requires revision of nomenclature applied to numerous described species. The conclusion is advanced that a majority of the Pennsylvanian and Permian bryozoans having structural characters like those of *Fistulipora* McCoy are assignable to *Cyclotrypa* Ulrich (1896); 26 species, of which 22 are new, are described as belonging to *Cyclotrypa*. A new genus that is distinguished from *Cyclotrypa* by strong lunaria with edges projecting into the zooecial tubes to form pseudosepta is named *Triphyllotrypa;* 8 species, of which all but one are new, are described. Two genera of bifoliate "fistuliporoids," which are treated in the paper, are *Meekopora* Ulrich (1890), represented by 6 species (5 new), and the new genus *Meekoporella,* represented by 3 previously undescribed species. *Meekoporella* is distinguished from *Meekopora* by difference in the type of bifurcation of the bifoliate cell layers; in the former, the planes of diverging sheets are separated by angles of about 120 degrees, whereas in the latter, branches lie approximately in the same plane.

Cyclotrypa is confined chiefly to Pennsylvanian and older rocks. *Meekopora* ranges from Silurian tc Permian, but in the midcontinent region is chiefly characteristic of Lower Permian beds. *Meekoporella* contains one known Pennsylvanian species and two from Permian rocks. *Triphyllotrypa* seems to occur only in the Permian.

The family to which these four genera belong is designated as the Cheilotrypidae, a new name emending Chilotrypidae Simpson (1897), which was based on erroneous spelling of the genus *Cheilotrypa* Ulrich (1884). Previously, bryozoans of "fistuliporoid" type have been assigned to the family Fistuliporidae Ulrich (1882), a name that must be abandoned inasmuch as it was based on *Fistulipora* McCoy, a homonym. The general morphology of all known cheilotrypid genera is reviewed briefly for the purpose of analyzing structures that may be considered to have validity in generic classification. A key for differentiation of genera of the Cheilotrypidae is included.

INTRODUCTION

The study of bryozoans reported in this paper comprises part of an extensive program of projected work on Pennsylvanian and Permian fossils of this invertebrate group, planned as a collaborative effort of Dr. George E. Condra, State Geologist of Nebraska, and the senior author of the present contribution. Interest in Late Paleozoic bryozoans that is responsible for this joint program is of long duration. Condra began research on the paleontology of Pennsylvanian and Lower Permian bryozoans of Nebraska 45 years ago, and his first scientific publication (Condra, 1902) was on this group of fossils. The paper mentioned contains descriptions and figures of bryozoan species then known from these rocks, including some new species, and notes occurrence in areas adjacent to Nebraska. With somewhat fuller treatment and addition of numerous illustrations, this work was republished in the following year (Condra, 1903) as a volume of the Nebraska Geological Survey. First detailed acquaintance with Carboniferous bryozoans was made by Moore during studies of Mississippian formations and fossils of Missouri, southeastern Iowa, and western Illinois in 1915, although a report on this work was considerably delayed (Moore, 1929a). Collection and study of Pennsylvanian and Permian bryozoans by Moore began in 1916 when he came to Kansas. In 1918 and following years, associated with Frederick B. Plummer in studies of the Pennsylvanian rocks of north-central Texas, he had opportunity to make collections of bryozoans from numerous horizons in that region. Identification of various genera and species was reported by Plummer and Moore (1921) and an unusually rich, well-preserved assemblage of bryozoans from the Wayland shale was described later (Moore, 1929).

Years of collecting bryozoans, along with other Late Paleozoic fossils of the midcontinent region, have resulted in gathering at the University of Nebraska and the University of Kansas a representation of Pennsylvanian and Permian forms that is unrivaled in magnitude and completeness, at least in North America. Several ten-thousands of these fossils have been brought together and, most important for purposes of stratigraphic paleontology, most of the lots are from very precisely known horizons and localities. The Nebraska and Kansas collections are supplemented, moreover, by large loans of bryozoan material from the University of Texas, representing Pennsylvanian and Permian formations of Texas; Yale University, including collections of the King brothers in the Glass Mountains region of western Texas; the University of New Mexico; Colorado School of Mines; and the Northern Arizona Museum at Flagstaff. The great bulk of all this study material comes from Nebraska, Kansas, Oklahoma, and Texas, but in aggregate there is a considerable quantity from Iowa, Missouri, Arkansas, New Mexico, Arizona, Colorado, Utah, Wyoming, and South Dakota. In general, stratigraphic placement of specimens obtained from localities outside of the midcontinent region is varyingly indefinite.

Plans for collaboration of Condra and Moore on bryozoan studies were outlined in a preliminary manner about 1930, but during the following ten years little real progress was made except in adding to the collection and sorting material. Pressure of official duties and interests in other directions, augmented by the factor of geographic separation, retarded joint effort. Eventually, decision was reached to divide the work so as to permit studies independently on assigned genera. Thus, Condra undertook to investigate the fenestrate bryozoans, whereas Moore assumed responsibility for studies on most of the massive and ramose forms. Specimens were assembled in accordance with this plan, benefits of collaboration being conserved by pooling the available study material in selected groups and by arranging to confer periodically as might be possible. Otherwise, the research would be carried on by each as separate, though related, projects. During recent years the Nebraska part of this program has been carried on by Condra in association with Dr. Maxim K. Elias, although partly interrupted by a major digression on the genus *Archimedes* (Condra and Elias, 1943). In 1939, the junior author of the present paper came to the University of Kansas, following graduate work at the University of Wisconsin in which she had specialized on Ordovician bryozoans. Well prepared for research on stony bryozoans from Pennsylvanian and Permian rocks, which fundamentally are little different from older Paleozoic fossils of this type, she has assisted the senior author in most of the arduous task of preparing, sorting, measuring, describing, and illustrating the large quantity of material investigated. This work, combined with other duties and interrupted at times, was continued to the summer of 1942.

Scope of Present Study

This paper presents results of extended investigations of "fistuliporoid" stony bryozoans from Pennsylvanian and Permian rocks of the central United States, ranging in age from Morrowan to Guadalupian. The group of fossils treated is characterized by thin-walled zooecial tubes, typically subcircular to trilobate in cross section, which are separated from one another by vesicular tissue. The colonies are commonly distinguished by massive growth that may attain breadth and thickness of many inches, but some zoaria are small rounded bodies or irregularly laminar in form. Excluded from this paper are descriptions of ramose "fistuliporoids," on which work has not been completed, but included are bifoliate forms of growth, which range from small ribbonlike stipes or very thin palmate expansions to moderately thick slablike structures. Late Paleozoic stony bryozoans that are not considered in this paper are the stenoporoids, which are distinguished by closely packed, somewhat thick-walled zooecial tubes of polygonal cross section, not separated by vesicular tissue.

The fossils studied are chiefly from Kansas and Nebraska, in the northern midcontinent region, and from north-central and western Texas, in the south, but there are numerous specimens from neighboring states, as already noted. The primary purpose of work on these bryozoans, as on parts of the collection not yet critically examined, has been to determine their usefulness as horizon or zone markers in stratigraphic investigations. The question was raised as to whether "fistuliporoids" from post-Mississippian rocks of the central United States represent only a half-dozen species, which so far have been recognized, or whether they are separable into a much larger number of species having more or less limited stratigraphic ranges. If these fossils, which exhibit a considerable range of differences in zoarial form, surface characters, and internal structure, actually belong to a few highly variable long-ranging species, they have little value in stratigraphic paleontology. On the other hand, it is reasonable to expect that the host of "fistuliporoids" and associated bryozoans occurring in Pennsylvanian and Permian formations may be divided into numerous determinable species having stratigraphic usefulness. This subject we have undertaken to explore.

The bryozoans here treated are assigned to four genera, of which two (*Triphyllotrypa* and *Meekoporella*) are new. A total of 46 species are described, all but 6 of which are new. The species are distributed as follows: *Cyclotrypa*, 28 species (24 new); *Triphyllotrypa*, 9 species (8 new); *Meekopora*, 6 species (5 new); and *Meekoporella*, 3 species (3 new).

Previous Work

Study of Pennsylvanian and Permian fossils.—Stony "fistuliporoid" bryozoans were included undoubtedly in fossil collections of Swallow and Hawn (1860) and other early geologists who studied rocks now classified as Pennsylvanian and Permian in Kansas, although this is not safely inferred from their published faunal lists; the inference is based on the common occurrence of such fossils in many strata examined by them. Forms were not described. The first paleontologic descriptions of examples of these bryozoans from the midcontinent area were given by Geinitz (1866, p. 66) in a paper on fossils from southeastern Nebraska that incorrectly assigns them to *Stenopora columnaris* Schlotheim. Meek (1872) subsequently reported on the Upper Pennsylvanian fauna of this region and described a new species, *Fistulipora nodulifera*, which is an incrusting bryozoan representing a group not treated in this paper. The first described massive "fistuliporoid" from Pennsylvanian rocks that is recognized as valid in establishing a new species is Ulrich's (1884) *Fistulipora carbonaria*, based on specimens collected at Kansas City, Mo. This bryozoan was described somewhat incidentally as part of one of Ulrich's several early papers on this group of fossils. Beede and Rogers (1900, 1902, 1904, 1906, 1908), in a series of "Coal Measures Faunal Studies," reported the occurrence of bryozoans in many rock formations of Kansas, and Rogers (1900) described several species but did not include stony "fistuliporoids."

Contributions by Condra (1902, 1903), already mentioned, are the earliest papers devoted to Late Paleozoic bryozoans of the central United States as an assemblage. Four species of "fistuliporoids" belonging to the group considered in the present paper are recognized. These include Ulrich's *Fistulipora carbonaria*, a new form described by Condra as *F. carbonaria* var. *nebrascensis*, and two new species by Ulrich, *Cyclotrypa? barberi* and *Meekopora prosseri*.

Girty (1903) reported *Fistulipora carbonaria* from the Hermosa formation in southwestern Colorado. An important monograph by this author (Girty, 1908) on Permian fossils of western Texas contains descriptions of four "fistuliporoid" bryozoans (exclusive of forms referred by him to *Domopora*), namely, *Fistulipora grandis* var. *guadalupensis*, *F. guadalupae*, *F.* sp., and *Meekopora* sp. A new Pennsylvanian species called *F. zonata* was described by Girty (1915) in a paper accompanying Hinds and Greene's (1915) important report on stratigraphy of the Pennsylvanian rocks of Missouri. In the same year, Girty (1915a) figured and described forms identified as *F. carbonaria* and *F. carbonaria nebrascensis* from the Wewoka formation, of Desmoinesian age, from Oklahoma, and Mather (1915) reported *Fistulipora* sp. from Morrowan beds of Oklahoma and Arkansas. Plummer and Moore (1921) identified *F. carbonaria* and illustrated a ramose "fistuliporoid" from Upper Pennsylvanian (Cisco) formations in north-central Texas. Species were described by Coryell (1924) from the Francis formation (*F. sutilis*), of Missourian age, in Oklahoma; Link (1928) from the Cisco (*F. bennetti*), of Virgilian age, in Texas; and Moore (1929), whose species *F. vaccula* is a synonym of *F. bennetti*.

Six specifically identified stony "fistuliporoids" from Pennsylvanian and Permian rocks recognized in previous work are now assigned to genera as follows: *Cyclotrypa carbonaria* (Ulrich), *C. nebrascensis* (Condra), *C. zonata* (Girty), *C. bennetti* (Link), *Triphyllotrypa guadalupensis* (Girty), and *Meekopora prosseri* Ulrich. *Cyclotrypa* (?) *barberi* Ulrich has structural characters differing from those of *Cyclotrypa* and other genera treated in this paper, and accordingly is excluded from description here. *Fistulipora nodulifera* Meek and *F. guadalupae* Girty are thin incrusting growths that are omitted from the present study. *F. sutilis* Coryell belongs to *Meekopora* and is considered to be a synonym of *M. prosseri* Ulrich.

Previous studies on "fistuliporoid" bryozoans.—Work on this group of bryozoans has been extensive inasmuch as they are common fossils occurring in Paleozoic rocks of all parts of the world. The oldest pertinent publication is by Rafinesque in 1831, which introduces the generic name *Fistulipora*. It is burdensome and profitless from our standpoint to delineate the course of more than a rather small part of previous studies on the morphology, classification, and nomenclature of the "fistuliporoid" bryozoans, but it is desirable to notice main steps in advancing knowledge. Much of the literature is concerned with classificatory problems, which include not only placement in family and order but the question whether these fossils belong among bryozoans or corals. There is now little doubt that the "fistuliporoids" are truly bryozoans. Some of the grounds for differentiation of the orders called Trepostomata, Cyclostomata, and Cryptostomata are not at all clear, however, and this lack of well-marked differentiation, along with generalized or overlapping characters of the "fistuliporoids," leaves uncertainty as to biologic relationships, despite all previous studies.

By far the most important work on this group of fossils is that of Ulrich, whose papers (1882, 1884, 1886, 1890) contain a well-drawn definition of a majority of the recognized genera, penetrating diagnosis of structural features, and enduring classificatory treatment. These papers also give illustrations and descriptions of numerous species. It is a tribute to the quality of Ulrich's studies that few additions or modifications have been shown needful for satisfactory recognition of any of the host of bryozoans treated by him. Ulrich's first paper on American Paleozoic Bryozoa (1882) introduced the family Fistuliporidae.

Chief contributions, additional to those just mentioned, are studies by Bassler (1906, 1911, 1913, 1929, 1934, 1935, 1936), who has described a number of "fistuliporoid" genera and published extensively on fossil bryozoans, and Nikiforova (1933, 1938), who is a leading student of the Carboniferous and Permian bryozoan faunas of the U.S.S.R. Hall and Simpson (1887) and Simpson (1897) are authors of somewhat elaborate works on Devonian "fistuliporoids" and other bryozoans, but their papers lack merit because descriptions and figures have been found unreliable in many instances. Pertinent parts of the observations and conclusions of these and other paleontologists will be noted in discussion of the genera here treated.

Study Procedure and Technique

A preliminary survey of specimens in our collection indicated the desirability of classifying them first according to zoarial type. Excepting bifoliate growth forms, all sorts of "fistuliporoid" colonies,—incrusting, free thinly laminate, massive, solid ramose, and hollow ramose,—have previously been referred to *Fistulipora;* all of these types, including bifoliate, range from Silurian or Devonian into the Permian. No assumption was made that classification of these bryozoans according to zoarial habit would have value for differentiation of genera, but it was thought that type of growth might be a useful means of distinguishing species or groups of species. Little difficulty was experienced in dividing the collection on the basis of zoarial form.

When this first step in classification of the specimens had been completed, each assemblage of similar zoaria was laid out in subdivisions according to stratigraphic occurrence, making segregations belonging to successive formations, groups, and series. The surface characters of specimens in the different lots were studied and individuals were selected for preparation of thin sections. Many hundred thin sections were made in order to determine the structural nature of specimens from different horizons and to establish constancy or variation in characters of specimens belonging to the same horizon but coming from several more or less widely distributed localities. In addition, polished sections or rough fracture sections of several individuals in a single lot commonly were made for the purpose of comparing with the thin sections and determining correlation of internal structures with readily observed external features. Most polished sections and many unpolished sections of these bryozoans reveal structural features satisfactorily when wetted with water, or better, with glycerine or a clear oil. Acceptable photomicrographs can be made of such sections, although they are rarely as good as photographs or projections of thin sections. An advantage of work with polished sections is the possibility of direct observation of relationships between longitudinal and transverse sections, and the relations of both types of sections to surface characters. This is an important aid to a correct understanding of some features shown in thin sections. A partial three-dimensional view of the internal structure of some specimens is possible when the tubes and vesicles are filled by transparent calcite or when spaces between silicified walls have been made open by leaching of the original fillings.

Photomicrographs having uniform magnification are an almost indispensible means for comparison of internal structures of "fistuliporoid" bryozoans, and they are useful for study of surface characters. Thin sections cannot be compared directly very well under the microscope. Only two such sections can be viewed together and this must be at relatively low power. On the other hand, a dozen or more photomicrographs may be spread out for comparison, and markings may be used to emphasize selected features. A simple technique, much used in our work because of its rapidity and altogether satisfactory nature, is employment of the thin section as a "negative" in an enlarging apparatus, projecting the image onto bromide paper. The photographic enlargement of the section, which is readily made at a selected standard scale (x10 or x20), shows wall structures of the bryozoan as white or light-gray lines against a black background.

The photographs of thin sections published with this paper were prepared mostly by projecting the thin section onto kodolith film in the manner just described, enlarging them about x5, and then printing at further enlargement from this negative at the desired scale. This reverses the image so as to give dark lines against a white background. The photographs were retouched by strengthening overweak lines and by whiting out extraneous matrix or marks made by calcite filling. Many of the figures here given show the spaces inclosed by zooecial walls filled in with India ink almost to the margin. This was done in order to differentiate the zooecia from surrounding vesicles at a glance. Magnifications of x10 and x20 have been used uniformly, and each species reported from different stratigraphic horizons commonly is illustrated by examples from more than one formation.

Most of the measurements recorded for the Pennsylvanian and Permian species here described were made with an ocular micrometer, studying specimens under the microscope, but some were made from photomicrographs. Commonly they are averages of many measurements, with statement of maxima and minima.

Note may be added concerning effort to study the method of budding of zooecial tubes in different types of "fistuliporoid" zoaria. For this purpose, serial sections were made and individual zooecia were traced to their points of origin. Camera lucida drawings of the successive sections were made.

Acknowledgments

Dr. George E. Condra, of the University of Nebraska, has been mentioned as collaborator in study of bryozoans, but it is appropriate to express special acknowledgment of his role in developing plans and a large part of the materials for this research. Loans of collections, which have contributed importantly to the scope of the study, call for thanks to Dr. Carl O. Dunbar, of Yale University;

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OCCURRENCE OF PENNSYLVANIAN AND PERMIAN BRYOZOANS

General Observations

Bryozoans are common and well-preserved fossils in many strata of the west-central United States from near the base of Morrowan beds, belonging to the Lower Pennsylvanian, to the Capitan limestone high in the Guadalupian series, of Permian age. Some deposits are very largely composed of bryozoan remains. They occur in limestones of many different types,—fine-, medium-, or coarse-grained, pure or very impure, earthy, siliceous, ferruginous, or carbonaceous, and in beds of very massive, flaggy, thin wavy-bedded, or shaly character. They are very abundant in some oölitic limestones. Bryozoans are also common in many Pennsylvanian and Permian shales, especially those of somewhat calcareous nature. Here they are characteristically associated with remains of crinoids, myalinid and pectinoid clams, and brachiopods such as *Chonetes*, *Derbya*, and *Juresania*. Marine sandy deposits may contain fairly numerous bryozoan colonies. The wide distribution and abundance of these fossils in many places have brought them to notice of field geologists working on marine Pennsylvanian and Permian deposits almost everywhere. They seem to be ubiquitous.

The statements just made should not be understood to imply that bryozoans are equally abundant in all types of marine Late Paleozoic strata. Such is not the case. Generally they favored the more shallow parts of the shallow inland sea, not necessarily confined to near-shore belts but being more at home in this habitat, seemingly, than in farthest offshore surroundings. This is suggested by the common occurrence of bryozoans in clayey beds just above layers of coal or in other first-formed marine deposits of cyclothems (strata comprising nonmarine and marine deposits of all types laid down during a single cyclic advance and retreat of a sea). Bryozoans are also characteristically numerous in the uppermost marine layers of a cyclothem, occurring associated with abundant algal remains and mollusks. Fusulinid-bearing limestones, which mark the culmination of marine submergence and belong to offshore relatively deeper waters, may contain bryozoan remains but rarely in any abundance.

Study of the distribution of Pennsylvanian and Permian bryozoans calls attention to the marked differences in some assemblages of these fossils from closely associated horizons. Probably such differences denote paleoecologic relationships. Some beds contain great numbers of slender ramose bryozoan colonies, chiefly *Batostomella* and *Rhombopora*, but almost no other kind of bryozoans; persistent zones of this type occur in clayey beds just below the Topeka and Deer Creek limestones. Several stratigraphic units consisting of nodular somewhat fragmental limestone are characterized by abundant algal remains, numerous specimens of the brachiopod *Composita*, and very common fenestrate bryozoans; nodular stony bryozoans may occur in this environment but ramose zoaria are mostly absent. "Fistuliporoids" of the type described in this paper are not clearly associated with a particular faunal assemblage or sedimentary environment. They are common in limestones, including fusulinid-bearing beds, and occur in some shaly deposits. A majority of our specimens has come from fine-grained limestones, especially wavy-bedded to nodular strata, containing a varied association of invertebrates.

An interesting observation of bryozoan communities, first noted by Condra and later described by Schoewe and Lenahan (1933), is the occurrence of "nests" of crowded *Meekopora* and some other bryozoans on the upper surface of the Brownville limestone near Admire Junction, in central Kansas. These "nests" are roughly circular patches, 2 or 3 feet in diameter, made up of close-packed bryozoan zoaria, surrounded by an upraised rim of barren limestone. The clusters comprising individual "nests" are separated by spaces of varying width, approximately 2 to 40 feet, over which brachiopods and other marine fossils are sparsely scattered at random. Local communities of various organisms like those described are reported to exist in some present-day shallow seas. The fact that marked localization of fossils in Pennsylvanian and Permian rocks is seen rarely is doubtless ascribable very largely to lack of opportunity in most places for the necessary sort of observation. At Admire Junction, a large area of Brownville limestone was laid bare by stripping away the overlying soft shale.

Stratigraphic Divisions

Named divisions of the Pennsylvanian and Permian deposits in the midcontinent region and adajcent Rocky Mountain states, to which reference is needed in reporting the occurrence of bryozoans, are numerous, especially in view of differing classifications that are employed in the several parts of this large area. Reference to many of these stratigraphic units and the most recent, carefully studied presentation of their correlation may be found in reports of the Pennsylvanian and Permian subcommittees of the National Research Council's Committee on Stratigraphy (Moore et al., 1944; Dunbar et al., 1944). Other papers giving details of the stratigraphic succession are the following: in Nebraska, by Condra and Reed (1943); in Iowa, by Condra (1933), Condra and Upp (1933, 1933a), and Cline (1941); in Missouri, by Hinds and Greene (1915) and McQueen and Greene (1938); in Kansas, by Moore (1936, 1940), Moore, Frye, and Jewett (1944), and Jewett (1941, 1941a); in Oklahoma, by Wilson and Newell (1937), Dott (1941), Oakes (1940, 1941), and Tomlinson (1929); in Arkansas, by Croneis (1930); in Texas, by Plummer and Moore (1921), Sellards (1932), Cheney (1940), and King (1937); in New Mexico, by Needham (1940) and Thompson (1942); in Arizona, by Darton (1925); in Colorado, by Johnson (1934); in Wyoming, by Condra and Reed (1933) and Condra, Reed, and Scherer (1940); and in South Dakota, by Condra, Reed, and Scherer (1940).

Distribution of Stony "Fistuliporoids"

The following tabulation summarizes the known occurrence of "fistuliporoid" stony bryozoans described in this paper.

Stratigraphic Distribution of Species

Species	Stratigraphic divisions[1]							
	Pennsylvanian					Permian		
	M	L	D	Mo	V	W	Ln	G
Cyclotrypa matheri	x-	--	--	----	----	----	----	----
Cyclotrypa horridula	--	x-	--	----	----	----	----	----
Cyclotrypa carbonaria	--	--	--	xxxx	----	----	----	----
Cyclotrypa nebrascensis	--	--	--	xxxx	----	----	----	----
Cyclotrypa acerba	--	--	--	x---	----	----	----	----
Cyclotrypa procera	--	--	--	x---	----	----	----	----
Cyclotrypa tenuicula	--	--	--	-x--	----	----	----	----
Cyclotrypa zonata	--	--	--	xx--	xxx-	----	----	----
Cyclotrypa repentis	--	--	--	--x-	----	----	----	----
Cyclotrypa decora	--	--	--	---x	----	----	----	----
Cyclotrypa capacis	--	--	--	----	xxxx	----	----	----
Cyclotrypa abdita	--	--	--	----	-x--	----	----	----
Cyclotrypa abnormis	--	--	--	----	-x--	----	----	----
Cyclotrypa imula	--	--	--	----	--x-	----	----	----
Cyclotrypa candida	--	--	--	----	--x-	----	----	----
Cyclotrypa idonea	--	--	--	----	--x-	----	----	----
Cyclotrypa disiuncta	--	--	--	----	--xx	----	----	----
Cyclotrypa pelagia	--	--	--	----	--xx	----	----	----
Cyclotrypa simplicis	--	--	--	----	--xx	----	----	----
Cyclotrypa torosa	--	--	--	----	--xx	----	----	----
Cyclotrypa bennetti	--	--	--	----	x---	----	----	----
Cyclotrypa perlaevis	--	--	--	----	----	xxxx	----	----
Cyclotrypa beata	--	--	--	----	----	xxxx	----	----
Cyclotrypa galerita	--	--	--	----	----	xxxx	----	----
Cyclotrypa hirta	--	--	--	----	----	----	xxxx	----
Cyclotrypa debilis	--	--	--	----	----	----	----	xx--
Triphyllotrypa passa	--	--	--	----	----	-x--	----	----
Triphyllotrypa speciosa	--	--	--	----	----	----	xxxx	----
Triphyllotrypa definita	--	--	--	----	----	----	xxxx	----
Triphyllotrypa spissa	--	--	--	----	----	----	xxxx	----
Triphyllotrypa patentis	--	--	--	----	----	----	xxxx	xx--
Triphyllotrypa proiecta	--	--	--	----	----	----	xxxx	xx--
Triphyllotrypa galeata	--	--	--	----	----	----	----	xx--
Triphyllotrypa abstrusa	--	--	--	----	----	----	----	xx--
Triphyllotrypa guadalupensis	--	--	--	----	----	----	----	--xx
Meekopora prosseri	--	--	--	-x-x	-x-x	xxx-	----	----
Meekopora mollis	--	--	--	----	---x	----	----	----
Meekopora vesca	--	--	--	----	---x	----	----	----
Meekopora opima	--	--	--	----	----	-x--	----	----
Meekopora parilis	--	--	--	----	----	-xxx	xxxx	xx--
Meekopora calamistrata	--	--	--	----	----	----	xxxx	----
Meekoporella dehiscens	--	--	--	---x	----	----	----	----
Meekoporella nexilis	--	--	--	----	----	xxxx	----	----
Meekoporella repleta	--	--	--	----	----	----	xxxx	xx--

[1] Stratigraphic divisions: M, Morrowan; L, Lampasan; D, Desmoinesian; Mo, Missourian; V, Virgilian; W, Wolfcampian; Ln, Leonardian; G, Guadalupian.

MORPHOLOGIC CHARACTERS OF "FISTULIPOROID" BRYOZOANS

Zoarial Forms

The different types of zoarial growths that are common among "fistuliporoid" bryozoans have already been mentioned. It is desirable here to consider briefly each type before giving attention to characters of internal structure.

The genus *Fistulipora* McCoy (1849), which is a homonym of *Fistulipora* Rafinesque (1831), was founded on an incrusting type of bryozoan, described by McCoy as a new species called *F. minor*. Incrusting zoaria, such as represented by McCoy's species, range from paper-thin growths to comparatively thick structures,—that is, having a thickness of 5 mm. The entire basal portion of the zoaria, or most of it, is fastened firmly to some foreign surface, such as a brachiopod, coral, crinoid stem, or other fossil. The peripheral part of some incrusting growths projects outward so as to lack direct contact with a supporting surface. Most incrusting bryozoan colonies are very thin, and they are characterized, accordingly, by the short length of the zooecial tubes. An immature zone is virtually lacking, inasmuch as it comprises only a very short recumbent portion of the tubes at the base of the zoarium.

Thin free lamellate zoaria have the form and structure of flat incrusting growths. They differ only in having a more or less wrinkled epitheca at the base of the colony. There is no evident demarcation between small wafer-like zoaria and large sheetlike growths designated as explanate forms. All such colonies are characterized by relative shortness of the zooecial tubes.

Most "fistuliporoid" zoaria that are called massive have thickness that is a considerable fraction of the greatest width, or it may exceed the width. The zooecial tubes are long, evenly spaced, and separated by vesicular tissue throughout their length. The zoaria are not divisible into immature and mature regions. The internal structural characters just indicated and the general shape of the zoarium, rather than size, are chiefly significant in distinguishing colonies called massive, but there is no sharp demarcation between so-called massive zoaria and large free lamellate growths or some subramose colonies.

Ramose "fistuliporoid" bryozoans (excluding bifoliate branching growths) may be divided into two groups,—solid branches and hollow branches. Cross sections of the branches are commonly circular but they may be ovoid, and their size ranges from a diameter of a few millimeters to more than 50 mm. The solid branches are characterized by the presence of an axial immature zone and a peripheral mature zone. These two regions are clearly distinguishable in most specimens and in many their characters are decidedly dissimilar.

Hollow branching zoaria differ from the solid types in having a large or small axial cavity that is bounded by the basal lamina of the colony. Commonly the axial space is filled by matrix. An immature region in the zoarium is restricted to the immediate vicinity of the basal lamina and it may be either well-developed or inconspicuous. The axial cavity of these bryozoans has been interpreted to signify the former existence of an easily destructible support for the bryozoan, such as the branching stems of seaweeds that are incapable of fossilization (Nikiforova, 1933, p. 33). Some such hollows in the middle of zoaria have been considered to be the tubes of annelid worms (Waagen and Wenzel, 1886, pl. 103). If such hypotheses are correct, the zoaria actually represent incrustations, and their ramose mode of growth expresses the nature of the support rather than attributes of the zoaria themselves. Some modern bryozoans grow as incrustations on seaweeds, and the possibility that Paleozoic bryozoans include forms having this habit is not to be denied. We are disposed to think that some of the hollow ramose "fistuliporoids" from Pennsylvanian and Permian strata are not incrusting growths, however, and, like Ulrich, we interpret these as showing a distinct independent growth pattern (1884, p. 49; 1890, p. 295). The basal epitheca surrounding the central cavity may show transverse corrugations that seem to have no relation to a hypothetical supporting plant structure. Also, there are specimens having a central cavity of such transverse and longitudinal outline that no plausible suggestion of a plant or other organism is given. At some localities hollow branching bryozoans are very abundant and all specimens are about the same in form and size. We have observed a few hollow ramose zoaria that give off solid branches, as reported by Nikiforova (1933, p. 33), but sporadic offshoots of this nature are not uncommon in lamellate, massive, or incrusting types of zoaria. The hollow branching form of growth seems to have value in classification of these bryozoans.

Bifoliate zoaria are distinguished by the presence of zooecial apertures on both sides of a ribbonlike or expanded sheetlike colonial structure. Transverse sections show that the zooecia grow back to back, arising from opposite sides of a median lamella that seems actually to consist of a double layer. Ulrich (1890, pp. 295, 483) reports observation of the double nature of the median lamella in thin sections studied by him, but it is not ordinarily determinable in thin sections. Some bifoliate zoaria may be split readily along the plane of the median lamella, seemingly because of parting between separate lamellae. Bifoliate "fistuliporoids" range in thickness from approximately 1 mm to more than 20 mm. Some specimens belonging to species that normally have a ribbonlike zoarial form are so thick that cross sections are nearly circular, but this is exceptional. The bifoliate form of growth is determinable externally, as well as from observation of fractured sections, because the edges of the median lamella are visible at margins of the ribbon or sheetlike growth.

Surface Features

Surface features of "fistuliporoid" bryozoans that have value for classification include the shape, spacing, and arrangement of zooecial apertures, the presence or absence of elevated peristomes and lunaria, the nature of interapertural spaces, and the development and nature of maculae.

The shape of the zooecial tubes in transverse section and attitude of the tubes near the surface mainly control the outline of the apertures. Generally, the openings are circular or ovoid, but species having prominent lunaria may have bilobate or trilobate apertures. Apertural characters of zooecial tubes that approach the surface nearly at right angles normally differ from those of tubes that intersect the surface obliquely. The latter are typically ovoid to subtriangular in outline. Sharply elevated narrow ridges form prominent peristomes that surround the apertures of some "fistuliporoid" species. These peristomes may be smooth or they may bear fine to coarse granules. Many colonies lack distinct peristomes. Lunaria are widely variable in nature, ranging from barely perceptible thickenings of the posterior part of the zooecial wall that do not project appreciably above other parts of the apertural rim and make no indentation of the zooecial walls, to very much thickened, strongly curved, sharply elevated, overarching structures that may largely conceal the zooecial openings and deeply indent the tubes. Some lunaria are very narrow and denticulate, as in *Buskopora,* but in most "fistuliporoids" the width of lunaria is one half or more of the diameter of the zooecial tubes.

Interapertural areas are narrow or wide, and they are smooth, granulose, ridged, or grooved. The position of vesicle walls is commonly evident in zoaria that lack deposits of stereome near the surface. This is accentuated by slight abrasion but it is observable on many perfectly preserved specimens owing to differential translucency of the calcite in walls and fillings next to the surface. A few "fistuliporoid" genera are characterized by the occurrence of interapertural ridges that form polygons around the apertures. In other forms shallow grooves may similarly define a polygonal pattern or they may trend flexuously over the surface, joining with neighbors only rarely.

Maculae belonging to this group of bryozoans differ widely in prominence and in various special characters. Many zoaria lack perceptible maculae. These areas, which are formed by a concentration of vesicular tissue and local absence of zooecial tubes, may be gently to strongly elevated above the general surface of the zoarium, forming monticules, but commonly they are slightly depressed or lie flush with the general surface of the zoarium. Outlines of the maculae tend to be roughly circular or ovoid but margins are not sharply defined. Zooecial apertures next to maculae are typically somewhat larger than the average. The spacing of maculae is generally very uniform on zoaria belonging to a given species.

The usefulness of surface characters for classification and identification of "fistuliporoid" bryozoans depends largely on preservation. If much of a zoarium is obscured by matrix or if the surface is weathered, external features cannot be determined very reliably. Always it is necessary to supplement observations of the surface by study of internal structure.

Internal Structure

"Fistuliporoid" bryozoans are composed internally of zooecial tubes and interzooecial vesicular tissue, the latter being more or less filled with calcareous deposits (stereome) in some forms. The zooecial tubes are distinguished by their continuity, relatively large size, and by their rounded transverse outline, except in the immature region of some genera. There are no acanthopores (except in *Lichenotrypa*) and the zooecial walls do not show beaded thickenings, as in some trepostomatous bryozoans.

The walls of zooecia and vesicles are characterized by very fine lamination of dense calcareous tissue and by the presence of more or less numerous pores that interrupt the walls and in some specimens even give them locally a spongy appearance. The zooecial tubes of most genera are interrupted by diaphragms arranged normally or obliquely to the side walls, and these partitions commonly are much thinner than the zooecial walls. The abundance of diaphragms varies greatly in different genera and species. In some, there are incomplete diaphragms joined to complete ones, and rarely the incomplete diaphragms may have a free edge, forming hemiphragms. The vesicles are small blister-like structures having curved walls that are more or less distinctly convex upward, or on the side toward the surface of the zoarium. The anterior and part of the lateral walls of zooecia in many "fistuliporoids" are composed of vesicular tissue having an irregular or decidedly ragged outline (example, pl. 35, fig. 1, this paper). There are no true mesopores in the "fistuliporoids." Mesopores, which are typically developed in the mature region of many trepostomatous bryozoans, are diminutive tubes crossed by numerous diaphragms. Unlike vesicular tissue, the mesopores resemble zooecial tubes, from which they are commonly distinguished only by their size, shape, and crowded diaphragms.

It is worthy of note that some "fistuliporoid" zoaria strongly resemble Trepostomata in having clearly differentiated immature and mature regions and in showing abrupt deflection of the zooecial tubes at or near the transition from immature to mature portions of the zoarium. These are not typical characters of the Cyclostomata, in which order the "fistuliporoids" generally have been classed. On the other hand, many "fistuliporoids" do not show the presence of immature and mature regions. The porous wall structure of these bryozoans and the occurrence in some specimens of enlarged cells that seem to be ooecia (ovicells) are characters that are interpreted to indicate relationship with the Cyclostomata. Bassler (1913, p. 326) introduced the suborder Ceramoporoidea, containing the families Ceramoporidae and Fistuliporidae, in order to segregate bryozoans that are intermediate in various characters between typical Trepostomata and well-defined Cyclostomata.

STATUS OF THE GENUS FISTULIPORA AND FAMILY FISTULIPORIDAE

Genus Fistulipora

One of the most widely known genera among Paleozoic bryozoans is that designated as *Fistulipora* McCoy (1849). Scores of species from all parts of the world and ranging in age from Ordovician to Permian have been assigned to *Fistulipora,* although some have been transferred to other genera. In view of this wide recognition and the selection of *Fistulipora* McCoy as a family type (Fistuliporidae Ulrich, 1882, p. 156), it is disturbing to learn that Rafinesque (1831, p. 5) published *Fistulipora* as the name for a Paleozoic fossil from Kentucky, antedating McCoy's paper by some 18 years. Rafinesque's brief characterization of his new genus is as follows:

> *Fistulipora* Raf. Differ from *Millepora* by being tubular. 1. *F. teres.* Cylindrical, nearly simple, smooth, pores round, nearly equal. Limestone of Kentucky.

The facts that the genotype of *Fistulipora* Rafinesque, which is *F. teres,* established by monotypy, was not figured and that the species is not now (or possibly ever) definitely recognizable do not permit avoidance of the conclusion that *Fistulipora* McCoy is an invalid homonym. The designation given by McCoy is a stillborn name and, as such, never has had scientific standing. Inquiry as to the structural features of McCoy's genotype, *F. minor* McCoy, which has been determined by Nicholson and Foord (1885) and others to be a junior synonym of *Calamopora incrustans* Phillips (1835), comes to have no importance in taxonomy but is merely of historical interest. Appeal might be made to the International Commission to validate McCoy's genus, setting aside the Rules, but this is deemed inadvisable. Accordingly, we reject *Fistulipora* McCoy as a generic name applicable to Paleozoic bryozoans. Also, we cannot refer the fossils commonly known as *Fistulipora* to *Fistulipora* Rafinesque.

Question is raised at once concerning the name that can be accepted in place of McCoy's term. *Calamopora* cannot be considered because the structure of this bryozoan is entirely different from that of the "fistuliporoids." Attention is directed to generic terms that have been interpreted previously as junior synonyms of *Fistulipora* McCoy. These include *Dybowskiella* Waagen and

Wentzel (1886) and possibly *Cyclotrypa* Ulrich (1890). *Didymopora* Ulrich (1882) cannot be considered because this is not a valid name. No genotype was mentioned when Ulrich published the name and no species was subsequently referred to it. Accordingly, the term has no standing in biologic nomenclature. In 1884, Ulrich concluded that the forms which he had planned to call *Didymopora* should be assigned to *Lichenalia* Hall, and therefore he classed *Didymopora* as a junior synonym of Hall's genus. Likewise, *Dybowskia* Waagen and Pichl (1886, p. 701), which is a homonym, was merely mentioned as a name planned for application to a bryozoan that later was named *Dybowskiella* Waagen and Wentzel (1886).

Dybowskiella is based on *Dybowskiella grandis* Waagen and Wentzel, from Permian rocks of the Salt Range in India. The zoaria consist of large hollow branches, and the zooecial tubes are characterized by the strong projections of the ends of the lunaria, which make pseudosepta indenting the tubes and giving them a trilobate cross section. If the view of Nikiforova (1933) and others is accepted, the zoarial form and prominent pseudosepta of *Dybowskiella* do not furnish ground for generic separation from bryozoans that generally have been assigned to *Fistulipora* McCoy. On the other hand, if the hollow zoarial form and accentuated lunaria of *D. grandis* are accepted as characters having significance in generic classification, several "fistuliporoids" can be differentiated under this name but the great majority must be placed somewhere else. Our study leads us to accept *Dybowskiella* as a valid genus.

Cyclotrypa Ulrich (1896) has been considered as a distinct genus by Nickles and Bassler (1900), Branson (1924), Bassler (1935), and various other authors. Supposedly, it is distinguished by the circular to ovoid transverse section of its zooecial tubes and the absence or inconspicuousness of lunaria. Transverse sections of "*Fistulipora*" *minor* McCoy (from a specimen designated as paratype in the Cambridge University Museum studied by Moore and partly figured by Bassler, 1929, pl. 230, fig. 5) show zooecial tubes of ovoid outline. Lunaria are very faint or unrecognizable. Whether or not *Cyclotrypa* is a junior synonym of *Fistulipora* McCoy is unimportant in view of the latter's status as a homonym, but there is need to determine identity or generic distinctness between *Cyclotrypa* and *Dybowskiella*. Ulrich's genus is characterized by weakness of lunaria and the genotype species has a solid, massive zoarium. Seemingly, *Cyclotrypa* properly may contain a majority of the bryozoans that formerly have been placed in *Fistulipora*. Our experience indicates that no practicable or significant division can be made between "fistuliporoid" zoaria having zooecial tubes with no lunaria or barely perceptible lunarial thickening of the zooecial walls and colonies in which definite, though generally weak, lunaria are recognized. We assign more than two dozen species from Pennsylvanian and Permian rocks to *Cyclotrypa*.

FAMILY FISTULIPORIDAE

If *Fistulipora* McCoy can be accepted no longer as a valid genus, revision of the name for Ulrich's family Fistuliporidae is required. The International Rules do not specify procedure for the nomenclature of families and subfamilies, except to provide that names of families shall end in *-idae* and those of subfamilies in *-inae*. Recognized good practice, however, dictates that the nomenclature of families should follow the pattern given by the Rules for designation of genera. Thus, the genus that gives a family its name is the nomenclatural type of the family, whether or not it ideally represents the characters ascribed to the family. Naturally, a family must contain the family type genus. The valid name of a family is that based on the first genus selected as family type among those that are considered to belong together in a family.

The Fistuliporidae, as interpreted by Bassler (1935), include 18 genera, of which all except *Botryllopora* Busk seem properly to belong together in the same family. Including an additional genus described in 1936, but omitting *Fistulipora* McCoy (1849) as a homonym and *Fistulipora* Rafinesque (1831) as an indeterminate genus, the list includes the following: *Eridopora* Ulrich (1882) (syn. *Pileotrypa* Hall, 1886), *Cheilotrypa* Ulrich (1884), *Buskopora* Ulrich (1886) (syn. *Glossotrypa* Hall, 1886, *Odontotrypa* Hall, 1886), *Hexagonella* Waagen and Wentzel (1886), *Selenopora* Hall (1886), *Coelocaulis* Hall and Simpson (1887), *Favicella* Hall and Simpson (1887) (syn. *Fistuliporidra* Simpson, 1897), *Lichenotrypa* Ulrich (1890), *Meekopora* Ulrich (1890), *Pinacotrypa* Ulrich (1890), *Strotopora* Ulrich (1890), *Cyclotrypa* Ulrich (1896), *Fistuliporella* Simpson (1897), *Fistulocladia* Bassler (1929), *Fistulotrypa* Bassler (1929), *Fistuliphragma* Bassler (1934), and *Cliotrypa* Ulrich and Bassler (1936). Family names that have been published, based on any of these genera, are: Chilotrypidae Simpson (1897), Selenoporidae Simpson (1897), Favicellidae

Simpson (1897), and Odontotrypidae Simpson (1897). The last named is founded on a junior synonym of *Buskopora* and may be disregarded. Among other family names, Chilotrypidae is based on a genus that more nearly represents average characters of the group than *Selenopora* or *Favicella* and accordingly we adopt it as a substitute for Ulrich's Fistuliporidae. In so doing, however, it is necessary to amend the spelling to agree with correct designation of the type genus which is *Cheilotrypa*. The name of the family is Cheilotrypidae.

NATURE AND RELATIONSHIPS OF VESICLE-BEARING STONY BRYOZOANS

The Cheilotrypidae, to which we now refer genera formerly classed as belonging to the family Fistuliporidae, are mainly characterized by the occurrence of vesicular tissue between the zooecial tubes, at least in part of the zoarium, and by porous structure of the walls of the zooecia. The latter feature, which is more strongly defined in the Ceramoporidae, is emphasized by Bassler (1913, p. 326) in differentiating the suborder called Ceramoporoidea, which contains the Ceramoporidae and "Fistuliporidae" (Cheilotrypidae). This group of bryozoans originally was classed with the Trepostomata, which generally are composed of massive, ramose, or laminar stony zoaria having immature and mature regions and showing a somewhat abrupt bending of the zooecial tubes in the transition zone between these two regions. Bassler concluded that affinities of the Ceramoporoidea are with the Cyclostomata and placed them in this order.

There are other vesicle-bearing bryozoans that resemble representatives of the Cheilotrypidae strikingly in structure and external appearance. A majority of these are currently classed in the family Sulcoreteporidae, which is placed in the order Cryptostomata. The cryptostomes are presumed to stand apart from other orders because zooecial tubes bear hemiphragms and an area near the aperture has the character of a vestibule that is deflected from the trend of earlier-formed parts of the zooecial tubes. Interzooecial spaces commonly are filled with stereoplasm near the surface of the zoarium. Zooecial walls are not porous. The Cryptostomata include incrusting, laminar, massive, ramose, and reticulate zoaria, and many genera have a bifoliate mode of growth. The Sulcoreteporidae comprise laminar, ramose, and reticulate bifoliate colonies.

Comparison of representative cheilotrypid and sulcoreteporid genera leads almost inevitably to the conclusion that these bryozoans do not belong very far apart in classification. Every structural peculiarity of one is found in examples of the other, except pore openings or passageways that interrupt zooecial walls. These openings are clearly seen in many specimens of cheilotrypids; they are extremely rare or lacking in others. Such perforations are not observed in species assigned to the Sulcoreteporidae. If these two groups, which now are placed in different orders, are closely related phylogentically, as they seem to be, the sulcoreteporids must be interpreted as the more advanced stock, for they all have a specialized zoarial form (bifoliate) and a predominantly later distribution (Devonian to Permian). The Cheilotrypidae include a few bifoliate genera but are mostly massive, ramose, laminar, or incrusting, and at least six genera occur in Silurian rocks, as compared with a single genus (*Coscinium*) of the Sulcoreteporidae reported from this system. It is interesting to note that the Ceramoporidae, distinguished by strongly porous zooecial walls, mostly begin in Ordovician horizons and die out in the Devonian, whereas the Cheilotrypidae, many of which are characterized by inconspicuous wall openings and others by none that have been seen, are a younger group (Silurian to Permian), and the Sulcoreteporidae, provided with imperforate walls, are mostly still younger (Devonian to Permian). The oldest representatives of the Cheilotrypidae and Sulcoreteporidae, however, occur in Ordovician rocks (Bassler, 1911, pp. 108, 146). Although the bryozoans here discussed are believed to be genetically related, this does not at all mean that Cryptostomata are derived from Cyclostomata, or that the Sulcoreteporidae are the ancestral stock of the Cryptostomata. There is much contrary evidence. We simply express doubt as to the validity of ordinal classification of Paleozoic bryozoans as currently accepted.

Attention may be directed to the occurrence of vesicle-bearing stony bryozoans among the Trepostomata, such as *Trematopora* in the family Trematoporidae and *Stellipora* in the Constellariidae. The interzooecial spaces in these genera correspond rather closely to characters seen in representatives of the Cheilotrypidae (for example, note figures of *Trematopora cystata* from Ordovicion of the Baltic region, Bassler, 1911, p. 271). The vesicles are strikingly similar to the superposed cystophragms of *Monticulipora, Homotrypa, Homotrypella,* and other genera of the Monticuliporidae. If such cystophragms are interpreted as extra-zooecial, instead of intra-zooecial, structures, which is not difficult, they closely match various specimens assigned to the Cheilotrypidae, particularly such bryozoans as *Cyclotrypa carbonaria* (pl. 32, fig. 2), *C. repentis* (pl. 32, fig. 8), *C. capacis* (pl. 35, fig. 1), and others that clearly show irregular zooecial walls that are formed by adjacent vesicles. Whether homologies between vesicular structures of Monticuloporidae and Cheilotrypidae are more indicative of genetic relationship than the inferred connection of cheilotrypids with the Ceramoporidae, based on porous wall structure, is conjectural. Although the Ceramoporidae lack interzooecial vesicular structure, Bassler (1911, p. 74) thinks that this family "is undoubtedly the progenitor of the equally important Fistuliporidae" (Cheilotrypidae).

CHARACTERS OF CHEILOTRYPID GENERA

A comparative examination of genera assigned to the family Cheilotrypidae, including pre-Pennsylvanian forms, is desirable as a basis for appraising characters that may be employed in generic diagnoses. Such a survey, also, provides an over-all view of zoarial forms and internal structures that may be formulated in a convenient tabular summary or key to identification of recognized genera. We arrange this review according to zoarial types, counting the thin incrusting colonies as most primitive and bifoliate structures as most specialized.

Thin Incrusting Zoaria

Five described genera belong in this and the next following group, of which one ranges from Silurian to Devonian, another Devonian to Permian, and the rest are confined to the Devonian. The zooecial tubes are very short and tend to intersect the surface of the zoarium obliquely. An indistinctly differentiated immature portion of the tubes is recumbent on the basal lamina of the colony. Vesicles are numerous and separate the zooecia throughout most of their length. Lunaria are commonly strong.

Eridopora Ulrich, 1882 (pl. 4, figs. 3a-c).—This genus is mainly distinguished by its very prominent overarching lunaria that partly conceal the ovoid to subtriangular zooecial apertures. The short zooecial tubes contain few diaphragms and there is no perceptible differentiation between immature and mature regions. Syn. *Pileotrypa* Hall (1886). Genotype, *E. macrostoma* Ulrich (1882). Devonian to Permian.

Selenopora Hall, 1886 (pl. 4, figs. 4a, b).—Apertures of this bryozoan are surrounded by ridges that form polygonal areas, and there are prominent projecting lunaria. Genotype, *Lichenalia circincta* Hall (1883). Devonian.

Lichenotrypa Ulrich, 1890 (pl. 3, fig.3).—Vesicles like those of other members of the family occur between the zooecial tubes but strong acanthopores are developed near the surface of the zoarium and project above adjacent apertures in the form of spines; irregular openings of vesicles appear on the surface. Genotype, *Lichenalia longispina* Hall (1883). Devonian.

Free Laminar Zoaria, Mostly Thin Expansions

Favicella Hall and Simpson, 1887 (pl. 4, figs. 5a, b).—Apertures are surrounded by ridges that form a polygonal pattern, lunaria absent but peristomes distinct; immature region marked by short recumbent portion of zooecial tubes, not sharply differentiated from mature region. Syn. *Fistuliporidra* Simpson (1897). Genotype, *Thallostigma inclusa* Hall (1883). Devonian.

Fistuliporella Simpson, 1897 (pl. 4, figs. 2a-c).—The apertures of this genus, like *Favicella* and *Selenopora*, are surrounded by ridges that form polygonal areas, but interstitial walls of *Fistuliporella* bear granular spinelike prolongations which are not acanthopores. Lunaria are distinct. The immature region is confined to a very narrow zone adjoining the basal lamina and is not clearly differentiated. Genotype, *Lichenalia constricta* Hall (1883). Silurian, Devonian.

Laminar to Massive Zoaria, Mostly Thick

The growth habit of bryozoans included in this section of the Cheilotrypidae is typically a rounded to irregularly shaped mass having long zooecial tubes. Some colonies are laterally extended in laminar form but are relatively thick. Generally, the zoaria are free growths having only a wrinkled epitheca at the base, but there are specimens that show an initial incrusting mode of growth. As a whole, the group termed laminar to massive is readily distinguished from others. We recognize two genera as belonging here.

Cyclotrypa Ulrich, 1896 (pl. 1, figs. 5a, b).—This genus is distinguished by long, comparatively straight zooecial tubes having a circular to ovoid cross section, generally weak lunaria, and lacking pseudosepta formed by indentations of the edges of the lunaria. There is no differentiation of the zoarium into immature and mature regions. Genotype, *Fistulipora communis* Ulrich (1890). Silurian to Permian.

Triphyllotrypa Moore and Dudley, new genus (pl. 5, fig.2; pl. 16, fig. 4; pl. 22, fig. 7; pl. 30, fig. 6; pl. 36, fig. 8.)—Zoaria assigned to this genus resemble *Cyclotrypa* but differ in having strong lunaria, the edges of which project into the zooecial tubes, typically forming distinct longitudinal indentations termed pseudosepta. Genotype, *Triphyllotrypa speciosa* Moore and Dudley, n. sp. Permian.

Solid Ramose Zoaria

A considerable number of vesicle-bearing bryozoans belonging to the family Cheilotrypidae have a branching mode of growth. Some are slender twiglike colonies that generally show one or more bifurcations if a sufficient height has been attained in growth. Others are coarse thick branches that in young colonies have external characters of a massive bryozoan. The ramose cheilotrypids are readily distinguished by the nature of their internal structure, which shows a clearly differentiated axial immature region and a peripheral mature region. One group of ramose zoaria is solid,—that is, zooecial tubes and vesicles make up the whole structure,—whereas another group of branching cheilotrypids has a pipelike form, being hollow. The solid branching forms comprise four described genera and one undescribed genus, all Devonian or younger; the group is best developed in Pennsylvanian and Permian rocks.

Fistulocladia Bassler, 1929 (pl. 2, figs. 1a-d).—The zoaria are slender cylindrical branches having an axial zone composed of narrow, tabulated, mesopore-like tubes and the peripheral mature region thickened by stereome that partially conceals the vesicular structure between zooecia. The zooecial tubes have few or no diaphragms. Lunaria are distinct. Genotype, *Fistulocladia typicalis* Bassler (1929). Permian.

Fistulotrypa Bassler, 1929 (pl. 2, figs. 4a, b).—The immature region is prominent, consisting of zooecial tubes in which diaphragms are rare or lacking and only a few elongate vesicles occur. The mature region is thickened by stereome that largely fills interzooecial spaces. Genotype, *Fistulotrypa ramosa* Bassler (1929). Pennsylvanian, Permian.

Fistuliphragma Bassler, 1934 (pl. 2, figs. 2a, b).—This genus resembles *Fistulotrypa* but typically has more vesicular tissue in the immature region and less stereome in the mature region. The zooecial tubes contain hemiphragms near the apertures. Lunaria are weak or absent. Genotype, *Fistulipora spinulifera* Rominger (1866). Devonian, Mississippian.

Cliotrypa Ulrich and Bassler, 1936 (pl. 2, figs. 3a-c).—The zoaria are narrow solid branches having strongly differentiated immature and mature regions, the former containing very few vesicles or diaphragms in the zooecial tubes and the latter showing considerable thickening of interzooecial areas by stereome. Hemiphragms are prominent and there are local inflations of the zooecial tubes that probably represent ovicells. Lunaria are moderately well defined but do not indent the tubes. Genotype, *Cliotrypa ramosa* Ulrich and Bassler (1936). Mississippian.

Hollow Ramose Zoaria

Four genera of the Cheilotrypidae, including *Cheilotrypa*, are distinguished by their ramose mode of growth and presence of an axial cavity, commonly matrix-filled, that is surrounded by a basal lamina from which zooecial tubes and vesicles arise. The central hollow is comparatively large in some zoaria but narrow and tube-like in other forms. It is reasonable to infer that these bryozoans may actually have been incrusting colonies that grew around branching stalks of marine algae. The presence of rare solid branchlets given off by the hollow zoarium and observation of closure at the growing tip of some branches are not inharmonious with this interpretation. Study of many specimens is desirable in order to establish growth characters of this group more definitely. Described genera are distributed from Silurian to Permian.

Cheilotrypa Ulrich, 1884 (pl. 1, figs. 3a-c).—Colonies belonging to this genus are rather slender branches that bear a narrow axial cavity. Immature and mature regions are clearly differentiated, the latter being accented commonly by deposits of stereome that obscure vesicular structure near the surface. Diaphragms are rare or absent and lunaria are weak. Genotype, *Cheilotrypa hispida* Ulrich (1884). Silurian to Mississippian.

Coelocaulis Hall and Simpson, 1887 (pl. 1, figs. 2a-c).—The comparatively large axial cavity of this bryozoan is lined by a cross-wrinkled striated basal lamina from which short tubes and vesicles grow outward. The immature region is so narrow that it is virtually imperceptible. The ovoid apertures are surrounded by a thin peristome but lunaria are not recognized. Genotype, *Callopora venusta* Hall (1874). Silurian, Devonian.

Strotopora Ulrich, 1890 (pl. 3, figs. 2a, b).—The distinguishing feature of this genus, according to descriptions by Ulrich, is the presence of fairly common large abruptly spreading cells that are visible on the surface of the zoaria. These are interpreted as ovicells. Study of thin sections of the genotype species, made available to the senior author through the aid of Dr. R. S. Bassler, shows that internal structural characters of *Strotopora* are not perceptibly different from those of *Cliotrypa*, except all observed specimens of *Strotopora* are flattened and crushed branches. With little doubt, originally they were rounded hollow branches. The zooecial tubes of *Strotopora* have numerous hemiphragms and there are scattered ovicell-like expansions, as in *Cliotrypa*. Immature and mature regions are well differentiated, the latter thickened by stereome. Genotype, *Strotopora foveolata* Ulrich (1890). Devonian, Mississippian.

Dybowskiella Waagen and Wentzel, 1886 (pl. 1, figs. 4a-c).—Colonies assigned to this genus are thick rounded branches that have a central hollow space. The zooecial tubes are comparatively long and straight, growing radially outward toward the surface and separated throughout most of their length by vesicular tissue. Lunaria are prominent, and their edges project so as to give the apertures a somewhat distinct trilobate outline. These indentations of the margins of the lunaria also produce longitudinal ridges (pseudosepta) along the interior of the zooecial tubes. There is no evident immature region adjoining the basal lamina and there is no crowding of diaphragms in the zooecial tubes or thickening of interzooecial areas near the periphery. Except in its hollow zoarium and characters of the zooecia, this genus resembles *Cyclotrypa*. Genotype, *Dybowskiella grandis* Waagen and Wentzel (1886). Permian.

Bifoliate Zoaria

Buskopora Ulrich, 1886 (pl. 1, figs. 1a, b).—This genus, which is chiefly characterized by strongly projecting lunaria, represents a partially established bifoliate mode of growth. Many specimens, including the syntypes of the genotype species, show zooecial tubes growing outward in opposite directions from a median lamella in typical bifoliate manner. This lamella is actually a double sheet, consisting of two layers of epitheca closely juxtaposed or tending to spread apart. Some specimens, or parts of zoaria, consist of a single layer of zooecial tubes and vesicular tissue that bears a wrinkled epitheca at the base. Thus, *Buskopora* seems to mark an intermediate stage between normal unilaminate and well established bifoliate modes of growth. The zooecial tubes of *Buskopora* have few or no diaphragms and an immature region is not well differentiated. Syn. *Glossotrypa* Hall (1886), *Odontotrypa* Hall (1886). Genotype, *Fistulipora lunata* Rominger (1866). Devonian.

Meekopora Ulrich, 1890 (pl. 3, figs. 1a-f).—Zoaria belonging to *Meekopora* are typically ribbonlike growths that bifurcate in the plane of the median lamella; some specimens are broad explanate sheets. The median lamella, or mesotheca, is actually a double layer that reaches to the edges of the bifoliate branches and is visible externally as a low ridge. The zooecial tubes have a short recumbent portion next to the point of origin and then bend abruptly toward the surface. Diaphragms are common. Well developed vesicular tissue occurs between the zooecia but near the surface this structure is obscured in many specimens by deposits of stereome. Apertures are ovoid and lunaria are weak or absent. Maculae are well developed and regularly arranged. Genotype, *Meekopora eximia* Ulrich (1890). Silurian to Permian.

Hexagonella Waagen and Wentzel, 1886 (pl. 3, figs. 4a-c).— This genus is essentially identical to *Meekopora* except in having ridges on the surface of the zoarium that form polygonal areas surrounding maculae. Genotype, *Hexagonella ramosa* Waagen and Wentzel (1886). Permian.

Meekoporella Moore and Dudley, n. gen. (pl. 37, fig. 5; pl. 38, fig. 3; pl. 43, fig. 5; pl. 47, fig. 4; pl. 48, figs. 1-3).—The distinctive feature of this bifoliate bryozoan, which otherwise closely resembles *Meekopora* in structure, is bifurcation of the mesotheca and its accompanying zooecial layers to form divergent planes separated at angles of about 120 degrees. In the genotype species, the sheets of zooecial tubes and vesicles grow in the form of deep chambers having inverted subpyramidal outlines. The genus somewhat resembles *Glyptopora* in the family Sulcoreteporidae. Genotype, *Meekoporella dehiscens* Moore and Dudley, n. sp .Pennsylvanian, Permian.

Tabular Summary of Cheilotrypid Genera

A tabular summary showing the known geologic distribution of cheilotrypid genera follows:

Geologic Distribution of Cheilotrypid Genera

	Ordovician	Silurian	Devonian	Mississippian	Pennsylvanian	Permian
Zoarium incrusting thin						
Eridopora Ulrich	—	×	×	×	×	×
Lichenotrypa Ulrich	—	—	×	—	—	—
Selenopora Hall	—	—	×	—	—	—
Zoarium thin free expansion						
Fistuliporella Simpson	—	×	×	—	—	—
Favicella Hall and Simpson	—	—	×	—	—	—
Zoarium thick laminar to massive						
Cyclotrypa Ulrich	×	×	×	×	×	×
Triphyllotrypa Moore and Dudley	—	—	—	—	—	×
Zoarium solid ramose						
Fistuliphragma Bassler	—	—	×	×	—	—
Cliotrypa Ulrich and Bassler	—	—	—	×	—	—
Fistulotrypa Bassler	—	—	—	—	×	×
Unnamed	—	—	—	—	×	×
Fistulocladia Bassler	—	—	—	—	—	×
Zoarium hollow ramose						
Cheilotrypa Ulrich	×	×	×	×	—	—
Coelocaulis Hall and Simpson	—	×	×	—	—	—
Strotopora Ulrich	—	—	×	×	—	—
Dybowskiella Waagen and Wentzel	—	—	—	—	—	×
Zoarium bifoliate						
Meekopora Ulrich	—	×	×	×	×	×
Buskopora Ulrich	—	—	×	—	—	—
Meekoporella Moore and Dudley	—	—	—	—	×	×
Hexagonella Waagen and Wentzel	—	—	—	—	—	×

A summary of the various genera assigned to the family Cheilotrypidae, arranged in the form of a key that may be useful in identifying these bryozoans, emphasizes characters that have practical value in rapid generic diagnosis.

Zoarium incrusting, thin
- Interapertural areas marked by ridges that define polygonal areas; lunaria strong .... *Selenopora*
- Interapertural areas lacking ridges
  - Lunaria extended into superficial network; acanthopores present, projecting as spines .... *Lichenotrypa*
  - Lunaria strongly overarching above ovoid to subtrigonal apertures; acanthopores absent .... *Eridopora*

Zoarium laminar thin free expansions
- Interapertural areas marked by vesicle-bearing ridges; zooecial tubes pseudoseptate, walls having granular spine-like prolongations; lunaria distinct .... *Fistuliporella*
- Interapertural ridges not vesiculose; zooecial tubes subcircular; lunaria weak or absent .... *Favicella*

Zoarium thick laminar to massive; zooecial tubes long and comparatively straight; no distinct immature zone
- Apertures circular to ovoid, lunaria mostly poorly defined; zooecial tubes not pseudoseptate .... *Cyclotrypa*
- Apertures trilobate, lunaria strong, their edges forming pseudosepta that indent the zooecial walls .... *Triphyllotrypa*

Zoarium solid ramose, divisible into an axial immature region and a peripheral mature region
- Zooecial tubes bear hemiphragms in mature region
  - Local inflations of tubes (?ovicells) present; lunaria distinct .... *Cliotrypa*
  - Tubes lack local inflations; lunaria weak .... *Fistuliphragma*
- Zooecial tubes lack hemiphragms
  - Immature region contains few or no vesicles, very sharply separated from mature region, which is much thickened by stereome .... *Fistulotrypa*
  - Immature region composed of narrow tabulated, mesopore-like tubes; mature region thickened by stereome .... *Fistulocladia*
  - Immature region containing more or less numerous vesicles and grading into mature region, which is defined by thickening of walls, crowding of diaphragms, and deposits of stereome .... Unnamed genus

Zoarium hollow ramose
- Immature region very well defined; axial cavity narrow; mature region thickened by stereome .... *Cheilotrypa*
- Immature region confined to narrow zone, not distinct; axial cavity relatively large
  - Zooecial tubes contain numerous hemiphragms; local inflations (?ovicells) in some tubes .... *Strotopora*
  - Zooecial tubes lack hemiphragms and local inflations
    - Apertures circular to ovoid, lunaria weak or absent; zooecial tubes short .... *Coelocaulis*
    - Apertures trilobate, lunaria strong; zooecial tubes long, pseudoseptate .... *Dybowskiella*

Zoarium bifoliate
- Colonies grow as irregular expansions, bifoliate habit not firmly established, as shown by occurrence of some unilaminate sheets; lunaria strong .... *Buskopora*

Colonies typically ribbonlike, with bifurcations in plane of mesotheca
  Surface marked by ridges that form polygons around maculae .... *Hexagonella*
  Surface not marked by ridges .... *Meekopora*
Colonies growing as bifoliate sheets that join at angles of about 120 degrees .... *Meekoporella*

SYSTEMATIC DESCRIPTIONS

Family CHEILOTRYPIDAE Moore and Dudley, new name

Chilotrypidae SIMPSON, *1897*, New York State Mus., 48th Ann. Rept. Regents (1894), vol. 2, p. 554.

Zoaria of varied form, ranging from thin incrusting or free laminae to massive, solid or hollow ramose, and bifoliate, comprise this family. The zooecial tubes are rounded or ovoid in transverse section except in the immature parts of some genera, in which they may be polygonal. Interspaces between the tubes are occupied by vesicular tissue that may be partly or wholly filled by stereome near the surface. The walls of zooecial tubes and vesicles are minutely porous. Diaphragms and in some genera hemiphragms occur in the zooecial tubes. Lunaria vary from obsolete to very strong, and their edges may indent the zooecial tubes to form pseudosepta. The apertures are separated by distinct interspaces that are smooth, granulose, ridged, or grooved. Most genera bear evenly spaced maculae that generally are slightly depressed but that may be elevated in the form of monticules. Range, Ordovician to Permian.

Discussion.—Considerations bearing on the nomenclature of this group of bryozoans have already been given. Representatives of the family are readily distinguished from most other genera, excepting bifoliate forms that closely resemble various sulcoreteporids, by the distinct interspaces separating the apertures and by occurrence of vesicles between the zooecial tubes.

Genus CYCLOTRYPA Ulrich, 1896

This genus includes small to very large zoaria that are mostly readily classifiable as belonging to the massive type, but some are more or less broad laminar growth forms. The colonies are not normally incrusting in habit. Zooecial tubes are long, relatively straight or gently curved, evenly spaced, and circular to irregularly ovoid in transverse section. Subhorizontal complete diaphragms are common in the zooecial tubes and incomplete diaphragms joined to complete ones may occur, but hemiphragms are not observed. Interspaces are filled with vesicular tissue, which is not filled or thickened by stereome near the surface. The internal structure of the zoarium shows no differentiation into immature and mature regions, such as characterizes many ramose genera. The zooecial tubes commonly intersect the surface nearly at right angles and the circular to ovoid apertures are surrounded by weak or strong peristomes. All degrees in development of lunaria are observed, from unrecognizable to moderately strong, but in no case do the margins of the lunaria project as pseudosepta into the zooecial tubes. Maculae are weak to strong and slightly depressed or elevated.

Genotype, *Cyclotrypa communis* Ulrich, Middle Devonian, Iowa.

Discussion.—As interpreted by us, a majority of the massive and free laminar bryozoans that previously have been referred to *Fistulipora* are assignable to *Cyclotrypa.* Ulrich intended this genus to include only "fistuliporoids" having nearly circular zooecial apertures that lack distinct lunarial structures. There are some species of this type. Some have no perceptible lunaria in parts of the zoarium and distinct, though weak ones, in others. In our judgment, it is neither practicable nor desirable to separate forms that seem to lack lunaria from those in which these structures are definitely recognized. *Cyclotrypa* differs from *Triphyllotrypa* Moore and Dudley, n. gen., in the absence of distinct pseudosepta indenting the zooecial walls. It does not include ramose bryozoans, such as "*Cyclotrypa?*" *barberi* Ulrich (Oread limestone, Pennsylvanian), which are classed by us as belonging to other genera.

Occurrence.—Ordovician to Permian. The oldest known representative of the Cheilotrypidae is a bryozoan from lower Middle Ordovician rocks of the Baltic region in Europe, described by Bassler (1911, p. 109) under the name *Fistulipora primaeva.* This fossil has the characters of *Cyclotrypa* except for the presence of acanthopore-like tubes composed of dark granular material. Inasmuch as structures of this type are not observed in typical *Cyclotrypa,* it is doubtful whether "*F.*" *primaeva* can properly be regarded as a species of *Cyclotrypa.* The Niagaran form published as *Fistulipora lockportensis* Bassler (1906, p. 23) and possibly some other Silurian "fistuliporoids" are referable to *Cyclotrypa.* The genus is common in Devonian, Mississippian, and Pennsylvanian rocks, and some Permian species are described in this paper.

CYCLOTRYPA MATHERI Moore and Dudley, n. sp.

Zoarium, pl. 5, fig. 10; *tangential sections,* pl. 9, fig. 4 (x10), pl. 17, fig. 7 (x20); *longitudinal sections,* pl. 23, fig. 1 (x10), pl. 31, fig. 1 (x20)

Fistulipora sp. MATHER, *1915,* Denison Univ. Bull., Jour. Sci. Labs., vol. 18, p. 110, pl. 4, figs. 1, 2. Morrowan, northwestern Arkansas and northeastern Oklahoma.

Zoaria assigned to this species are small laminar expansions having a flat or irregularly convex upper surface and a base covered by concentrically wrinkled epitheca. Average specimens measure about 8 mm in breadth and 1 to 4 mm in thickness. The surface is pitted by small, deep, circular maculae that are 4 to 5 mm apart. The zooecial apertures are bordered by strong lunaria that become taller and thicker-walled at edges of the maculae.

Tangential sections show the circular outline of zooecial tubes, which are very uniform in size. They are separated by relatively wide interspaces that contain one or two rows of vesicles notably variable in size. Lunarial wall thickenings are distinct but the zooecial cavities are not indented. Longitudinal sections indicate that the zooecial tubes rise obliquely from the basal lamina and curve to meet the upper surface of the zoarium at right angles. The walls are even and fairly straight, not indented by the protruding walls of adjoining vesicles. Diaphragms are regularly spaced although somewhat variable in attitude. Vesicular tissue is mostly fine.

Measurements of the type specimen, in millimeters, are as follows: Diameter of zooecial tubes, 0.23 to 0.27 (mean 0.25); width of interspaces, 0.18 to 0.27 (mean 0.24).

Discussion.—The zoarial form and internal structure of *Cyclotrypa matheri* are not sufficiently close to observed Pennsylvanian species to call for discussion. This new species does resemble *C. rubra* (Girty) from Mississippian rocks of Arkansas in mode of growth and appearance in thin sections, except for the more circular cross section of the zooecial tubes in *C. matheri* and presence of maculae, which are lacking in Girty's species. One specimen, which is illustrated on plate 5, figure 10, differs from the numerous associated forms that are assigned to *C. matheri;* this zoarium is distinguished by its large size and unusual prominence of its strongly depressed maculae. Internal structure is identical with that of *C. matheri,* and, accordingly, the specimen is considered to belong with the others here described.

Occurrence.—Limestone of the Hale formation, Morrowan series, at Greenleaf Lake, southeast of Braggs, Okla. Several dozen specimens, collected by R. C. Moore, were available for study. They vary somewhat in preservation of surface characters but they correspond in general appearance of the zoaria and average small size and most of them show the macular and lunarial characters of the species.

Type.—University of Kansas, no. 738531, a specimen having well preserved surface and internal characters.

Cyclotrypa horridula Moore and Dudley, n. sp.

Tangential sections, pl. 10, fig. 1 (x10), pl. 18, fig. 5 (x20); *longitudinal sections,* pl. 24, fig. 8 (x10), pl. 32, fig. 3 (x20)

This species is based upon a single well preserved specimen from the Atoka formation of southern Oklahoma, which possesses a combination of characters differing from any other massive Pennsylvanian *Cyclotrypa* observed. It is a very irregular mass 38 mm in height and 76 mm in maximum length, bearing knobs, stubby branches, and sharply depressed areas; distinct maculae 7 mm apart occupy the summits of low monticules that are surrounded in unworn areas by strongly arched outward-facing lunaria. The zooecial apertures are closely spaced, separated by interspaces less than their own diameter; they are suboval to circular in outline and lunaria occur both on apertures bordering the maculae and those of the intermacular areas. The zooecial tubes are irregularly oval in transverse section; they are separated by one or, rarely, two large vesicles and they lack lunarial wall flexures. In longitudinal sections the zooecia are uniformly thin-walled, the walls straight on one side and bounded on the other by protruding surfaces of vesicles. Diaphragms are thin, horizontal, regularly spaced at an average of 0.31 mm apart; vesicles are unusually large, and seemingly the same in depth as the zooecial cells formed by successive diaphragms. The zoarium lacks horizontal zonation.

Measurements of the type specimen, in millimeters, are as follows: diameter of zooecial tubes, 0.27 to 0.32 (mean 0.30); width of interspaces, 0.18 to 0.23 (mean 0.205).

Discussion.—In surface characters *Cyclotrypa horridula* resembles *C. nebrascensis* (Condra) from the Stanton limestone of Nebraska, especially in characters of the lunaria and elevated maculae. The two species are similar also in zoarial form and in arrangement of the diaphragms of the zooecial tubes. *C. horridula* differs internally from Condra's species, however, in having much coarser and more uniform vesicular structure. *C. horridula* resembles *C. decora*, n. sp., in macular spacing and in the size and coarseness of zooecia and vesicles, but it has much stronger lunaria and has an irregular massive-branching zoarial form, whereas *C. decora* consists of evenly subconical zoaria. In coarseness of vesicular structure *C. horridula* approaches *C. capacis*, n. sp., from upper Shawnee and Wabaunsee beds, but the former may be distinguished by its much less strongly developed lunaria and its smaller zooecial tubes.

Occurrence.—Atoka formation, SW sec. 2, T. 1 S., R. 8 E., 0.75 mile north of Clarita, Okla. Collected by H. D. Miser, U.S. Geol. Survey.

Type.—University of Kansas, no. 219231.

Cyclotrypa carbonaria (Ulrich)

Zoarium, pl. 5, fig. 3 (x1), pl. 6, fig. 7 (x1); *tangential sections*, pl. 10, fig. 6 (x10), pl. 11, figs. 1-3 (x10), pl. 18, fig. 6 (x20), pl. 19, figs. 6, 7 (x20), pl. 20, fig. 5 (x20); *longitudinal sections*, pl. 24, figs. 5, 6 (x10), pl. 25, fig. 4 (x10), pl. 32, fig. 2 (x20), pl. 33, figs. 5, 6 (x20), pl. 34, fig. 5 (x20)

Fistulipora carbonaria Ulrich, *1884*, Cincinnati Soc. Nat. Hist. Jour., vol. 7, p. 45, pl. 3, figs. 1, 1a.

Not *Fistulipora carbonaria* Ulrich, Condra, *1903*, Nebraska Geol. Survey, vol. 2, pt. 1, p. 32, pl. 1, figs. 6-10.———Girty, *1915*, U.S. Geol. Survey, Bull. 544, p. 44, pl. 26, fig. 5.

Ulrich's original description of *Fistulipora carbonaria*, although reasonably accurate for this species, for many years was interpreted to include every Carboniferous massive "*Fistulipora*" from North America. The type on which Ulrich's observations were based and from which the original figures were made is from the "Upper Coal Measures" at Kansas City, Mo. The horizon of the type specimen is not recorded, but it is almost certainly from the Kansas City group and probably from the Wyandotte limestone. A small fragment of the holotype given to the University of Kansas museum was sectioned and additional illustrations were made from sections of the type, which is deposited in the U.S. National Museum. Among other "fistuliporoids" available to us are numerous well preserved specimens from the Argentine limestone member of the Wyandotte formation, Kansas City group, at the Wyandotte Lake dam, northwest of Kansas City, Kan. Studies of external and internal features of these zoaria indicate them to be identical with Ulrich's original of *F. carbonaria.* The following description of the species is based on Ulrich's type and the Wyandotte dam specimens.

The zoarium is compact, 3 to 30 mm thick, forming nearly flat irregular curved expansions or convex broadly nodose masses. Monticules are poorly developed, rising slightly above the general surface, or absent. Small inconspicuous maculae occur at summits of the low monticules or are depressed; they generally are spaced 7 mm apart, although some specimens are noted on which the maculae vary in spacing from 7 to 9 mm. Zooecial apertures are comparatively large, separated by interspaces of less than their own diameter, rimmed on unworn surfaces by low peristomes that rise on the posterior side of the tubes to form moderately strong lunaria.

The zooecial tubes are large, subcircular to ovate in tangential sections, and they commonly show perceptible lunarial wall flexures and thickenings on one side. In some cross sections deep in the zoarium, large subangular or irregular lobate cavities appear, closely bordered by oval zooecia of normal diameter; these are seen in longitudinal section to be zooecial tubes of unusually large and variable size that in some instances lie immediately adjacent to other smaller zooecia. Most tangential sections reveal zooecia of fairly uniform size separated by a single series of large vesicles. Diaphragms are abundant in longitudinal section; they are horizontal or consistently oblique in some tubes, but inclined in opposite directions or coalescing in others. Vesicles are large and fairly uniform in size; they lack zonation in all of the specimens examined, and protrude into the zooecial tubes on one side so as to form a prominent undulating bounding wall.

One well preserved specimen from the Argentine limestone is a variant of *Cyclotrypa carbonaria.* In internal structure it is identical with typical examples of the species, but externally it differs in the presence of sharp evenly spaced monticules at intervals of 8 mm. A clearly defined macula occupies the summit of each monticule and is surrounded by tall lunaria that become less prominent on the intermacular apertures. This variant differs from the monticulose representatives of *C. capacis,* n. sp., found in lower Shawnee strata, in the much closer spacing of its monticules.

Measurements of the type specimen (A) and of a typical example (B) from the Argentine limestone (Univ. Kansas, no. F246c) are as follows, in millimeters: height of zoarium, A ?, B 12; greatest width of zoarium, A ?, B 55; spacing of maculae, A "irregular," B 7 to 8; diameter of zooecia, A 0.27 to 0.72 (mean 0.395), B 0.32 to 0.36 (mean 0.34); width of interspaces, A 0.045 to 0.18 (mean 0.10), B 0.14 to 0.27 (mean 0.19).

Discussion.—The large rounded zooecial tubes and large vesicles characterize *Cyclotrypa carbonaria* but, as shown in tangential sections, they are very similar to features of *C. decora,* n. sp., *C. repentis,* n. sp., *C. procera,* n. sp., *C. abdita,* n. sp., and some other species. However, the large size of the vesicles serves to distinguish *C. carbonaria* (pl. 18, fig. 6; pl. 19, figs. 6, 7). Longitudinal sections aid especially in identification of Ulrich's species, for they reveal the distinctive irregularities in the diameter of the zooecial tubes, obliquity of the diaphragms in many tubes, and the marked unevenness of anterior walls of the tubes formed by irregular vesicles (pl. 32, fig. 2; pl. 34, fig. 5). Combined with characters of the zoarium and surface markings, these internal features serve satisfactorily to differentiate this species.

Occurrence.—Numerous well preserved specimens identified as belonging to *Cyclotrypa carbonaria* have been collected from the Argentine limestone member of the Wyandotte formation, Kansas City group, near Kansas City. This may be the horizon of the type. Inasmuch as no specimens of *Cyclotrypa carbonaria* have been found by us in collections from the Drum limestone at Kansas City, whereas the species is common in the Argentine limestone, some question is raised as to the true horizon of the type specimen. This doubt is supported by close lithologic resemblance of the type to Argentine specimens. On the other hand, it is difficult to imagine that the Argentine (which was long identified as Iola limestone) could be mistaken as Drum limestone. Other specimens in our collection referred to this species come from the Hertha limestone in Missouri, Drum limestone in southern Kansas and northern Oklahoma (Dewey), Cherryvale shale in Iowa, and Stanton limestone in Nebraska. All of these rocks belong to the Missourian series, upper Pennsylvanian. The occurrence of this species in the vicinity of Manhattan, Kan., as reported by Nickles and Bassler (1900, p. 267) and Condra (1903, p. 33), and various other post-Missourian identifications of *C. carbonaria* by Condra (*idem*) are believed to be erroneous. Likewise very doubtful is the identification of this species by Girty (1915, p. 44) from the Wewoka formation, Desmoinesian, of Oklahoma, inasmuch as internal structural features were not determined.

Type.—U.S. National Museum. no. 43243. A fragment of the type specimen given to the University of Kansas and thin sections from this portion of the zoarium carry the University of Kansas no. 79731.

CYCLOTRYPA NEBRASCENSIS (Condra)

Zoarium, pl. 8, fig. 3 (x1); *tangential sections*, pl. 10, figs. 4, 5 (x10), pl. 11, figs. 6, 7 (x10), pl. 18, fig. 7 (x20), pl. 19, figs. 3-5 (x20); *longitudinal sections*, pl. 24, figs. 2, 3 (x10), pl. 25, figs. 7, 8 (x10), pl. 32, fig. 1 (x20), pl. 33, figs. 1-3 (x20)

Fistulipora carbonaria-nebrascensis CONDRA, *1902*, Am. Geologist, vol. 30, no. 6, pp. 337, 338, pl. 18, figs. 1, 2.———BARBOUR, *1903*, Nebraska Geol. Survey, vol. 1, p. 127.———CONDRA, *1903*, Nebraska Geol. Survey, vol. 2, pt. 1, p. 33, pl. 2, figs. 1, 2.———(?) GIRTY, *1915*, U.S. Geol. Survey, Bull. 544, p. 45, pl. 26, figs. 6, 7.

The large massive zoarium of this species is formed of loosely superposed thick crusts, extremely irregular to subhemispherical in shape, with knobs and minor surface protuberances; it ranges from 8 to 16 cm in breadth, and 5 to 8 cm in height. Monticules are low, irregular, unequally developed over the zoarium, and spaced 5 to 7 mm apart. Maculae are visible but not conspicuous; they are small and are marked chiefly by the prominent outward-facing lunaria of zooecia that surround them. The apertures are circular, moderately small, variable in spacing, and separated by interspaces less than their own diameter. Peristomes are thick and conspicuous. Lunaria are strongly developed, thick-walled; they are low and overarching in intermacular areas, but become more prominent near the maculae.

In tangential sections, the zooecia are subcircular, fairly thick-walled, and separated by one series of angular vesicles, which are distinctly variable in size. Longitudinal sections reveal the consecutive growth laminae of the zoarium; these are commonly separated by thin layers of rock matrix and are distinguished by the fact that zooecia can not be traced through them and into the succeeding laminae. Horizontal diaphragms are widely spaced in the majority of tubes. Vesicles vary widely in structure; some resemble the mesopores of *Trepostomata* containing closely spaced diaphragms; others are fairly large and typically vesicular.

Discussion.—This bryozoan was described by Condra (1902, p. 337) on the basis of massive zoaria that differs from *Cyclotrypa carbonaria. C. nebrascensis* is characterized by apertures that are smaller than those of Ulrich's species, by more strongly developed lunaria, and by a more loosely constructed zoarium; internally it is similar to *C. carbonaria* in the presence of vesicles that protrude irregularly into the zooecial tubes, but the vesicles of *C. nebrascensis* are generally smaller.

Measurements of a metatype are as follows, in millimeters: size of zoarium, 120 to 160 in breadth, 60 in height; spacing of monticules, 6 to 7; diameter of zooecia, 0.27 to 0.32 (mean 0.29); width of interspaces, 0.14 to 0.23 (mean 0.18).

Occurrence.—Metatype and five other specimens, well preserved externally, from the Bonner Springs shale, upper Kansas City group, Ash Grove Cement Company quarry, NW sec. 15, T. 12 N., R. 11 E., near Louisville, Neb. Collected by G. E. Condra; shale above basal Stanton limestone, Kiewitz quarry, west of Meadow, Neb. Three small specimens from the Winterset limestone of Nebraska and Missouri are indistinguishable from the metatype in lunarial development and internal characters and are identified as belonging to the species. Girty (1915, p. 45) has identified a bryozoan from the Wewoka formation, of Desmoinesian age, in Oklahoma as belonging to this species but no thin sections were made or illustrated. We have not been able to study specimens from this horizon but think that Girty's identification is not established. Range Winterset to Stanton, Missourian series.

Type.—The type specimen, deposited in the Morrill Natural History Museum, University of Nebraska, cannot be located. A metatype, collected by G. E. Condra and used in this study, is in the collections of the Nebraska Geol. Survey. Part of this specimen and thin sections are University of Kansas no. 311031.

CYCLOTRYPA ACERBA Moore and Dudley, n. sp.

Zoarium, pl. 7, fig. 1 (x1); *tangential sections*, pl. 11, fig. 5 (x10), pl. 19, fig. 1 (x20); *longitudinal sections*, pl. 25, fig. 3 (x10), pl. 33, fig. 7 (x20)

This species is described from a single remarkably preserved large zoarium from the Ladore shale, lower Missourian, of Nebraska. The specimen is very massive, about twice as long as it is wide, with irregular knobby projections extending as much as 40 mm from the main zoarial mass (pl. 7, figs. 1a-c).

Monticules are small but prominent; they are regular in distribution and bear at their summits conspicuous maculae surrounded by apertures slightly larger than average. Apertures of intermacular areas are circular and small, separated by interspaces equal to or less than their own diameter. Lunaria are tall and overarching, concealing half of the zooecial apertures on the intermacular areas; they become even higher and more thick-walled at the borders of the maculae.

Tangential sections reveal subcircular zooecial tubes that have slight lunarial wall flexures, which become better defined near the maculae; in intermacular areas the zooecia are separated by one series of fairly large angular vesicles.

Zooecial walls are moderately thin, extremely regular in contour in some parts of the zoarium, but less so in others. A few growth laminae are distinguished in large polished longitudinal sections by the fact that the zooecial tubes do not pass through them. Other horizontal zones are formed by denser calcite and more closely packed vesicles than normal; the zooecial tubes pass through these unchanged in contour. Diaphragms are horizontal or consistently sloping; they are evenly and comparatively widely spaced. Between the narrow zones of tightly packed vesicles, which are 5 to 12 mm apart, the vesicles are large and regular.

Measurements of the type specimen are as follows, in millimeters: zoarium width, 150, length, 240; spacing of monticules, 5.6 to 6; diameter of zooecia, 0.23 to 0.29 (mean 0.245); width of interspaces, 0.19 to 0.28 (mean 0.20).

Discussion.—A massive irregular zoarium, strong lunaria, and small zooecial apertures are features common to both *Cyclotrypa acerba* and *C. nebrascensis* (Condra). *C. acerba* may be differentiated on the basis of its clear-cut regularly spaced maculae and more compact growth. Internally the two species are indistinguishable.

Occurrence.—Ladore shale, Bronson group, Missourian series; Dyson Hollow, west of LaPlatte, Neb.

Type.—Nebraska Geol. Survey collection (Univ. Kansas, no. 549931).

CYCLOTRYPA PROCERA Moore and Dudley, n. sp.

Tangential sections, pl. 11, fig. 8 (x10), pl. 19, fig. 2 (x20); *longitudinal sections*, pl. 25, fig. 2 (x10), pl. 33, fig. 4 (x20)

Zoaria belonging to this species consist of low irregular expansions 5 to 15 mm thick; one fragment has two nodes 6 and 10 mm high. The surface is marked by low gently rounded but distinct monticules, 7 to 8 mm apart, that bear conspicuous maculae at their apices. Zooecial apertures are large, but they are partly covered by unusually tall lunaria that increase in thickness and prominence around the maculae. In tangential sections zooecial tubes are seen to be thick-walled and suboval in intermacular areas and they are separated by one series of fairly large vesicles. The zooecial tubes are irregular in contour in longitudinal section, bounded on one or on both sides by the surface of the large vesicles between them. Diaphragms are abundant in the tubes; they are horizontal, fairly evenly spaced, and less than the diameter of zooecial tubes apart.

Measurements of the type specimen are as follows, in millimeters: diameter of zooecia, 0.32 to 0.36 (mean 0.35); width of interspaces, 0.14 to 0.27 (mean 0.20).

Discussion.—The strong lunaria of *Cyclotrypa procera* suggest *C. nebrascensis* (Condra), but study of thin sections indicates that *C. procera* has distinctly larger zooecial tubes and more widely spaced maculae.

Occurrence.—Hertha limestone, Bronson group, Missourian series; railroad cut southeast of Princeton, Mo.

Type.—University of Kansas, no. 701131.

CYCLOTRYPA TENUICULA Moore and Dudley, n. sp.

Tangential sections, pl. 11, fig. 4 (x10), pl. 19, fig. 8 (x20); *longitudinal sections,* pl. 25, fig. 1 (x10), pl. 33, fig. 8 (x20)

This species is similar to some small specimens of *Cyclotrypa nebrascensis* (Condra) in zoarial form and size of monticules but differs so markedly in characters of the maculae, size of zooecia, and spacing of diaphragms that it seems best to separate it as a distinct species.

The zoarium is discoid, low and irregular, formed by superposed laminae; the base is unevenly concave. The extremely uneven surface is marked by broad unequal upswellings and barely perceptible monticules spaced about 6 mm apart and bearing clearly defined maculae. Zooecial apertures are circular, large, strikingly close set, and separated by interspaces one half to three fourths their own diameter. Thin peristomes with granulose edges are distinct in intermacular areas. Lunaria are well developed in the intermacular areas and they become taller near the maculae, which are large and conspicuous in tangential section. Each macula shows an elongate cell representing a zooecial tube nearly parallel to the plane of the tangential section, surrounded by zooecia of greater than average size. These large zooecial tubes have strong lunarial wall flexures. The zooecia of intermacular areas are subcircular to circular in transverse section and they are very closely spaced, being separated by a single series of relatively small angular vesicles.

Longitudinal sections show that the zooecia have horizontal closely spaced diaphragms, some of which bend downward and join subjacent diaphragms. Interzooecial vesicles are shallow and evenly distributed; horizontal zones of more closely packed vesicular structure are not observed. The vesicles of the macular areas are also shallow and wide, which makes it difficult to distinguish them from zooecial tubes in some areas.

Measurements of the type specimen, in millimeters, are as follows: size of zoarium, height 12, diameter 28 by 32; distance between monticules, 6; diameter of zooecia, 0.32 to 0.36 (mean 0.35); width of interspaces, 0.11 to 0.27 (mean 0.205); distance between diaphragms, 0.09 to 0.18 (mean 0.14).

Discussion.—In general zoarial form, size, and spacing of monticules, *Cyclotrypa tenuicula* is similar to specimens from the Winterset referred to

C. nebrascensis (Condra). It differs from that species in having more conspicuous maculae as revealed in tangential section, larger zooecial tubes, and more closely spaced diaphragms.

Occurrence.—Dewey limestone, Kansas City group, Missourian series; 3 miles east of Dewey, Okla.

Type.—University of Kansas, no. 216531.

CYCLOTRYPA REPENTIS Moore and Dudley, n. sp.

Zoarium, pl. 6, fig. 8 (x1); *tangential sections,* pl. 10, fig. 2 (x10), pl. 18, fig. 8 (x20); *longitudinal sections,* pl. 24, fig. 4 (x10), pl. 32, fig. 8 (x20)

Zoaria belonging to this species are small irregularly subhemispherical growths about 10 mm high and 25 mm in diameter. Unlike most hemispherical bryozoan colonies, however, the convex surface does not bear the subcircular apertures of zooecial tubes, but is marked radially by tubes lying nearly parallel to this surface and belonging to the basal part of the zoarium. The concave surface bears the apertures of the zooecial tubes. Thus, the zoarium is a centrally much thickened saucer.

The surface shows the subcircular apertures of the zooecial tubes, less than their own diameter apart, bordered by very low lunarial elevations. Maculae and monticules are absent. In tangential section the zooecial tubes are thin-walled, slightly inflected by lunaria and separated by a single row of large vesicles. The tubes are fairly straight-walled on the posterior side, but on the opposite side they are bounded by the undulating front of protruding vesicles. Diaphragms are predominantly horizontal, less than a tube diameter apart, but their regular arrangement is interrupted at several places by oblique diaphragms. Vesicles are large, tumid, and uniform in size.

Measurements of the type specimen, in millimeters, are as follows: Diameter of zooecia, 0.36 to 0.46 (mean 0.40); width of interspaces, 0.14 to 0.27 (mean 0.19).

Discussion.—This species differs in zoarial habit from all other known massive Pennsylvanian Cheilotrypidae. It is similar to *Cyclotrypa carbonaria* (Ulrich), *C. zonata* (Girty), *C. capacis,* n. sp., and some other species in the development of large vesicles that form an irregular bounding wall of the zooecial tubes. *C. repentis* is distinguished from these species chiefly by its zoarial form and the absence of maculae.

Occurrence.—Lower Plattsburg limestone, Lansing group, Missourian series; 2½ miles west of Neodesha, Kan. Collected by R. C. Moore.

Type.—University of Kansas, no. 461031.

CYCLOTRYPA DECORA Moore and Dudley, n. sp.

Zoarium, pl. 5, fig. 8 (x1); *tangential sections,* pl. 10, fig. 7 (x10), pl. 18, fig. 1 (x20); *longitudinal sections,* pl. 24, figs. 1, 7 (x10), pl. 32, fig. 4 (x20)

Small symmetrical zoaria of rounded subconical to subhemispherical form, and elliptical to circular in basal outline, belong to this new species. The upper surface slopes gradually to the thin flat periphery and the underside is concave. Monticules are absent, and maculae are visible only on the sides and periphery of the zoarium where the surface is best preserved. They are depressed or on faint swellings, evenly distributed, clearly marked by large smooth areas surrounded by large zooecial apertures and strong lunaria. The apertures are circular, fairly small, increasing in diameter toward the maculae, and separated by interspaces of slightly less than their own diameter. Peristomes are thin and lunaria are moderately well developed in the intermacular areas, becoming prominent near the maculae.

Zooecial tubes are subcircular in tangential section and fairly thin-walled; they increase in size toward the maculae, and these show distinct lunarial wall flexures; the tubes are separated by a single series of large angular vesicles. In longitudinal sections the internal structure is striking because of its coarseness and regularity. The zooecial tubes are even in contour, straight-walled, and they contain horizontal regularly spaced diaphragms. The vesicles, which occur in one series between the zooecia, are generally uniform; a few inconspicuous horizontal zones of more closely packed vesicles are visible.

Measurements of the type specimen, in millimeters, are as follows. Size of zoarium, height 15, greatest width 77; distance between maculae, 5 to 7, diameter of zooecia, 0.33 to 0.60 (mean 0.40); width of interspaces, 0.07 to 0.53 (mean 0.16); distance between diaphragms, 0.10 to 0.51 (mean 0.16).

Discussion.—The low regularly conical form and thin periphery of the zoarium of *Cyclotrypa decora* characterize this species. These features, combined with absence of distinct monticules, distinguish it externally from all American massive Carboniferous Cyclotrypas except *C. candida*, n. sp., which differs from the species here described in possessing more conspicuous lunaria in the intermacular areas, smaller zooecia, and smaller and more numerous vesicles between the zooecial tubes.

Occurrence.—This species is based upon five specimens, one of which is incomplete. The surface features of all are moderately well preserved but weathering has removed the lunaria from the highest central portion of each zoarium. Stanton formation, Lansing group, Nebraska; and Iatan limestone, Pedee group, Nebraska. The type and another specimen were collected from the Stoner limestone member, Stanton limestone, Lansing group, Missourian series, near Rock Lake, southeast of Ashland, Neb. One specimen is from shale above the basal bed of the Stanton in Kiewitz quarry, west of Meadow, Neb., and another from the same horizon at the Murphy quarry at Louisville, Neb. One specimen is from the Iatan limestone, in sec. 1, T. 1O N., R. 12 E., Nebraska.

Type.—Nebraska Geol. Survey collection. (Univ. Kansas, no. 685231).

Cyclotrypa zonata (Girty)

Zoarium, pl. 6, fig. 6 (x1); *tangential sections*, pl. 9, figs. 1-3 (x10), pl. 17, figs. 1, 5, 6 (x20); *longitudinal sections*, pl. 23, figs. 2-5 (x10), pl. 31, figs. 2, 3, 5, 8 (x20)

Fistulipora zonata Girty, *1915*, Missouri Bur. Geology Mines, vol. 13, ser. 2, p. 322, pl. 29, figs. 1, 2.

Zoaria belonging to this species are nodular to irregularly hemispherical in form, 10 to 45 mm in diameter and 15 to 55 mm in height. Most specimens referred to *Cyclotrypa zonata* in our study consist of moderately small nodular masses, 18 to 25 mm in height. The colonies are compact, built up by laminae that form an evenly convex zoarium or, in some cases, one marked by successive overlapping caps. An epitheca covers the concave base that is deeply grooved radially in large hemispherical specimens and it encircles the sides of nodules forming the lower 1 to 2 mm of each successive growth lamina. The surface lacks distinct monticules or maculae; some low irregular swellings are visible on a few specimens and tangential sections of several specimens reveal poorly defined macular areas 6 and 7 mm apart but they are never a conspicuous or constant feature. The zooecial apertures are subcircular, and well preserved specimens show them to be surrounded by thin peristomes. Low lunaria that do not arch over or project into the zooecial cavity are observed.

Tangential sections show circular zooecia separated by one or, less commonly, two fairly large vesicles. Longitudinal sections indicate that the zooecial tubes are straight-walled, not indented by protruding vesicles, and crossed by irregularly spaced horizontal, oblique and unevenly curving diaphragms. The vesicular structure is distinctly zonate in most specimens, the zonation being formed by alternate thin bands of tightly packed flat vesicles and wider bands of more loosely aggregated convex vesicles.

Measurements of a syntype (A) from the Oread limestone, a specimen (B) from the Deer Creek limestone 2 miles north of Oskaloosa, Kan. (Univ. Kansas, no. F147), and a specimen (C) from the Winterset limestone at Gallatin, Mo. (Univ. Kansas, no. 5535) are as follows, in millimeters: Height of zoarium, A (?), B 27, C 10; diameter of zoarium, A (?), B 17, C 12; diameter of zooecia, A, 0.27 to 0.32 (mean 0.30), B, 0.27 to 0.36 (mean 0.31), C, 0.32 to 0.36 (mean 0.34); width of interspaces, A, 0.27 to 0.36 (mean 0.30), B, 0.23 to 0.36 (mean 0.29), C, 0.27 to 0.36 (mean 0.30).

Discussion.—This species is one of the most prolific representatives of *Cyclotrypa* in Pennsylvanian rocks of the midcontinent region. It ranges from the Bronson group, early Missourian, to the Wabaunsee group, late Virgilian, and may be gathered literally by the bushel from limestones of the Shawnee group, such as the Oread and Deer Creek. Owing to its nodular or subhemispherical zoarial form, it was included with *Fistulipora carbonaria* by earlier authors, and Girty (1915, p. 322), in segregating these forms as a distinct species, notes that they were probably included by Condra (1903) in the latter's identification of *F. carbonaria*. Study of thin sections furnishes convincing evidence of the validity of *C. zonata* as a well characterized species.

Girty's choice of a name for the species and his discussion stresses the presence of vesicular zonation. Our studies of very numerous polished sections and thin sections of Pennsylvanian and Permian specimens of massive Cheilotrypidae, however, convince us that this character is not in itself of specific significance. The nature of zoarial growth by the superposition of laminae accounts for the difference in texture of successive vesicles. Zonation similar to that of *Cyclotrypa zonata* occurs in otherwise widely dissimilar species and is exceedingly variable in intensity within the same species. *C. zonata* cannot be recognized on the basis of its zoarial form alone, although the small nodular examples of the species that are so abundant in the Oread, Deer Creek, and Howard rocks are externally duplicated only by a few West Texas Permian species. Zoaria of *C. zonata* attain smoothly subhemispherical or irregularly laminar shapes approximating those of *C. capacis,* n. sp., and *C. carbonaria* (Ulrich). The lack of either distinct maculae or strong lunaria, the straight-walled zooecial tubes, and the size of zooecia and vesicles separate *C. zonata* from other American Carboniferous species of *Cyclotrypa.*

Occurrence.—The type of this species (Missouri Geol. Survey, no. 2893) comes from the Plattsmouth limestone member of the Oread limestone, Shawnee group, in the Leavenworth quadrangle, about 1 mile northwest of Leavenworth, Kan. (NW cor. sec. 27, T. 8 S., R. 22 E.), collected by G. H. Girty. The species is also listed by Girty from the Stanton limestone, Lansing group, and from the Lecompton limestone, Deer Creek limestone, and Calhoun shale, of the Shawnee group. Specimens from the Winterset limestone, Bronson group, and from the Howard limestone, Wabaunsee group, besides abundant material from the formations listed by Girty, have been identified by us as belonging to *Cyclotrypa zonata.*

Type.—U. S. Geol. Survey collection.

Cyclotrypa capacis Moore and Dudley, n. sp.

Tangential sections, pl. 12, figs. 1-3 (x10), pl. 14, fig. 3 (x10), pl. 21, figs. 3-6 (x20); *longitudinal sections,* pl. 26, figs. 2-6 (x10), pl. 22, fig. 2 (x20), pl. 35, figs. 1, 3, 6, 8 (x20)

The zoarium of this species is variable in size and form, specimens ranging from low spreading irregularly convex growths to large thick masses 190 mm high by 350 mm in greatest width. The base is unevenly concave, and commonly it reveals the overlapping laminae that form the zoarium. The surface is characterized by broad, widely spaced monticules that vary in prominence from slightly rounded swellings to strong subconical tubercles. The type specimen, like most others, has low monticules that are somewhat variable in distribution, the space between them ranging from 7 to 10 mm. Two specimens from the Oread limestone assigned to this species display prominent monticules that are regularly spaced at intervals of 9 to 10 mm. Maculae at the center of monticules are made distinct by the tall markedly overarching lunaria of zooecial apertures surrounding them. Exceptionally well preserved surfaces show the presence of lunaria in intermacular areas as well as adjoining the maculae. On the type specimen, the lunaria overarch so strongly that they cover a large portion of the zooecial aperture near the maculae. Peristomes are low and inconspicuous.

In tangential sections maculae are striking, being surrounded by oblique thick-walled zooecia; between the maculae the generally large zooecia are subovate to subcircular in outline, the majority having lunarial flexures, and being separated by one series of large vesicles. Longitudinal sections demonstrate the exceedingly variable nature of the zoaria of this species. Fairly small zooecial tubes, 0.32 mm in diameter, give way in a short distance vertically to others as much as 0.45 mm in diameter; zones of moderately close-packed flat vesicles are succeeded by extremely large and irregular deep vesicles. Zooecial tubes are widely variable in the nature of diaphragms; in some tubes diaphragms are uniformly horizontal and evenly spaced at distances of about 0.36 mm; in others they are oblique or convex upwards and extremely irregular in arrangement. The walls of zooecia are bounded on the anterior side by the unevenly convex walls of adjacent vesicles.

Measurements of the type specimen, in millimeters, are as follows: size of zoarium, 19 cm in height, 35 cm in maximum length; spacing of monticules, 7 to 10 mm apart; diameter of zooecia, 0.32 to 0.36 (mean 0.35); width of interspaces, 0.14 to 0.23 (mean 0.19).

Discussion.—The species here described embraces forms that vary notably in size, shape, and surface characters, but the assemblage seems, nevertheless, to belong together. On the basis of size of zooecial tubes and character of vesicles they are indistinguishable; the spacing of their maculae varies within similar limits, and in development of lunaria they are similar. This variation in size of vesicles, projection of vesicles into zooecial tubes, and character of maculae is shown by the specimens figured on plates 12, 14, and 26. *Cyclotrypa capacis* resembles *C. candida* in the size and spacing of the zooecial tubes, but it has much fewer and coarser vesicles and structure of the macular areas is quite dissimilar. Comparison of *C. capacis* and *C. abdita* are given under discussion of the latter species.

Occurrence.—Type specimen from the Calhoun shale, Shawnee group, Sheldon quarry, Nehawka, Neb. Other specimens identified as *Cyclotrypa capacis* have been obtained from the Oread, Lecompton, Calhoun, and Topeka formations, Shawnee group, and from the Reading limestone, Wabaunsee group, Kansas and Nebraska.

Type.—University of Kansas, no. 798031.

Cyclotrypa abdita Moore and Dudley, n. sp.

Tangential sections, pl. 12, fig. 4 (x10), pl. 21, fig. 1 (x20); *longitudinal sections,* pl. 26, fig. 1 (x10), pl. 35, fig. 2 (x20)

The zoarium of this species is a large, massive, irregularly subhemispherical form, the type measuring 85 mm in maximum height and 200 mm in greatest width; the base is slightly concave and covered by epitheca. The surface bears maculae, spaced 7 to 8 mm apart, but these are not very conspicuous. Tangential sections show that in intermacular areas the zooecia are subcircular and have indistinct lunarial flexures; the tubes are separated by a single series of large vesicles. Near the maculae, the zooecial tubes are somewhat oblique, but not strongly so, and they have distinct lunarial flexures and thickened walls.

Measurements of the type specimen, in millimeters, are as follows: diameter of zooecial tubes, 0.32 to 0.36 (mean 0.35); width of interspaces, 0.18 to 0.32 (mean 0.25).

Discussion.—The chief distinguishing feature of *Cyclotrypa abdita* as compared with *C. capacis*, n. sp., which it most resembles, is the greater regularity of the vesicular structure; this is best shown in longitudinal sections. The vesicles of *C. abdita* are very uniform and large, and they project into the zooecial tubes so as to form an undulating wall; the vesicles of *C. capacis* are irregular and most of them are larger than in the species here described. The zooecial tubes of *C. abdita* contain abundant horizontal or oblique diaphragms that are more closely spaced in the majority of tubes than in *C. capacis.*

Occurrence.—Clay Creek limestone member, Kanwaka shale, Shawnee group, Virgilian, from outcrop about 2 miles west of Lecompton, Kan.

Type.—University of Kansas, no. 798331.

CYCLOTRYPA ABNORMIS Moore and Dudley, n. sp.

Tangential sections, pl. 13, fig. 3 (x10), pl. 17, fig. 8 (x20); *longitudinal sections*, pl. 27, fig. 8 (x10), pl. 31, fig. 6 (x20)

The zoarium belonging to this species is massive, large, and subhemispherical. The surface is uneven. A cross section of the zoarium reveals that the mode of growth is entirely different from that which is suggested by the exterior; it does not show tubes and vesicles growing evenly in a single direction or regularly superposed laminae above the seeming flat base of the colony. The zooecia grow outward in two directions from a median zone. Although the surface of the type, which is the only specimen now referred to this species, is not well preserved, low monticules are distinguishable at somewhat irregular intervals. The zooecial apertures are circular, small, and separated by intervals less than their own diameter; peristomes and lunaria are not observed.

Tangential sections permit identification of maculae composed of numerous vesicles, but they are not conspicuous inasmuch as the zooecial tubes adjoining them are not appreciably larger than average and they do not bear clearly defined lunaria. The zooecia are circular, fairly thick-walled, and they have only very slight lunarial wall flexures; commonly they are separated by a single series of small angular vesicles. In longitudinal section, the zooecial tubes are straight, thick-walled, and intersected by unevenly spaced diaphragms that are highly irregular in attitude. The vesicles are generally small and they tend to be arranged in distinct bands of varying width that differ in compactness of structure.

Measurements of the type specimen, in millimeters, are as follows: thickness of zoarium, 176; length of zoarium, 175; spacing of maculae, 6 to 8; diameter of zooecia, mean 0.27; width of interspaces, 0.27 to 0.36 (mean 0.31).

Discussion.—The zoarial form of *Cyclotrypa abnormis* is not unlike that of some other massive Carboniferous "fistuliporoids," but it differs in the internal disposition of zooecia which are inclined in two directions from a middle zone. This feature may lack importance as a specific character. *C. abnormis* most closely resembles *C. capacis*, n. sp., in general features of internal structure but is distinguished in possessing smaller more widely spaced zooecial tubes and smaller vesicles.

Occurrence.—Lecompton limestone, Shawnee group, Virgilian, NW sec. 25, T. 14 S., R. 17 E., Douglas County, Kansas.

Type.—University of Kansas, no. 502631.

CYCLOTRYPA IMULA Moore and Dudley, n. sp.

Zoarium, pl. 5, fig. 5 (x1); *tangential sections,* pl. 13, fig. 1 (x10), pl. 17, fig. 4 (x20); *longitudinal sections,* pl. 27, fig. 1 (x10), pl. 34, fig. 2 (x20)

The zoarium of this species is small and convex, composed of superposed laminae, and the nearly flat base is covered by epitheca. The surface has very small, closely spaced upswellings about 5 mm apart and these bear conspicuous smooth or depressed maculae at their centers. The zooecial apertures are small and subcircular; they do not increase in size noticeably toward the maculae, and they are separated by interspaces of slightly less than their own diameter. Peristomes and lunaria are low and thick, the latter increasing in height near maculae but not attaining a pronounced height or overarching strongly.

Transverse sections show subcircular zooecial tubes that have distinct lunarial wall flexures; they are separated by one and two moderately large angular vesicles. The zooecial tubes are straight-walled and have numerous horizontal or slightly inclined diaphragms. The vesicles are fairly large, uniform in size, and they lack vertical zonation.

Measurements of the type specimen, in millimeters, are as follows: height of zoarium, 6; width of zoarium, 20; distance between maculae, 5; diameter of zooecia, 0.27 to 0.32 (mean 0.29); width of interspaces, 0.14 to 0.27 (mean 0.22).

Discussion.—The principal difference between this species and other species of *Cyclotrypa* from the American Carboniferous is the close spacing of its maculae. *C. imula* possesses moderately large vesicles that do not protrude into the zooecial cavity as do those of *C. carbonaria* (Ulrich).

Occurrence.—Deer Creek limestone, Shawnee group, Virgilian series; 3 miles east of Moline, Kan.

Type—University of Kansas, no. 798431.

CYCLOTRYPA CANDIDA Moore and Dudley, n. sp.

Zoarium, pl. 5, fig. 9 (x1); *tangential sections,* pl. 9, figs. 5, 6 (x10), pl. 17, figs. 2,3 (x20); *longitudinal sections,* pl. 27, figs. 5, 6 (x10), pl. 31, figs. 4, 7 (x20)

The zoaria assigned to this species are massive, compact, subhemispherical growths, ranging from low subconical forms with a thin periphery to even dome shapes; the base is concave. The size of the zoarium is variable, as illustrated by a group of the best preserved examples from one locality that contains forms ranging from 12 to 90 mm in height and 25 to 115 mm in diameter. The surface bears monticules of variable height, which range from slight upswellings to prominent but low protuberances; none of the monticules are sharply conical. They are evenly distributed and where most strongly developed, as in the holotype, they form curved intersecting rows. Conspicuous maculae are located at apices of the monticules, forming slight depressions at the center of the low upswellings; they consist of smooth areas surrounded by zooecia that are spaced more widely apart than in other parts of the zoarium and that carry unusually tall outward facing lunaria. The zooecial apertures are circular, small, and somewhat widely spaced, being separated by interspaces greater than their own diameter. Lunaria are tall in intermacular areas, but they become still taller, more thick-walled and strongly overarching around maculae. Peristomes, which are low and thin, are rendered inconspicuous by the towering lunaria.

Maculae are sharply defined in tangential sections, which show them to be large and uniformly spaced. Zooecial tubes are nearly circular and thin-walled; they have well defined lunarial wall flexures that increase in size near the maculae. One or two series of small angular vesicles commonly separate the zooecial tubes but in some areas three or more rows of vesicles may occur between the tubes. Longitudinal sections show that the vesicles are arranged in alternating zones having coarse and fine structure, respectively; the closely packed vesicles form zones 0.5 to 2 mm thick, whereas the larger more coarsely arranged vesicles occur in thicker zones. Diaphragms are horizontal and evenly spaced in some zooecial tubes but highly irregular in attitude and spacing in others; their distribution is unaffected by vesicular zonation.

Measurements of the type specimen, in millimeters, are as follows: height of zoarium, 20; approximate diameter of zoarium, 70 by 75; spacing of monticules, 7; diameter of zooecia, 0.25 to 0.38 (mean 0.33); width of interspaces, 0.13 to 0.47 (mean 0.26).

Discussion.—This species is a very common Virgilian bryozoan but can not have been included by authors in Ulrich's *Fistulipora carbonaria* because it differs markedly from that form in its smaller zooecia and vesicles, stronger lunaria, and distinctive characters of the zoarium.

The more regular form of the zoarium of *Cyclotrypa candida* and the wider spacing of maculae on its surface differentiate this species from *C. nebrascensis* (Condra), but these two species are similar in size of zooecial tubes and strength of lunaria. Marked zonation of vesicular tissue is a character that is not restricted to *C. candida*, for it is very commonly developed in *C. zonata* (Girty) and *C. bennetti* (Link). The new species here described differs from *C. zonata* in having more or less strongly developed monticules, prominent maculae, and tall lunaria. Zooecial tubes and vesicles of the two forms are similar. *C. candida* differs from *C. bennetti* in having a smaller, more compact zoarium, smaller zooecia, more closely spaced maculae, and more strongly developed lunaria. In longitudinal sections of *C. bennetti*, the lower extremity of many of the zooecia is characterized by a sharp right-angled turn from the prostrate to the erect position; this feature has not been observed in *C. candida*.

Occurrence.—This species is common in the Coal Creek limestone member of the Topeka limestone, upper part of the Shawnee group, Virgilian, in Nebraska and Kansas.

Type.—University of Kansas, no. 485131, from the Coal Creek limestone, south of the Poor Farm, northeast of Topeka, Kan.

Cyclotrypa disiuncta Moore and Dudley, n. sp.

Tangential sections, pl. 13, fig. 2 (x10), pl. 20, fig. 3 (x20); *longitudinal sections,* pl. 27, fig. 7 (x10), pl. 34, fig. 8 (x20)

Under this name we range specimens from the Wabaunsee group that correspond very closely to *Cyclotrypa candida,* n. sp., in zoarial form, in the size and spacing of the zooecia, and in characters of the lunaria and vesicles. They differ in having slightly more widely spaced maculae, measuring 8 mm apart, whereas those of *C. candida* are 7 mm apart. This is seemingly a minor distinction, but inasmuch as it is observed to be constant and the zoaria having more widely spaced maculae are from strata 100 to 450 feet stratigraphically above the horizon of *C. candida,* they are given a separate status.

Occurrence.—Wakarusa limestone, 2½ miles northwest of Elk Creek, Neb.; Tarkio limestone, near C. B. & Q. bridge at Nebraska City, Neb.; Brownville limestone, 4 miles west of Strohm, Okla.; all belonging to the Wabaunsee group, Virgilian series, uppermost Pennsylvanian.

Type.—University of Kansas, no. 798731, from the Wakarusa limestone northwest of Elk Creek, Neb.

Cyclotrypa bennetti (Link)

Zoarium, pl. 8, fig. 1 (x1); *tangential sections,* pl. 13, figs. 4, 5 (x10), pl. 20, fig. 4 (x20); *longitudinal sections,* pl. 27, figs, 2, 3 (x10), pl. 34, fig. 7 (x20)

Fistulipora bennetti Link, *1928,* Jour. Paleontology, vol. 2, pp. 268-271, pl. 35.
Fistulipora vaccula Moore, *1929,* Jour. Paleontology, vol. 3, p. 6, pl. 1, figs. 5, 7, 10, 11.

This species, which is common in the Wayland shale of Texas, has a large and massive zoarial form that consists of irregular flattened colonies 50 to 300 mm in breadth and 20 to 100 mm in thickness. Vesicular zonation, which was emphasized by Link in his original description, is common, but neither this zonation nor the sharp right-angle turn exhibited at the lower extremity of many zooecial tubes among Link's specimens can be considered of specific importance. Both characters exist in widely different species found in rocks from Missourian to Leonardian in age.

The surface of the zoarium is gently uneven. Low but distinct monticules occur at fairly regularly spaced intervals, 8 to 9 mm apart; they bear smooth, flat, or slightly depressed maculae about 2 mm in diameter. Zooecial apertures are nearly circular in outline; they are surrounded by a thin peristome. Lunaria are weak. Transverse sections show the relatively large size of the zooecial tubes, their thin walls that may have slight lunarial flexures, and their nearly circular form. The zooecial tubes are separated by one or two rows of vesicles and in intermacular areas the interspaces range from about one fourth the diameter of the tubes to slightly more than their diameter. In longitudinal section, the zooecia are seen to have very regular straight-walled tubes that are not indented by vesicles. Straight diaphragms intersect the tubes horizontally or obliquely, at intervals of 0.2 to 1.0 mm.

Measurements of types, in millimeters, based on Link's description, are as follows: diameter of zoarium, 95 by 122; spacing of maculae, 8 to 15; diameter of zooecia, 0.32 to 0.46 (at edges of maculae). Measurements of typical specimens in the University of Kansas collection, in millimeters, are as follows: width of zoarium, 150; thickness of zoarium, 75; spacing of maculae, 8 to 9; diameter of zooecia, 0.36 to 0.45 (mean 0.41); width of interspaces, 0.13 to 0.50 (mean 0.21).

About 50 specimens were available for study, of which a dozen have been examined internally on the basis of thin sections and polished surfaces.

Discussion.—Widely spaced monticules, large zooecial tubes, poorly developed lunaria, large vesicles, and the form of the zoarium distinguish *Cyclotrypa bennetti* from other species of the Pennsylvanian and Permian rocks of the United States.

Occurrence.—Gunsight limestone ("Campophyllum bed"), Graham group, Pennsylvanian, Eastland County, Texas; Wayland shale, Graham group, 5 miles west of Eastland, Tex.; Graham group, 3 miles northeast of Lohn, Tex.; Jacksboro formation, Graham group, 10½ miles southeast of Graham, Tex.

Types.—Walker Museum, University of Chicago, nos. 34917 to 34919, from the "Campophyllum bed", Eastland County, Texas.

CYCLOTRYPA PELAGIA Moore and Dudley, n. sp.

Zoarium, pl. 6, fig. 3 (x1); *tangential sections*, pl. 10, fig. 3 (x10); pl. 14, figs. 1, 2 (x10), pl. 18, figs. 2-4 (x20), pl. 22, fig. 1 (x20); *longitudinal sections*, pl. 28, figs. 1-3 (x10), pl. 32, figs. 5-7 (x20).

Description of this species is based on several zoaria that stand apart from the other known species by reason of a combination of characters. The zoarium is small and discoid, formed by superposed laminae commonly built upon a brachiopod. Monticules are low but distinct, uniform in spacing, fairly distant, and they bear large smooth maculae at the centers. The zooecial apertures are large, separated by interspaces less than their own diameters, provided with strong peristomes and moderately strong lunaria that increase slightly in height toward the maculae.

Transverse sections show the subcircular form of the zooecial tubes and the very slight lunarial wall flexures; the tubes are fairly thin-walled and are separated by a single series of large angular vesicles. In longitudinal section zooecial tubes are seen to be straight in contour, bearing diaphragms that are horizontal or irregularly bent and uneven in spacing. In some tubes a diaphragm bends down to join the adjacent one and forms an isolated vesicle in the tube. Interzooecial vesicles, which are fairly large, lack vertical zonation.

Measurements of the type specimen, in millimeters, are as follows: width of zoarium, 22 by 26; height of zoarium, 10; distance between monticules, 8; diameter of zooecia, 0.27 to 0.36 (mean 0.31); width of interspaces, 0.14 to 0.27 (mean 0.20).

Discussion.—This species has a zoarial form and lunaria like those of *Cyclotrypa carbonaria* (Ulrich). It may be distinguished from that species by the smaller size of its zooecial tubes and its smaller vesicles. *C. pelagia* differs from *C. tenuicula*, n. sp., in possessing more widely spaced maculae and more distant diaphragms.

Occurrence.—Six specimens that are well preserved internally but poorly preserved externally were studied. These come from various horizons in the Magdalena limestone, 75 to 600 feet below the base of the Abo sandstone, near Jemez Springs, N. M.

Type.—University of New Mexico, no. J-14, collected by Professor Northrop from the Magdalena limestone 175 to 275 feet below the base of the Abo sandstone, in first small gully below Battleship Rock, above Jemez Springs, N. M.

CYCLOTRYPA IDONEA Moore and Dudley, n. sp.

Zoarium, pl. 6, fig. 1 (x1); *tangential sections*, pl. 13, fig. 6 (x10), pl. 20, fig. 8 (x20); *longitudinal sections*, pl. 27, fig. 4 (x10), pl. 34, fig. 6 (x20).

The zoarium belonging to this species is a compact, evenly hemispherical form, 9 to 37 mm high and 20 to 60 mm in diameter; the base, which is concave, reveals the thick superposed laminae forming the colony; an epitheca is absent. The surface is evenly convex; the best preserved surfaces show very gently rounded low but distinct monticules, 9 to 11 mm apart, that bear maculae at their centers. Apertures of the zooecia are circular, widely spaced both in intermacular areas and at the edges of maculae; they are separated by interspaces equal to or greater than their own diameters. Lunaria, which are visible only in a few less worn areas, are low, not appreciably inflecting the zooecial wall, but they are slightly higher on the flanks of monticules.

In tangential section the zooecia are small, suboval tubes that increase in diameter near the maculae; they lack lunarial wall thickenings. Vesicles are irregular in size but none of them are extremely large; they occur in one to three rows between the zooecial tubes. In longitudinal section, the zooecial tubes appear remarkably regular in contour, straight-walled, and provided with abundant horizontal or oblique diaphragms that are spaced irregularly. The vesicles lack vertical zonation.

Measurements of the type specimen, in millimeters, are as follows: width of zoarium, 49 by 55; height of zoarium, 37; distance between maculae, 9 to 11; diameter of zooecia, 0.27 to 0.32 (mean 0.30); width of interspaces, 0.32 to 0.36 (mean 0.31).

Discussion.—The less robust, more regular form of zoarium, more widely spaced maculae, smaller zooecia and vesicles distinguish *Cyclotrypa idonea* from *C. bennetti* (Link) of the Graham group in Texas. *C. idonea* resembles *C. disiuncta*, n. sp., from Wabaunsee strata of the northern midcontinent, but differs in possessing more widely spaced maculae and zooecial tubes, larger zooecia, and more uniform vesicular structure.

Occurrence.—Thrifty formation, Cisco group (Virgilian), 3 miles north of Thrifty, Brown County, Texas; six specimens collected by Prof. W. F. Cummins.

Type.—University of Texas, no. 12257-1.

CYCLOTRYPA SIMPLICIS Moore and Dudley, n. sp.

Zoarium, pl. 6, fig. 2 (x1); *tangential sections*, pl. 14, fig. 5 (x10), pl. 21, fig. 8 (x20); *longitudinal sections*, pl. 28, fig. 6 (x10), pl. 35, fig. 7 (x20).

The zoarium representing this species is an elongate-subhemispherical mass having a slightly concave base that reveals successive growth laminae but no visible epitheca. The type specimen has a height of 36 mm and a greatest diameter of 72 mm. The surface bears distinct maculae of irregular shape, 8 to 9 mm apart. Zooecial apertures are circular, and they bear low inconspicuous lunaria that do not make appreciable indentations; the apertures are separated by interspaces less than their own diameter.

Transverse sections show the circular zooecial tubes and fairly large vesicles arranged in one or two rows between the zooecia; lunarial wall flexures are apparent in areas immediately adjacent to maculae but not in zooecia of intermacular areas. As seen in longitudinal section, the zooecial tubes are even in contour, straight-walled, and transected by horizontal or consistently oblique diaphragms that are more or less than a tube diameter apart. Vesicles occur in one to three rows, in slight horizontal zonation, fairly large and uniform in size.

Measurements of the type specimen, in millimeters, are as follows: diameter of zooecia, 0.27 to 0.32 (mean 0.31); width of interspaces, 0.14 to 0.27 (mean 0.21).

Discussion.—This species differs sharply from associated massive bryozoans from Permian rocks of West Texas that have much more pronounced lunaria and coarser vesicular structure. These forms having strongly marked lunaria are here referred to *Triphyllotrypa*. *Cyclotrypa perlaevis*, n. sp., which also occurs in Wolfcampian strata, has relatively coarse vesicles like *C. simplicis*, but it possesses stronger lunaria, as shown especially by the lunarial thickening in tangential sections, and it has larger more widely spaced zooecial apertures. *C. simplicis* is most similar internally to *C. galerita*, n. sp., from the Hughes Creek shale, Lower Permian, of Nebraska. The strongly arching lunaria of the latter species, reflected in tangential section by the much thickened walls, the greater variation in diameter of zooecia between intermacular and macular areas, and the slightly smaller vesicles of *C. galerita*, distinguish this form from *C. simplicis*.

Occurrence.—Gaptank formation, Pennsylvanian, 2 miles south of Gaptank, Pecos County, Texas; collected by F. B. Plummer. Lower Wolfcampian beds, Glass Mountains, western Texas; collected by Charles Schuchert.

Type.—University of Texas, Bureau of Economic Geology, no. 3101, Plummer collection, from Gaptank formation.

CYCLOTRYPA TOROSA Moore and Dudley, n. sp.

Tangential sections, pl. 14, fig. 4 (x10), pl. 21, fig. 7 (x20); *longitudinal sections*, pl. 28, fig. 4 (x10), pl. 35, fig. 4 (x20).

Description of this species is based on a large distinctive zoarium from the *Uddenites* zone, upper Cisco, of western Texas. It is a compressed hemispherical mass 75 mm high having a worn surface that lacks external macular and lunarial characters. Cross sections reveal large zooecial tubes whose walls are irregularly crenulate but lacking in discernible lunarial flexures. Maculae have not been identified either in polished or thin sections. Vesicles are irregular in size, the majority being large and forming a single series between the zooecia. The walls of zooecial tubes are irregular in contour as seen in longitudinal section; they are formed on one or both sides by the projecting surfaces of vesicles. Diaphragms are thin and irregular in disposition and spacing. Vesicles are large and irregular and they lack vertical zonation.

Measurements of the type specimen, in millimeters, are as follows: diameter of zooecia, 0.36 to 0.45 (mean 0.40); width of interspaces, 0.14 to 0.23 (mean 0.19).

Discussion.—This species most closely resembles *Cyclotrypa capacis,* n. sp., from Upper Pennsylvanian strata of the northern midcontinent. Similarity is observed especially in the large irregular vesicles that indent the zooecial tubes and the large size of the zooecia, but *C. torosa* has zooecia of more irregular outline. The structure of zooecia and vesicles is distinctly coarser than in *C. perlaevis,* n. sp., and *C. simplicis,* n. sp.

Occurrence.—*Uddenites* zone, upper Cisco series, Pennsylvanian (bed 1b, section 24 of R. E. and P. B. King at Wolfcamp), Lat. 30° 21′ N., Long. 103° 08′ W., 12 miles N. 35° E. from Marathon, Glass Mountains, western Texas.

Type.—Yale University, Peabody Museum, no. 88-30, collected by R. E. and P. B. King.

CYCLOTRYPA PERLAEVIS Moore and Dudley, n. sp.

Tangential sections, pl. 15, fig. 4 (x10), pl. 22, fig. 4 (x20); *longitudinal sections,* pl. 29, fig. 6 (x10), pl. 36, fig. 2 (x20)

The type of this new species is an excellently preserved specimen from Wolfcampian strata of the Glass Mountains in western Texas. The zoarium is a fairly large nodular mass 54 mm in height and approximately 35 mm in diameter, built up of loosely superposed laminae. The surface bears somewhat inconspicuous maculae, 6 to 7 mm apart. The zooecia are separated by interspaces equal to their own diameter; their apertures are nearly circular, surrounded by peristomes, and the posterior wall thickened by lunaria that do not indent tubes by inward projections of the ends of the lunaria.

Tangential sections show clearly the thickened character of the walls on the posterior side and the absence of lunarial indentations. Diaphragms are horizontal, the width of a zooecial tube or more apart. The vesicles are comparatively large, occurring in two and more rows between the zooecia; they do not show distinct zonation.

Measurements of the type specimen, in millimeters, are as follows: diameter of zooecia, 0.32 to 0.36 (mean 0.35); width of interspaces, 0.23 to 0.32 (mean 0.28).

Discussion.—This species is most closely similar to *Cyclotrypa beata,* n. sp., from Lower Permian rocks of the northern midcontinent region. The West Texas species is distinguished by the form of the zoarium, the slightly closer spacing of the maculae, and the less conspicuous lunarial thickening of the zooecial walls. *C. perlaevis* has distinctly finer vesicles than *C. galerita*, n. sp.

Occurrence.—Wolfcampian series, bed 4 of section 24, measured by R. E. King and P. B. King at Wolfcamp, Lat. 30° 21′ N., Long. 103° 08′ W., 12 miles N.35°E. from Marathon, Glass Mountains, Texas.

Type.—Yale University, Peabody Mus., no. 89-30; collected by R. E. and P. B. King.

Cyclotrypa beata Moore and Dudley, n. sp.

Zoarium, pl. 5, fig. 6 (x1); *tangential sections*, pl. 15, figs. 2, 3 (x10), pl. 20, figs. 1, 2 (x20); *longitudinal sections*, pl. 29, figs. 1, 2 (x10), pl. 34, fig. 4 (x20), pl. 36, fig. 5 (x20)

The zoarium of this species has a low, subhemispherical form that is built up by superposed laminae; specimens range from 20 to 30 mm in height and 34 to 85 mm in diameter. The concave base of the zoarium is covered by a concentrically wrinkled epitheca. The surface lacks nodes or projections but monticules consisting of extremely low upswellings, 7 to 8 mm apart, are present. Conspicuous depressed maculae occur at apices of the monticules in some areas but they are distributed without relation to the monticules in other areas. Apertures of the zooecia are circular, large, and separated by interspaces less than their own diameter. Lunaria are prominent on all apertures; they are highest and most strongly overarching at borders of the maculae.

In tangential section the zooecial tubes are circular, but they show marked lunarial wall thickenings; the zooecia enlarge in diameter near the maculae. Vesicles are angular, markedly small in size, and they are arranged in one or two series between zooecia. Longitudinal sections show widely and irregularly spaced diaphragms in the zooecial tubes; they are horizontal in some tubes, oblique, bowed, or coalescing in others. Vesicles are small and tumid; they do not show zonation.

Measurements of the type specimen, in millimeters, are as follows: diameter of zooecia, 0.32 to 0.36 (mean 0.36); width of interspaces, 0.18 to 0.27 (mean 0.25).

Discussion.—The combination of large zooecia, strongly developed lunaria, and small tumid vesicles devoid of zonation characterize *Cyclotrypa beata*, and render it distinct from other forms. The conspicuous maculae and relatively prominent lunaria of this species resemble those of *C. candida*, n. sp. but *C. beata* has larger zooecia and smaller vesicles.

Occurrence.—Lower Permian; Hughes Creek shale, 2 miles west of Zeandale, Kan., 0.5 mile northeast of Humboldt, Neb., and northwest of Glenrock, Neb.; Foraker limestone near Cushing, Okla., and 5 miles west of Fairfax, Okla.; Red Eagle limestone west of Reece, Kan.

Type.—University of Kansas, no. 798631, from the Hughes Creek shale northeast of Humboldt, Neb.; collected by G. E. Condra.

Cyclotrypa galerita Moore and Dudley, n. sp.

Zoarium, pl. 5, fig. 11 (x1); *tangential sections*, pl. 15, fig. 1 (x10), pl. 20, fig. 6 (x20); *longitudinal sections*, pl. 29, fig. 5 (x10), pl. 34, fig. 3 (x20)

This species has a massive, subhemispherical zoarium from 20 to 40 mm in height and 35 to 60 mm in diameter, with a slightly concave base covered by a concentrically wrinkled epitheca; the type is laterally compressed, but excellently preserved on its surface. The surface is marked by very low upswellings, at the center of which are conspicuous depressed maculae, 7 to 8 mm apart. The zooecial apertures are moderate in size, circular, and separated by interspaces of less than their own diameter. Lunaria are prominent, tall and arching on all apertures, and becoming more thick-walled at the borders of the maculae. Peristomes, which are seen on all apertures, are thin and rendered inconspicuous by the tall lunaria.

Transverse sections show the circular outline of the zooecia in intermacular areas and their markedly increasing size toward the maculae; the zooecial tubes become more elliptical in cross section near the maculae, owing to the marked lunarial flexures in these regions. Vesicles are fairly large and angular, one series of vesicles occurring between the zooecia. Longitudinal sections reveal straight zooecial tubes having thin horizontal evenly spaced diaphragms. Vesicles appear uniform in size, without zonation.

Measurements of the type specimen, in millimeters, are as follows: diameter of zooecia, 0.27 to 0.32 (mean 0.31); width of interspaces, 0.18 to 0.27 (mean 0.23).

Discussion.—The form that seems most closely to resemble *Cyclotrypa galerita* is *C. candida*, n. sp. The species here described may be differentiated in thin sections from *C. candida* by its larger and more closely spaced zooecial tubes and by the absence of marked vesicular zonation. Superficially, these two species are similar because of their conspicuous maculae and lunaria, but the monticules of *C. galerita* are less marked than those of *C. candida*.

Occurrence.—Specimens assigned to this species have been collected from the Hughes Creek shale member of the Foraker limestone, 1 mile southeast of Bennett, Neb., and from the Fort Riley limestone member of the Barneston formation, near Helmick, Morris County, Kan.; Lower Permian.

Type.—University of Kansas, no. 54-31, from the Hughes Creek shale southeast of Bennett, Neb.

Cyclotrypa hirta Moore and Dudley, n. sp.

Tangential sections, pl. 14, fig. 6 (x10), pl. 21, fig. 2 (x20); *longitudinal sections*, pl. 28, fig. 5 (x10), pl. 35, fig. 5 (x20)

The zoarium belonging to this species is irregularly massive, nodose, and low hemispherical or lamellar and somewhat ramose. The type specimen is a rounded form about 35 by 44 mm that bears knobby projections 4 to 9 mm high. The surface is covered by distinct subcircular maculae 6 and 7 mm apart. Zooecial apertures are irregular in shape, unusually small and somewhat crowded in intermacular areas. They become larger and obscurely trilobate at edges of the maculae.

Transverse sections show conspicuous maculae, which are characterized especially by the oblique attitude and much larger size of the surrounding zooecial tubes. The zooecia are separated by one to four rows of fine vesicles. In longitudinal section the vesicles are seen to be irregular in size and to protrude unevenly along the edges of the zooecial tubes on one or both sides, giving the tubes an uneven ragged appearance. Oblique or horizontal diaphragms are spaced irregularly in the zooecial tubes.

Measurements of the type specimen, in millimeters, are as follows: diameter of zooecia, 0.19 to 0.23 (mean 0.20); width of interspaces, 0.14 to 0.27 (mean 0.19).

Discussion.—Identification of *Cyclotrypa hirta* may be made on surface characters, inasmuch as this species is distinguished from other known forms by its very small, irregular crowded zooecial apertures having poorly developed lunaria. This feature, together with a marked difference in shape of the zooecial tubes in transverse section and the type of inwardly protruding vesicles, seen in longitudinal sections, separates *C. hirta* from *Triphyllotrypa speciosa*, n. sp., and the other generally similar forms.

Occurrence.—Leonardian series (upper 400 feet), Middle Permian, at Clay Slide, 2 miles west of Iron Mountain, Lat. 30° 18′ N., Long. 103° 18′ 30″ W., 7.5 miles N. 30° W. from Marathon, Glass Mountains, western Texas. Also, Word formation, Guadalupian series, Middle Permian, Glass Mountains; and Clyde formation, Leonardian series, north-central Texas.

Type.—University of Kansas, no. 741431.

CYCLOTRYPA DEBILIS Moore and Dudley, n. sp.

Tangential section, pl. 16, fig. 7 (x10); *longitudinal section*, pl. 30, fig. 7 (x10)

Lamellose to nodular zoaria, 5 to 15 mm in thickness and diameter, bearing low irregular knobs and broad upswellings, are included in *Cyclotrypa debilis*, n. sp. Maculae are small but distinct, flat or slightly elevated, and evenly spaced at intervals of 6 mm over the entire upper surface and sides of the zoarium. Apertures of the zooecia are subcircular, surrounded by low peristomes and bordered by slight lunaria that become somewhat more prominent at the edges of maculae. The zooecia are separated by interspaces of less than their own diameter in intermacular areas but they are more widely spaced near the maculae.

Transverse sections show that the zooecial tubes are relatively thick-walled, nearly circular, and separated by one to four rows of fine vesicles. Longitudinal sections indicate that diaphragms are fairly abundant in the tubes; they are horizontal but irregular in spacing. Vesicles are extremely fine, uniform in size, and in many places there are three to four rows of vesicles between zooecial tubes.

Measurements of the type specimen, in millimeters, are as follows: height of zoarium, 12; diameter of zooecia, 0.27 to 0.32 (mean 0.28); width of interspaces, 0.14 to 0.27 (mean 0.20).

Discussion.—This species superficially resembles *Cyclotrypa perlaevis*, n. sp., in that it bears nearly circular zooecia separated by one to four rows of fine vesicles. *C. debilis* differs very evidently from *C. perlaevis*, however, in the much greater distinctness of its maculae, its smaller zooecial tubes, and its much finer vesicular tissue. In size of zooecia and vesicles, *C. debilis* resembles *Triphyllotrypa speciosa*, n. sp., and *T. definita*, n. sp., but differs from these in the absence of strongly developed, inwardly projecting lunaria.

Occurrence.—Word formation, Guadalupian series, Middle Permian, Hess Canyon, Lat. 30° 24′ N., Long. 103° 10′ W., about 1.5 miles west of Word ranch, 14 miles NNE from Marathon, Glass Mountains, western Texas.

Type.—University of Kansas, no. 53431, collected by R. C. Moore.

Genus TRIPHYLLOTRYPA Moore and Dudley, n. gen.

Zoaria having massive or thick laminate growth forms and characterized by distinct pseudosepta that indent the zooecial tubes are included in the genus *Triphyllotrypa*. A wrinkled epitheca covers the base of the colony. There is no perceptible immature zone, the long straight or gently curved zooecial tubes are evenly spaced and are separated by abundant vesicular tissue. The tubes are bilobate or trilobate in transverse section. They bear more or less closely spaced diaphragms and longitudinal sections of the zoaria may show intercepts of the pseudosepta that appear as lines within the tubes parallel to the outer walls. In addition to complete diaphragms, there may be incomplete ones that branch from the others. New zooecial tubes that appear at various heights within the zoarium grow laterally from the parent tube for a short distance and then turn abruptly upward. There are no surficial deposits of stereome in the interspaces between the tubes. The apertures commonly bear well defined peristomes and strong lunaria. Maculae of varying prominence occur at regularly spaced intervals.

Genotype.—*Triphyllotrypa speciosa*, n. sp., Leonardian series, Lower Permian, Glass Mountains, western Texas.

Discussion.—Species belonging to this new genus are separated without difficulty from *Cyclotrypa* because of a distinctive appearance of the zooecial tubes of *Triphyllotrypa* in transverse and longitudinal sections, owing to the presence of pseudosepta. *Dybowskiella* Waagen and Wentzel corresponds to *Triphyllotrypa* in characters of the zooecial tubes, but differs in the form of its zoaria, which are hollow branches.

Occurrence.—Permian, Texas and Kansas.

TRIPHYLLOTRYPA SPECIOSA Moore and Dudley, n. sp.

Zoarium, pl. 5, fig. 2 (x1); *tangential sections*, pl. 16, fig. 4 (x10), pl. 22, fig. 7 (x20); *longitudinal sections*, pl. 30, fig. 6 (x10), pl. 36, fig. 8 (x20)

The zoarium of this species is small; it is composed of loosely superposed layers that form flattened hemispherical to elongate nodular masses, 10 to 34 mm in greatest diameter. An epitheca is present at the base and it is clearly visible at the edges of successive laminae. Maculae are present but inconspicuous; they are distributed 4.5 to 6 mm apart and are surrounded by zooecia of slightly larger than average diameter. Monticules are absent. The zooecial apertures are small, distinctly trilobate, and evenly spaced; in intermacular areas they are separated by less than their own diameter, but near the edges of maculae they are more widely spaced. Lunaria are well developed but not overarching; their extremities form ridges that project sharply into the zooecial cavities for a distance of as much as one third the diameter of the zooecia.

Transverse sections show clearly the strongly trilobed outline of the zooecial tubes and the deep indentations of extremities of the lunaria; some tubes (pl. 16, fig. 4) are notably wider along the axis that does not intersect the lunarium than at right angles to this line. Two to four rows of fine vesicles separate adjacent zooecia. Maculae are identifiable in the sections but are not prominent, as in some other species. Longitudinal sections reveal a noticeably irregular orientation of the zooecial tubes; a majority of the tubes are parallel, following the same general direction, but a number of zooecia arise at right angles to these and appear in the section as semicircular orifices. These are present not only at the base of the colony, where it is natural that direction of growth is variable, but in the central and upper regions. The extended edges of lunaria are represented in several places by intercepts running parallel to the zooecial walls and, where a zooecium departs from the plane of the section, extending down into the zooecial cavities as prongs. Diaphragms are widely and irregularly spaced; they are horizontal or oblique in attitude. Two and three series of fine fairly uniform vesicles devoid of vertical zonation separate the zooecia. The vesicles do not form an irregular wall projecting into the zooecial cavity, but are bounded by smooth walls.

Measurements of the type specimen, in millimeters, are as follows: height of zoarium, 22; greatest diameter of zoarium, at base, 14; diameter of zooecia, 0.27 to 0.45 (mean 0.33); width of interspaces, 0.18 to 0.32 (mean 0.25).

Discussion.—This species is characterized by the small nodular form of the zoarium, the fine structure of the vesicles, the shape of zooecia in transverse section, and the inconspicuous maculae. Superficially, *Triphyllotrypa speciosa* resembles *T. guadalupensis* (Girty), but it differs from that form in the much more strongly trilobate outline of the zooecial aperture and in its somewhat finer vesicles. Girty's species is reported from the Capitan and Delaware Mountain (Guadalupian) strata, whereas *T. speciosa* occurs characteristically in Leonardian beds, although some specimens from the Word and Delaware Mountain formations are referred to it by us.

Occurrence.—Lower, middle, and upper Leonardian series, and Word formation, Guadalupian series, Glass Mountains, western Texas; Delaware Mountain formation, Guadalupian series, Delaware Basin, western Texas.

Type.—University of Kansas, no. 741433, Leonardian series (about 400 feet from top), at Clay Slide, 2 miles west of Iron Mountain, Lat. 30° 18′ N., Long. 103° 18′ 30″ W., 7.5 miles N. 30° W. from Marathon, Glass Mountains, Texas; collected by R. C. Moore.

TRIPHYLLOTRYPA PASSA Moore and Dudley, n. sp.

Zoarium, pl. 5, fig. 1 (x1); *tangential sections*, pl. 15, fig. 5 (x10), pl. 20, fig. 7 (x20); *longitudinal sections*, pl. 29, fig. 3 (x10), pl. 34, fig. 1 (x20)

Description of this species is based on several fragmentary zoaria from Lower Permian rocks of Kansas. The type specimen is a flat, nearly straight-sided, straplike expansion, 75 mm long, 30 mm in greatest width, and 4 mm thick; it bears one short lateral expansion that is 8 mm in length. The basal surface, which is irregularly concave, is covered by a longitudinally wrinkled epitheca. The upper surface is gently convex and bears small elevations of variable diameter rising 1 or 2 mm above the general surface; these monticules are 4 to 6 mm apart. The centers of some of the elevations are occupied by maculae surrounded by zooecia of greater than average diameter that have low heavy-walled outward-facing lunaria. Other maculae that are depressed below the surface occur between the slight protuberances. Zooecia are small, very closely spaced, surrounded by thick low peristomes, and, in unworn areas, bordered by fairly tall lunaria.

Maculae are extremely conspicuous in transverse sections. They are surrounded by relatively large zooecia having unusually prominent thick lunaria. The zooecial tubes of intermacular areas are subcircular to elliptical in outline but they have lunarial wall flexures that project into each zooecial cavity in the form of two small cusps. The zooecia are separated by one or two series of tiny vesicles. In longitudinal section, the zooecial tubes are seen to lie recumbent on the basal lamina for a distance of nearly ½ mm from their point of origin and then to curve upwards. The tubes contain horizontal or irregularly bowed diaphragms that are extremely irregular in spacing. Vesicles are minute, uniform in size, and they lack zonation.

Discussion.—This species differs from all other observed representatives of *Triphyllotrypa* in its zoarial form, its small knoblike monticules, and especially in its exceedingly fine vesicles.

Occurrence.—Florena shale member, Beattie limestone, Council Grove group, Wolfcampian series, Lower Permian, Brown County, Kansas.

Type.—University of Kansas, no. 40431.

TRIPHYLLOTRYPA PATENTIS Moore and Dudley, n. sp.

Zoarium, pl. 5, fig. 4 (x1); *tangential sections*, pl. 16, fig. 6 (x10), pl. 22, fig. 5 (x20); *longitudinal sections*, pl. 30, fig. 5 (x10), pl. 36, fig. 4 (x20)

Zoaria belonging to this species range from 20 to 30 mm in height and superficially resemble *Triphyllotrypa speciosa*, n. sp., in the character of zooecial apertures and maculae. Tangential sections reveal a similar degree of lunarial development and strong indentation of the zooecial tubes. Longitudinal sections, however, show a distinctly coarser vesicular structure than in *T. speciosa*. The zoarial form, structure of the vesicles, and size of the zooecial tubes in *T. patentis* resemble these features in *T. guadalupensis*

(Girty), but the species here described has much more strongly indenting lunaria and the shape of the zooecial tubes in transverse sections of the two species is seen to be quite dissimilar.

Measurements of the type specimen, in millimeters, are as follows: height of zoarium, 29; diameter of zooecia, 0.36 to 0.45 (mean 0.40); width of interspaces, 0.14 to 0.27 (mean 0.20).

Occurrence.—Leonardian (upper part) and Guadalupian series (Word and Delaware Mountain formations), Middle Permian, Glass Mountains and Delaware Basin, western Texas.

Type.—University of Kansas, no. 741423, from the upper 400 feet of the Leonardian series at Clay Slide, 2 miles west of Iron Mountain, Lat. 30° 18′ N., Long. 103° 18′ 30″ W., 7.5 miles N. 30° W. from Marathon, Glass Mountains, Texas; collected by R. C. Moore.

TRIPHYLLOTRYPA DEFINITA Moore and Dudley, n. sp.

Tangential section, pl. 16, fig. 2 (x10); *longitudinal section,* pl. 30, fig. 8 (x10)

The zoarium of this species forms a nodular mass composed of loosely superposed layers, as in *Triphyllotrypa speciosa,* n. sp., and *T. patentis,* n. sp. The type specimen is 26 mm high and about 30 mm in maximum diameter. The surface is marked by distinct maculae, 5 to 6½ mm apart, which are surrounded by zooecia of greater diameter than average that have especially strong lunaria. The zooecial apertures are small and consistent in shape and size; they are strongly trilobate in cross section, owing to prominent indentations of the uniformly compact lunaria.

Transverse sections show that the zooecial tubes of intermacular areas are unusually close-spaced, many tubes being almost in contact with their neighbors. Commonly only a single row of small vesicles occurs between the tubes. Longitudinal sections indicate the straight-walled nature of the zooecial tubes, comparatively wide spacing of the diaphragms, and fine texture of the vesicular tissue.

Measurements of the type specimen, in millimeters, are as follows: diameter of zooecia, 0.27 to 0.36 (mean 0.32); width of interspaces, 0 to 0.27 (mean 0.18).

Discussion.—This species closely resembles *Triphyllotrypa spissa,* n. sp., especially as represented by longitudinal sections, but *T. definita* is distinguished from this and other observed species by the shape and close spacing of the zooecial tubes.

Occurrence.—Leonardian series, Glass Mountains (R. E. and P. B. King, section 17, bed 14), Lat. 30° 20′ 30″ N., Long., 103° 14′ 40″ W., 9.5 miles north of Marathon, Tex.

Type.—Yale University, Peabody Museum, no. 123-35; collected by R. E. and P. B. King.

TRIPHYLLOTRYPA PROIECTA Moore and Dudley, n. sp.

Tangential sections, pl. 16, fig. 5 (x10), pl. 22, fig. 6 (x20); *longitudinal sections,* pl. 30, fig. 1 (x10), pl. 36, fig. 6 (x20)

The form of the zoarium in *Triphyllotrypa proiecta*, n. sp., is lamellose; the thickness ranges from 3 to 7 mm in the four specimens referred to this species. The surface is marked by well defined subcircular maculae, 6 to 7 mm apart. The zooecial apertures are small, separated by interspaces equal to or greater than their own diameter; indentations of the extremities of the lunaria give them a strikingly trilobate outline. The zooecia do not increase in size appreciably in the vicinity of the maculae.

Tangential sections best reveal the conspicuous projections of the lunaria into the cavity of the zooecial tubes. The shape and size of the tubes is constant in macular and intermacular zooecia. One or two rows of relatively coarse vesicles occur between the zooecia. Lunaria are prominent in longitudinal section; intercepts of their projecting ends appear as lines running vertically inside the zooecial tubes. Diaphragms are extremely irregular in attitude; they are horizontal or inclined, and some of them seem crinkled. Vesicles of uniform size form one or two series between zooecia.

Measurements of the type specimen, in millimeters, are as follows: diameter of zooecia, 0.27 to 0.36 (mean 0.33); width of interspaces, 0.14 to 0.27 (mean 0.19).

Discussion.—This species may be distinguished from other known forms of *Triphyllotrypa* by its unusually strong inward-projecting lunaria. It is most like *T. speciosa*, n. sp., but has even stronger lunaria and it is characterized by slightly coarser vesicular tissue. The form of the zoarium, spacing of maculae, and the shape and size of the zooecial tubes serve also to differentiate *T. proiecta.*

Occurrence.—Leonardian series (top of bed 12, section 14, by R. E. and P. B. King), Lat 30° 17′ 30″ N., Long. 103° 18′ 30″ W., 7 miles N. 30° W. from Marathon, Glass Mountains, Texas, and Guadalupian series (Word formation), Lat. 30° 22′ N., Long. 103° 16′ W., 11 miles north of Marathon, near mouth of Road Canyon west of Hess Ranch, Glass Mountains, Texas.

Type.—Yale University, Peabody Museum, no. 12-35, from the Leonardian series.

TRIPHYLLOTRYPA SPISSA Moore and Dudley, n. sp.

Zoarium, pl. 5, fig. 7 (x1); *tangential section*, pl. 16, fig. 8 (x10); *longitudinal section*, pl. 36, fig. 7 (x20)

This species, which is especially characterized by its small closely spaced elongate zooecial apertures, has an irregular zoarial form. The type specimen, which is attached to a productid, has a width of about 30 by 35 mm and an average thickness of 5 mm, but it bears local upward projections, one of them 16 mm high. Its surface is marked by low knobby elevations that carry small distinct maculae 5 to 6 mm apart. Adjacent zooecia bear tall lunaria but the apertures are small in diameter. Between maculae the zooecia are irregularly elongate and separated by a single series of moderately fine vesicles or simply by the zooecial wall. They are indented by strongly defined lunaria that are not so large in proportion to the zooecial cavity as those of *Triphyllotrypa speciosa*, n. sp., or *T. patentis*, n. sp.

Zooecial tubes are straight-walled and they contain occasional horizontal, faintly perceptible diaphragms.

Measurements of the type specimen, in millimeters, are as follows: diameter of apertures, 0.19 to 0.36 (mean 0.27); width of interspaces, 0.14 to 0.27 (mean 0.20).

Discussion.—This species is especially characterized by its small, elongate trilobed, mostly close-spaced apertures, and well defined maculae that are located on low monticules. It is distinguished from *Triphyllotrypa definita*, n. sp., which it most closely resembles, by its smaller zooecia and the low monticules on its surface.

Occurrence.—Leonardian series, Middle Permian, north of Leonard Mountain, section 17, bed 14 (R. E. and P. B. King, 1930, p. 139), Lat. 30° 20′ 30″ N., Long. 103° 14′ 40″ W., 9.5 miles north of Marathon, Glass Mountains, Texas.

Type.—Yale University, Peabody Museum, no. 123-36, collected by R. E. and P. B. King.

TRIPHYLLOTRYPA GALEATA Moore and Dudley, n. sp.

Tangential sections, pl. 16, fig. 3 (x10), pl. 22, fig. 8 (x20); *longitudinal sections*, pl. 29, fig. 4 (x10), pl. 30, fig. 4 (x10), pl. 36, fig. 3 (x20)

Available specimens of this bryozoan are curved fragments of zoaria, which suggest that the whole colony possibly may have a tubular form, the lower or inner surface being lined by epitheca. The outer surface bears circular maculae, about 1.5 mm in diameter, which are surrounded by zooecia having tall, outwardly directed lunaria; the spacing of the maculae cannot be determined satisfactorily. Zooecial apertures are subtriangular in outline. The lunaria are strong, their edges slightly projecting, and in intermacular areas rather low; they occupy half to two thirds of the circumference of the zooecial tubes. The parallel orientation of the zooecia between maculae, as shown by the position of lunaria and shape of apertures, is striking. The lunaria are moderately thin-walled as seen in tangential sections, and their edges do not form distinct pseudosepta as in *Triphyllotrypa speciosa*. Longitudinal sections commonly show several successive growth laminae, about 2 mm thick, in each of which the zooecial tubes are straight-walled, bearing one or two horizontal diaphragms; the tubes are separated by one or two rows of fine vesicles.

Measurements of the type specimen, in millimeters, are as follows: maximum thickness of zoarium, 5 mm; diameter of zooecial apertures, 0.27 to 0.36 (mean 0.32); width of interspaces, 0.14 to 0.23 (mean 0.18).

Discussion.—Specimens of this bryozoan stand apart from other observed western Texas forms, primarily on account of the markedly subtriangular shape of the zooecial apertures. The apertures somewhat resemble those of a specimen of "*Fistulipora grandis* var. *guadalupensis*" by Girty (1908, pl. 25, fig. 7), part of which is reproduced in this paper in plate 22, figure 3. *Triphyllotrypa galeata* has distinctly smaller and more elongate apertures and finer vesicles than the bryozoan described by Girty. *T. galeata* seems obviously to differ from all observed examples of *Cyclotrypa* that are illustrated.

Occurrence.—Delaware Mountain formation, Guadalupian series, Permian, west of the 6-Bar ranch house in Culberson County, Texas.

Type.—University of Texas, Bureau of Economic Geology, no. 6586.

TRIPHYLLOTRYPA ABSTRUSA Moore and Dudley, n. sp.

Tangential section, pl. 16, fig. 1 (x10); *longitudinal section,* pl. 30, fig. 2 (x10)

The zoarium of this species is irregularly nodular, subspherical or cylindrical, specimens ranging from 15 to 45 mm in diameter and height. Low monticules on the surface, 4 to 5½ mm apart, bear maculae at their centers. Zooecial apertures are trilobate, indented by distinct lunaria similar to those of *Triphyllotrypa speciosa,* n. sp.; they are separated by interspaces equal to or greater than their own diameter.

Transverse sections show strongly trilobate zooecial tubes of comparatively uniform size, and numerous small intervening vesicles. Maculae are recognized as areas of crowded vesicles lacking zooecia; the lunaria of zooecial tubes adjacent to the maculae are on the side of the tubes toward the macula. The longitudinal sections show numerous diaphragms and somewhat variable sizes of vesicles.

Measurements of the type specimen, in millimeters, are as follows: diameter of zooecia, 0.32 to 0.36 (mean 0.34); width of interspaces, 0.18 to 0.27 (mean 0.22).

Discussion.—This species is most similar to *Triphyllotrypa speciosa,* n. sp., in its well developed lunaria and the size of its zooecia and vesicles, as shown in tangential section. It differs from this species in having more abundant diaphragms and low but distinct monticules.

Occurrence.—Word formation, Guadalupian series, Middle Permian, Glass Mountains, Texas.

Type.—University of Texas, no. T148-35, Word formation, from the tank one half mile north of Word ranch, Lat. 30° 22′ 15″ N., Long. 103° 08′ W., 14.5 miles northeast of Marathon, Glass Mountains, Texas.

TRIPHYLLOTRYPA GUADALUPENSIS (Girty)

Tangential section, pl. 22, fig. 3 (x20); *longitudinal sections,* (?) pl. 30, fig. 3 (x10), (?) pl. 36, fig. 1 (x20)

Fistulipora grandis var. *guadalupensis* GIRTY, *1908,* U.S. Geol. Survey, Prof. Paper 58, pp. 125, 126, pl. 17, fig. 18; pl. 25, fig. 7; pl. 27, fig. 17.

At the time Girty described this bryozoan, three species assigned to *Fistulipora* (*F. carbonaria* Ulrich, *F. carbonaria-nebrascensis* Condra, *F. nodulifera* Meek) had been described from Upper Carboniferous rocks of North America. Girty's species, here designated as *Triphyllotrypa guadalupensis*, is entirely distinct from these in its zoarial form, prominent lunaria, and dimensions of zooecial tubes and vesicles. Girty considered his specimens from Upper Permian rocks of western Texas most nearly similar to *Dybowskiella grandis* Waagen and Wentzel, from the Productus limestone (Permian) of India.

Comparison of figures of both species show that *T. guadalupensis* clearly differs from the Indian species in possessing lunaria of greater diameter, fewer and less distinct maculae, and a more loosely built nodular zoarium that is not a hollow branch, as in *Dybowskiella grandis*.

Measurements of *Triphyllotrypa guadalupensis*, according to Girty's description and figures, are as follows (in millimeters): height of zoarium, maximum 50; spacing of maculae, not given; diameter of zooecia, mean 0.4; width of interspaces, mostly about 0.2; spacing of diaphragms, 10 to 24 in 2 mm.

Discussion.—No Permian specimens examined by us seem to be assignable to *Triphyllotrypa guadalupensis* (Girty). The shape and size of the zooecial apertures of this species differ markedly from those of *T. speciosa*, n. sp., *T. patentis*, n. sp., *T. proiecta*, n. sp., and similar species having a very strongly trilobate form produced by the fairly small size and prominently projecting ends of the lunaria. The zooecia of *T. guadalupensis* have a more nearly circular cross section and the large lunaria extend a shorter distance into the zooecial cavity in a position more nearly parallel to the zooecial wall. *T. guadalupensis* is most closely similar to *T. galeata*, n. sp., in the shape of the zooecial apertures; these two species are readily distinguished by difference in the size and spacing of the zooecial tubes and the size of the vesicles.

Girty's published illustrations of "*Fistulipora grandis* var. *guadalupensis*" represent three specimens from different localities and horizons. Strangely enough, two of these are designated as "the typical specimen,"—one from the Delaware Mountain formation at Guadalupe Point (sta. 2919) being illustrated by a tangential section (Girty, 1908, pl. 25, fig. 7) and the other from "dark limestone" at Pine Spring (sta. 2930) being illustrated by a longitudinal section (Girty, 1908, pl. 17, fig. 18). The specimens from which these sections were taken are not preserved. Study of the sections themselves leads to doubt that they represent the same species, and we here designate the form illustrated by the traverse section (Girty's pl. 25, fig. 7) as the type.

Occurrence.—Capitan limestone and Delaware Mountain formation, Guadalupian series, Upper Permian, Guadalupe Mountains, western Texas.

Type.—U. S. Geological Survey collection (Girty, 1908, pl. 25, fig. 7), Delaware Mountain formation at Guadalupe Point, Tex.

Genus Meekopora Ulrich, 1890

Bifoliate zoaria of ribbonlike or somewhat laterally extended sheetlike form and having zooecial tubes separated by vesicular tissue are assigned to *Meekopora*. The median lamella, which seems actually to be a closely joined double layer, reaches the surface at the edges of the zoaria, and is perceptible even on much thickened colonies having nearly cylindrical form, which are decidedly nontypical. A thin immature region next to the median lamella is characterized by recumbent portions of the zooecial tubes, by coarseness of vesicles, and by thinness of the walls of zooecia and vesicles. The zooecia bend abruptly upward from the immature zone and they meet the surface nearly at right angles. The walls of the tubes may be much thickened in the mature zone and their inner diameter constricted. Somewhat widely spaced complete diaphragms are present. Vesicles commonly increase in numbers and decrease in size from the median lamella toward the surface of the zoarium, and the outer parts commonly bear dense deposits of stereome that may fill the interspaces solidly. The zooecial apertures are circular to elongate ovoid and, although well defined lunaria are commonly present, their extremities do not indent the apertures. Strong thin peristomes are present in some species. The surface of interspaces is smooth, granulose, or furrowed. Somewhat elongate maculae are prominent.

Genotype.—*Meekopora eximia* Ulrich, Chesterian series, Upper Mississippian, Illinois.

Discussion.—No other previously described genus having cyclotrypoid internal structures has a bifoliate zoarial growth form, but some specimens of *Meekopora* rather closely resemble robust species of *Sulcoretepora* D'Orbigny. The latter genus, which belongs among the Cryptostomata, is distinguished by a vestibular outer portion of the zooecial tubes. There are also distinctions in the distribution and arrangement of the apertures in *Sulcoretepora* and an absence of maculae, which aids in separating that genus from *Meekopora*.

The internal and external characters of *Meekopora* correspond entirely to those of the new genus *Meekoporella* except for distinction in the manner of bifurcation of branches. In *Meekopora*, branches of the zoarium lie approximately in the same plane, whereas in *Meekoporella* the planes of the branches diverge strongly and large polygonal chambers having inverted pyramidal form may be produced. Specimens of *Meekoporella* seem to split much more readily along the median lamella than in *Meekopora*.

Occurrence.—Silurian to Permian, North America.

MEEKOPORA PROSSERI Ulrich

Zoarium, pl. 37, figs. 3, 4 (x1); *surface*, pl. 38, figs. 1, 8 (x5), pl. 39, fig. 3 (x10); *tangential sections*, pl. 41, fig. 7 (x10), pl. 44, figs. 1, 2 (x20); *longitudinal sections*, pl. 42, figs. 1-3 (x10), pl. 45, figs. 1, 2, 4 (x20), pl. 46, figs. 4, 8 (x20)

Meekopora prosseri ULRICH, *1902*, in Condra, Am. Geologist, vol. 30, no. 6, p. 339, pl. 18, fig. 9, pl. 19, figs. 1-6. ———— BARBOUR, *1903*, Nebraska Geol. Survey, vol. 1, p. 127. ———— CONDRA, *1903*, Nebraska Geol. Survey, vol. 2, p. 36, pl. 3, figs. 1-7.

Fistulipora sutilis CORYELL, *1924*, in Morgan, Oklahoma Bur. Geology, Bull. 2, pl. 38, figs. 1, 2.

Ulrich's description is as follows:

Zoarium bifoliate, forming palmate fronds or frequently dividing branches 8 to 40 mm wide, 1 to 2 mm thick; edges of branches nonporiferous, subacute; zooecia opening on both faces of fronds, comparatively small, ovate, very slightly oblique, directed distally, separated by interspaces as wide or wider than their longer diameter, arranged in rather regular intersecting series, about 11 in 5 mm; peristome thick, highest on the lower or lunarial side; interspaces, like the maculae, which are rather large and occur at regular intervals of 4 or 5 mm, concave and covered by minute granules. Zoaria usually fragmentary, rarely over 10 cm high, generally 4 or 5 cm, 1 to 3 mm thick, apertures 0.16 by 0.2 mm across, 11 to 13 in 5 mm. Diaphragms few, wanting in some tubes; vesicles numerous, arranged more or less in series, not very different in size in different parts of the zoarium, sometimes quite filled by a deposit near the surface. There are two forms of growth, one with narrow, and the other with wide branches.

Several hundred specimens in our collection, mostly from Lower Permian beds, are referable to this species. They are characterized by the relatively wide breadth and thinness of the flat or gently curved ribbons. Excepting the broadened areas near bifurcations of branches, the width of the bifoliate ribbons is commonly 20 to 25 mm. Thickness is almost invariably less than 4 mm, but parts of some specimens that show growth of successive laminae may exceed 6 mm in thickness. Study of specimens having a thickness of less than 2 mm indicates that the full width of branches is attained before any appreciable thickening through elongation of zooecial tubes and accumulation of vesicular tissue takes place; this is shown clearly by specimens that represent the tips of growing branches. Juvenile parts of colonies do not have near-surface vesicles that are thickened or filled by stereome. Mature parts of zoaria commonly show a dense interapertural structure at and near the surface. Measurements of specimens ranging from middle Missourian to lower Wolfcampian (Council Grove group) are practically identical and they agree with those given by Ulrich.

Discussion.—Chief diagnostic features of *Meekopora prosseri* are the relative breadth and thinness of the branches, and a rather strong obliquity in attitude of the zooecial tubes as shown in longitudinal sections parallel to direction of growth of the branches. *M. mollis,* n. sp., is a much more delicate species that has slender branches. *M. parilis,* n. sp., and *M. opima,* n. sp., have stout, thick branches.

Occurrence.—Chanute shale and Drum limestone, Missourian, at Kansas City, Mo.; Stanton limestone, Missourian, at Eudora, Kan.; Wakarusa limestone, Virgilian, near Tablerock, Neb.; Stonebreaker limestone, Virgilian, west of Cleveland, Okla.; Thrifty formation, Virgilian, 3 miles west of Graham, Tex.; Brownville limestone, Virgilian, 7 miles west of Strohm, Okla.; Saddle Creek limestone and underlying shaly beds (Waldrip) of the Harpersville formation, Wolfcampian, 7 miles northwest of Fife, Tex., and 4 miles east of Santa Anna, Tex.; Hughes Creek shale, Foraker formation, Wolfcampian, at scores of localities from northern Oklahoma to southern Nebraska; Florena shale, Beattie formation, Wolfcampian, at many Kansas localities. By far the greatest number of specimens have been obtained from the Hughes Creek shale.

Types.—U.S. National Museum and Morrill collection, University of Nebraska, nos. 18-10-00 and 15-12-7-01 (Condra, 1903, p. 37).

MEEKOPORA MOLLIS Moore and Dudley, n. sp.

Surface, pl. 38, fig. 5 (x5), pl. 39, figs. 7, 8 (x5), pl. 39, fig. 2 (x10); *tangential sections,* pl. 41, figs. 1, 3 (x10), pl. 44, figs. 3, 4 (x20); *longitudinal sections,* pl. 43, fig. 1 (x10), pl. 46, figs. 1-3 (x20)

Zoarium consisting of narrow bifoliate ribbons, 3 to 8 mm wide and 1.5 to 2.5 mm thick. The lateral margins are straight or gently sinuous, acute and nonporiferous. Oval-shaped maculae that are elongate parallel to the direction of growth of the branch occur at intervals of 5 to 5.5 mm, but on some specimens they are restricted to the margins of the branch. Zooecial apertures are small, somewhat ovoid, and arranged in series that are accentuated by groovelike depression of the interapertural areas; there are 5 to 6 apertures in 2 mm along the line of such series. The posterior margin of apertures is elevated in the form of a lunarium but there is no perceptible indentation of the zooecial walls at edges of lunaria. Tangential and longitudinal sections show structural characters that are closely similar to those of *Meekopora prosseri*, but there is very little thickening of vesicular walls or filling by stereome in interzooecial areas. The zooecial tubes, which are recumbent on the median lamella, bend obliquely upward and contain few diaphragms.

Discussion.—The chief distinguishing character of this species is the slenderness of thin ribbons that form the zoaria. The colonies branch, as in *Meekopora prosseri*, becoming wider just below points of bifurcation, but there are no sheetlike expansions, such as occur commonly in *M. prosseri*. The branches of *M. mollis* are much thinner and generally more delicate than those of *M. vesca*, n. sp., which has very blunt, serrate margins.

Occurrence.—Auburn shale, Virgilian, 1.5 miles northwest of Elk Creek, Neb.; Langdon shale, Virgilian, north of Nebraska City, Neb.; Dover limestone, Virgilian, at Nebraska City, Neb.; Brownville limestone, topmost Virgilian, at numerous places from Nebraska to Oklahoma; and Waldrip No. 1 limestone, Harpersville formation (about 75 feet below Saddle Creek limestone), 4 miles east of Santa Anna, Tex. This species is most abundant and characteristic of the Brownville limestone, numbers of fine specimens being obtained especially from Admire Junction, Kan., and a few miles southwest of Strohm, Okla. The zoaria are associated with the distinctive plates of the crinoid genus *Triceracrinus* Bramlette, which is known only from the Brownville limestone in the northern midcontinent region and the Waldrip No. 1 horizon in north-central Texas. Bramlette (1943) considers the *Triceracrinus* and *Meekopora mollis*-bearing Waldrip as Lower Permian rather than uppermost Pennsylvanian. Inasmuch as several other fossils having very narrow known vertical range are common to the Brownville and Waldrip, they are thought to be closely equivalent in age.

Type.—University of Kansas, no. 217532, from the Brownville limestone at Admire Junction, 0.5 mile north of Admire, Lyon county, Kan.

MEEKOPORA VESCA Moore and Dudley, n. sp.

Surface, pl. 38, figs. 10-12 (x5), pl. 39, fig. 1 (x10); *tangential sections*, pl. 41, fig. 4 (x10), pl. 44, fig. 8 (x20); *longitudinal sections*, pl. 43, fig. 3 (x10), pl. 46, fig. 6 (x20)

Fragments of zoaria representing this species are slender but stout branches having elliptical to nearly circular cross section. Available specimens range in length up to 20 mm and show only infrequent bifurcations. Width of the branches is typically 4 or 5 mm but at bifurcations it may be 8 mm; thickness ranges from 3 to 4 mm. The lateral margins are very distinctly and somewhat evenly serrate, zooecial apertures extending to the median lamella at each projection of the branch and receding from it at each concavity of the margin. The nonporiferous areas in the concavities are actually maculae, and excepting areas at bifurcations (upper part of pl. 38, fig. 10a), maculae are confined to the marginal portions of the branch. There are 2.5 maculae in 10 mm and each macula is 2.5 to 3 mm across. The zooecial apertures are small, suboval, and exhibit a very indistinct linear arrangement; spacing is somewhat variable but there are typically 4 aperture-interspace units in 2 mm. On well preserved parts of the zoarium a raised rim is observed around the apertures; lunaria are not distinguished. Sections show that the near-surface parts of the branches are much thickened by stereome, but arrangement of zooecial tubes, size of vesicles, and spacing of structural features are not distinctive.

Discussion.—This new species resembles *Meekopora mollis* in the narrow width of its branches and restriction of maculae to the lateral edges for the most part. *M. vesca* differs from *M. mollis* in having much thicker branches, more prominent serrate margins, and less depressed interapertural areas. Also, the dense outer structure of *M. vesca* is lacking in *M. mollis*. *M. parilis* is a distinctly coarser, more robust species than the form here described.

Occurrence—Gaptank formation (?upper part, ?Virgilian), at Gaptank, Pecos County, western Texas; represented by several dozen specimens.

Type.—University of Kansas, no. 559235.

MEEKOPORA OPIMA Moore and Dudley, n. sp.

Zoarium, pl. 37, fig. 10 (x1); *surface*, pl. 38, fig. 9 (x5), pl. 39, fig. 9 (x10); *tangential sections*, pl. 41, fig. 8 (x10), pl. 44, fig. 6 (x20); *longitudinal sections*, pl. 42, figs. 5, 6 (x10), pl. 45, figs. 5-7 (x20)

The zoarium of this species consists of thick undulating fronds, 5 to 9 mm thick and 15 to 90 mm in breadth. Margins are rounded but there is a slight nonporiferous projection that marks the median lamella. Maculae are well developed, subcircular, evenly spaced for the most part, 5 to 6 mm from center to center, and each macula about 2 mm across. They are not appreciably depressed. The zooecial apertures are small, subcircular, and not arranged in regular linear series; rims are slightly elevated and lunaria are weakly developed near the maculae. There are 3.5 to 4 aperture-interspace units in 2 mm. Sections show the regular arrangement of zooecial tubes, which approach the surface nearly at right angles and contain relatively numerous diaphragms, and the fairly even lacelike vesicular structure between the tubes; the peripheral zone tends to be thickened by stereome but this is not prominent.

Discussion.—The broad thick nature of the zoarium of *Meekopora opima* readily distinguishes it from specimens of *M. prosseri*, which it most resembles. The maculae of *M. opima* are larger, more widely spaced, and less distinctly elongate than in *M. prosseri*. The zooecial tubes are longer, more erect, and contain more numerous diaphragms in *M. opima*.

Occurrence.—Florena shale, Beattie formation, Lower Permian; south and southwest of Dexter, Kan., near Hooser, Kan., and west of Cottonwood Falls, Kan.

Type.—University of Kansas, no. 346931, from a locality 0.5 mile south of Dexter, Kan.

MEEKOPORA PARILIS Moore and Dudley, n. sp.

Zoarium, pl. 37, fig. 6 (x1), pl. 40, fig. 1 (x1); *surface*, pl. 38, fig. 2 (x5), pl. 39, fig. 6 (x10); *tangential sections*, pl. 41, figs. 5, 6 (x10), pl. 44, figs. 5, 7 (x20); *longitudinal sections*, pl. 42, figs. 4, 7 (x10), pl. 43, fig. 4 (x10), pl. 45, fig. 3 (x20), pl. 46, figs. 5,7 (x20); *transverse sections*, pl. 43, fig. 2 (x10), pl. 45, fig. 8 (x20)

Meekopora sp. GIRTY, *1908*, U.S. Geol. Survey, Prof. Paper 58, p. 127, pl. 31, fig. 18; Delaware Mountain formation, Permian, western Texas.

Zoarium a large fanlike growth of flattened branches that bifurcate frequently and locally inosculate. An incomplete but very remarkable silicified specimen that was etched with acid from limestone measures 80 by 120 by 180 mm (pl. 40). Most of the branches are 8 to 10 mm in width and 4 to 5 mm in thickness; some branches are 15 mm wide and near the base of the large zoarium just mentioned there are local sheetlike expansions 20 mm across. Margins of the branches are mostly straight or gently curved but some are faintly sinuate; in profile the margins are rounded to subacute and the nonporiferous line that marks the position of the median lamina is readily visible on all specimens. Maculae occur at regular intervals on the surface and along margins of the branches, distance from center to center being 5 to 6 mm; the maculae are subcircular to slightly elongate, 1.5 to 2 mm across, and not depressed. Zooecial apertures are small, nearly circular, and lacking in perceptible lunaria or raised peristomes; about 4 aperture-interspace units occur in 2 mm but the apertures are not arranged in clearly marked series. Internal structural features are typical of the genus and no specially significant characters are observed. Diaphragms in the zooecial tubes are comparatively few and widely spaced. Thickening of mature parts of the colony, near the surface, by deposits of stereome is well marked.

Discussion.—The characters of *Meekopora parilis* are closest to those of *M. prosseri* Ulrich, especially in the mode of zoarial growth. The branches of *M. parilis* are uniformly thicker, the margins more rounded, maculae less elongate and more widely spaced, and attitude of the zooecial tubes more erect than in *M. prosseri*. *M. parilis* is readily distinguished from *M. vesca*, n. sp., by the difference in shape of the branches.

Occurrence.—Wolfcampian limestone at several points in the vicinity of Wolfcamp (type specimen from bed 4 of P. B. and R. E. King's section 24 at Wolfcamp, Lat. 30° 21′ N., Long. 103° 08′ W., 12 miles N. 35° E. from Marathon); Leonardian beds on first ridge west of Iron Mountain and at Split Tank (1 mile northeast of old Word ranch), north of Marathon, Tex.; Word formation, Guadalupian, 5.5 miles due east of Altuda and 1.5 miles southwest of Sullivan Peak (in the King brothers' section 11, beds 1 and 2), and 1 mile southwest of Hill 5935, Glass Mountains, north of Marathon, Tex.

Type.—Yale University, Peabody Museum, no. 93-36, collected by P. B. and R. E. King from the Wolfcampian northeast of Wolfcamp, northeast of Marathon, Tex.

MEEKOPORA CALAMISTRATA Moore and Dudley, n. sp.

Zoarium, pl. 37, figs. 8, 9 (x1); *tangential section*, pl. 41, fig. 2 (x10); *longitudinal section*, pl. 43, fig. 6 (x10)

Zoarium composed of thick, irregularly curved leaves that attain a width of more than 90 mm, margins rounded to obtusely angled, thickness 5 to 14 mm. The surface bears subcircular maculae that are 1 to 1.5 mm in diameter and 4 to 6 mm from center to center. The zooecial apertures are slightly smaller and more closely spaced than other observed Pennsylvanian and Permian species; the apertures are commonly arranged in linear series having about 5 aperture-interspace units in 2 mm. Lunaria are observed, most distinct at the edges of maculae. Tangential sections show solid interspaces between the apertures, with little or no discernible vesicular structure. Longitudinal sections reveal a rather dense laminated vesicular filling of spaces between the erect zooecial tubes that contain relatively numerous slightly concave diaphragms.

Discussion.—This species is distinguished mainly by the growth form of the zoarium in large, very irregular sheets that do not show well defined proliferations or bifurcations. Judging by specimens partly embedded in matrix and broken at edges, some colonies attain a height or length exceeding 300 mm. *Meekopora calamistrata* somewhat resembles *M. opima*, n. sp., in the massive sheetlike zoarial habit, but the former is much more irregular and is characterized by excessive thickening due to deposition of stereome; also the vesicles of *M. calamistrata* are uniformly finer.

Occurrence.—Kaibab limestone, Leonardian, Middle Permian, from Kaibab Plateau 2.5 miles east of Jacobs Lake and on Clover Creek, Grand Canyon, Ariz.; collected by G. E. Condra.

Type.—University of Nebraska collection, from the Jacobs Lake locality.

Genus MEEKOPORELLA Moore and Dudley, n. gen.

The internal structural features of *Meekoporella* are essentially the same as those described for *Meekopora* Ulrich. Both genera are bifoliate, but whereas *Meekopora* grows in ribbonlike stems or sheetlike expansions of varying width that bifurcate approximately in the plane of the median lamella, *Meekoporella* consists of bifoliate sheets that join at angles of about 120 degrees to the planes of the median lamellae. The sheets diverge and coalesce so as to form steep-sided, deep polygonal chambers having an inverted pyramidal form. Some specimens show a marked tendency to divide along the various median lamellae, indicating that these lamellae consist of double sheets of tissue; they represent the basal thecae of two unilaminate cell layers growing back to back. Although not determinable from study of most specimens of *Meekopora,* the median lamella of this genus is doubtless also morphologically double.

Genotype.—Meekoporella dehiscens, n. sp., Stanton limestone, Missourian, Pennsylvanian, near Fredonia, Kan.

Discussion.—The comparison of this genus with *Meekopora* given in the above description indicates that a small fragment of *Meekoporella* cannot be differentiated from *Meekopora,* but any fragment that shows the mode of branching can be identified easily. A typical representative of this new genus that occurs in Permian rocks of Australia was erroneously identified as a gigantic, remarkably elevated *Evactinopora* (Hudleston, 1883, p. 593, pl. 23, figs. 2a-c).

MEEKOPORELLA DEHISCENS Moore and Dudley, n. sp.

Part of zoarium, pl. 37, fig. 5 (x1), pl. 38, fig. 3 (x0.75); *tangential sections,* pl. 43, fig. 8 (x10), pl. 47, fig. 5 (x20); *longitudinal sections,* pl. 47, fig. 4 (x20), pl. 48, fig. 1 (x20), figs 2, 3 (x10)

Zoarium composed of several thin bifoliate sheets joined together at angles of about 120 degrees so as to form deep chambers of inverted subpyramidal form that typically are six-sided. These chambers or cups are 30 to 60 mm in height and greatest width and they narrow nearly to a point at the base. The walls, consisting of two layers of zooecia and vesicles growing outward from closely appressed basal lamellae, range in thickness from 0.5 to about 4 mm. The lamellae or basal thecae that form the middle of the walls in this species split apart so readily that it is difficult to collect specimens having the bifoliate wall between adjacent chambers complete, and this tendency made the construction of thin sections such as those illustrated in plate 48, figures 2b, 2d, and 3a, far from easy. The appressed surfaces of the two thecae forming the middle of a wall are irregularly wrinkled so as to form striae running approximately normal to the vertical axes of adjoining chambers (pl. 37, fig. 5; pl. 38, fig. 3); this character reflects the direction of growth, which is from the point of the inverted pyramidal cup toward its outer rim. Accordingly, bifurcation of the median lamellae at the 120-degree angles of adjoining cups is a continuous and progressing growth development, rather than a simultaneously effected departure along the entire length of a wall in a new direction of growth.

None of the available specimens permit direct observation of the surface of parts of the zoarium inasmuch as matrix fills the polygonally walled cups. The arrangement of zooecial apertures and distribution of maculae can be determined, however, by grinding the walls tangentially. Such preparation shows the presence of suboval maculae, 1 to 1.5 mm in longer diameter, evenly distributed at intervals of 3 to 3.5 mm from center to center. The zooecial tubes are subcircular in cross section, 0.18 to 0.22 mm in diameter; they curve upward from the median lamella somewhat less abruptly than in most species of *Meekoporella* and *Meekopora* but are nearly normal to the outer surface, except near maculae where they tend to curve away from the macula. Diaphragms are unevenly distributed, some tubes containing 3 or 4 and others seemingly none. Vesicular structure is fine and there is no perceptible thickening of interzooecial areas near the surface by deposition of stereome.

Discussion.—The chief distinguishing feature of *Meekoporella dehiscens* is the thinness of the bifoliate walls, and possibly the regular form of subpyramidal chambers that is produced by the diverging walls. The very marked tendency to split along the median lamellae has been observed in no other species and has suggested the name *M. dehiscens,* but this may be a peculiarity of preservation. *M. nexilis* and *M. repleta* are obviously much coarser than *M. dehiscens.*

Occurrence.—Stoner limestone member of the Stanton formation, Missourian, Pennsylvanian, from a cement plant quarry about 1 mile south of Fredonia, Kan.; collected by R. C. Moore.

Type.—University of Kansas, no. 17439.

MEEKOPORELLA NEXILIS Moore and Dudley, n. sp.

Part of zoarium, pl. 37, fig. 7 (x1); *surface,* pl. 38, figs. 6, 7 (x5), pl. 39, fig. 5 (x10); *tangential sections,* pl. 47, fig. 3 (x10), pl. 47, fig. 1 (x20); *longitudinal sections,* pl. 48, fig. 4 (x10), pl. 47, fig. 2 (x20)

Description of this species is based on a single good-sized fragment of a zoarium; it is a very well preserved silicified specimen that shows both surface and internal characters excellently but the size and shape of a complete zoarium are unknown.

The bifoliate walls of the zoarium join one another at angles of about 120 degrees, junctures being notably thickened by excess growth of zooecia and vesicles so as to make rounded concave surfaces at the angles and base of cups formed by the walls. The dimensions of these cups are not determinable but their size must be much larger than in *Meekoporella dehiscens.* The fragment of *M. nexilis* here described is about 30 by 40 by 40 mm. The thickness of walls is 2 to 4 mm, except near junctions with other walls where thickness may increase to nearly 20 mm. The surface is marked by small but conspicuous, slightly elevated circular maculae, 1.5 to 2 mm in diameter, 4 to 4.5 mm from center to center. The zooecial apertures are subcircular and separated by interspaces about equal to their diameter; there are 4.5 to 5 aperture-interspace units in 2 mm. The apertures of zooecia adjoining the maculae are distinctly larger than average and they bear lunaria that are fairly well defined; lunaria are weak or unrecognizable in intermacular areas. Tangential sections show lunarial thickening of the posterior walls of zooecial tubes and flexures of the walls, both near maculae and in intermacular areas. Longitudinal sections indicate abrupt bending of the zooecial tubes above the recumbent portion next to the median lamella and they show 2 or 3 flat to concave diaphragms in most tubes. Vesicular tissue is regular and fine, not indenting the walls of zooecial tubes. Deposits of stereome are not evident.

Discussion.—This new species is distinguished from *Meekoporella dehiscens* by average greater thickness of walls, rounding at wall junctions by increase of zooecia and vesicles, and greater size of the polygonal depressions formed by coalescing walls. *M. nexilis* has larger more closely spaced zooecial apertures than in *M. repleta* and maculae are more prominent.

Occurrence.—Wolfcampian limestone (bed 8 in P. B. and R. E. King's section 24), at Wolfcamp, Lat. 30° 21′ N., Long. 103° 08′ W., 12 miles N. 35° E. from Marathon, western Texas.

Type.—Yale University, Peabody Museum, no. 90-31, collected by P. B. and R. E. King.

MEEKOPORELLA REPLETA Moore and Dudley, n. sp.

Part of zoarium, pl. 37, figs. 1, 2 (x1); *surface*, pl. 38, fig. 4 (x5), pl. 39, fig. 4 (x10); *tangential sections*, pl. 43, fig. 7 (x10), pl. 43, fig. 5 (x20), pl. 47, figs. 6,7 (x20); *longitudinal sections*, pl. 48, figs. 5, 6 (x10), pl. 47, fig. 8 (x20), pl. 48, fig. 7 (x20)

The zoarium of this bryozoan closely resembles that of *Meekoporella nexilis* but the depressions formed by converging walls seem to be even broader and less strongly marked; as in *M. nexilis* there is excess growth of zooecia and vesicles at the wall junctions, which produces smoothly rounded concave surfaces. Maculae are present but they are very poorly defined, 3 to 5 mm from center to center, and not raised above the general surface. The zooecial apertures, 0.17 to 0.21 mm in diameter, are slightly smaller than in *M. nexilis* and are separated by wider interspaces, although aperture-interspace units measure about the same, 4 to 4.5 in 2 mm. Lunaria are very indistinct or lacking. Diaphragms are common in the zooecial tubes which are straight-walled and approach the surface at right angles. Vesicular structure is fine and commonly shows alternating zones that reflect varying rates of growth.

Discussion.—This bryozoan is somewhat doubtfully separated from *Meekoporella nexilis*, which it most closely resembles. *M. repleta* seems to have somewhat different zoarial habit, smaller zooecia, and much less well developed maculae, and accordingly is designated as a distinct species.

Occurrence.—Leonardian limestone (bed 14 of P. B. and R. E. King's section 17), Lat. 30° 20′ 30″ N., Long. 103° 14′ 40″ W., 9.5 miles north of Marathon, and Word formation, Guadalupian (King brothers' section 12, bed not recorded), northwest of Marathon, Tex., both in the Glass Mountains.

Type.—Yale University, Peabody Museum, no. 123-4, collected by P. B. and R. E. King from the Leonardian at the section 17 locality.

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Explanation of Plate 1

Figure	Page
1—*Buskopora lunata* (Rominger), genotype of *Buskopora*, from the Onondaga limestone, Middle Devonian, at the Falls of the Ohio, near Louisville, Ky. (after Ulrich). *a*, Longitudinal section (x10), showing pseudosepta in zooecial tubes formed by projecting edges of lunaria. *b*, Part of surface (x10), showing projecting denticulate lunaria and narrow interspaces	263
2—*Coelocaulis venustus* (Hall), genotype of *Coelocaulis*, from Helderbergian, Lower Devonian, rocks of New York. *a*, Part of surface (x20), showing elongate ovoid apertures surrounded by strong peristome, lunaria lacking (after Hall and Simpson). *b*, Longitudinal section (x10) of part of zoarium showing its axial hollow lined by transversely wrinkled striate epitheca (after Simpson). *c*, Part of 2*b* (x20) showing zooecial tubes and vesicular interspaces	262
3—*Cheilotrypa hispida* Ulrich, genotype of *Cheilotrypa*, from Chesterian, Upper Mississippian, rocks at Tateville, Ky. (after Ulrich). *a*, Partial transverse section of branch (x20), showing central cavity and surrounding immature and mature regions. *b*, Longitudinal section (x20), the axial cavity at right side of figure. *c*, Tangential section (x20), showing lunaria as thickenings on posterior side of zooecial tubes and indicating dense interspaces of the mature region.	261
4—*Dybowskiella grandis* Waagen and Wentzel, genotype of *Dybowskiella*, from the Middle Productus limestone, Permian, at Morah, Salt Range, India (after Waagen and Wentzel). *a*, A natural transverse section of zoarium (x1), showing central cavity and long, straight zooecial tubes. *b*, Longitudinal section (x20), showing pseudosepta in zooecial tubes and vesicles of interspaces. *c*, Part of surface (x20), seemingly somewhat abraded, so that vesicular walls are seen in interspace and macular areas; apertures are strongly lobate, owing to inward projections of edges of the lunaria that form pseudosepta	262
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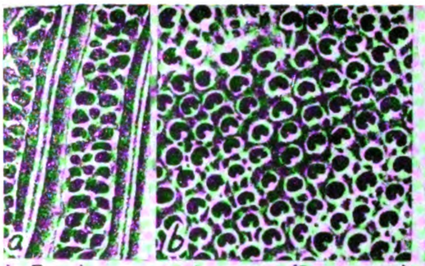
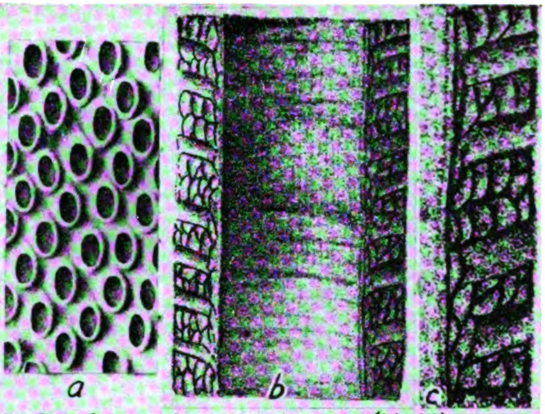
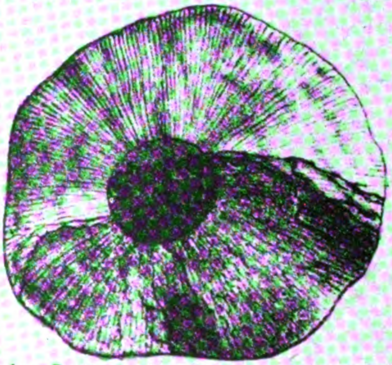


1. *Buskopora lunata* (Rominger)

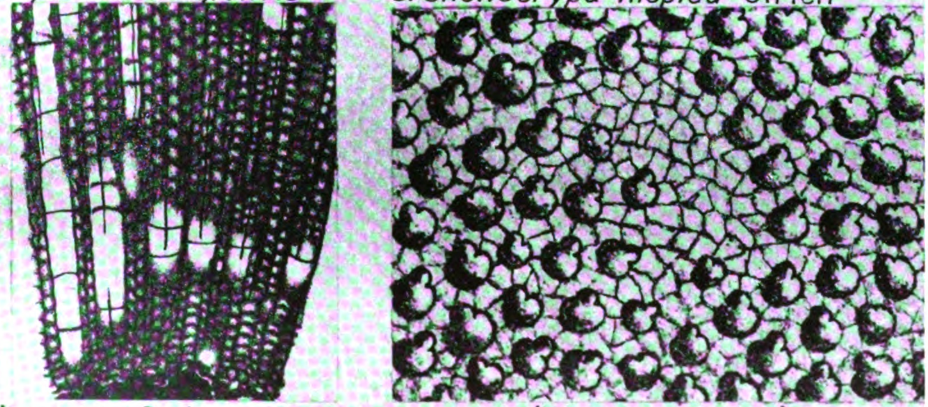


2. *Coelocaulis venustus* (Hall)

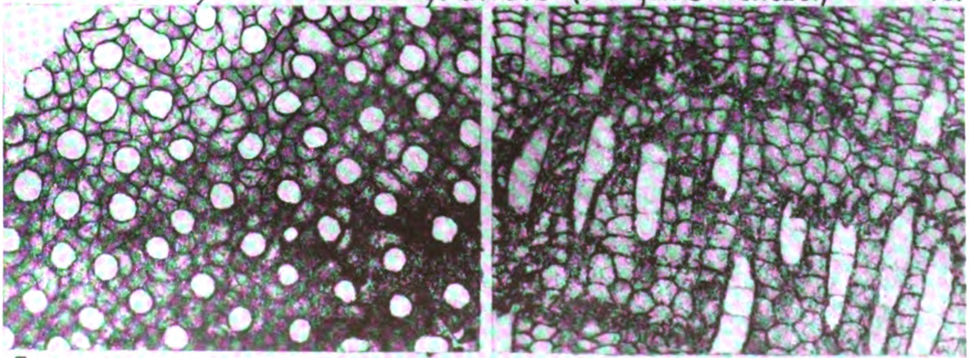


4a. *Dybowskiella grandis*

3. *Cheilotrypa hispida* Ulrich



4b. *Dybowskiella grandis* (Waagen & Wentzel) 4c.



5a *Cyclotrypa communis* (Ulrich) 5b

Explanation of Plate 2

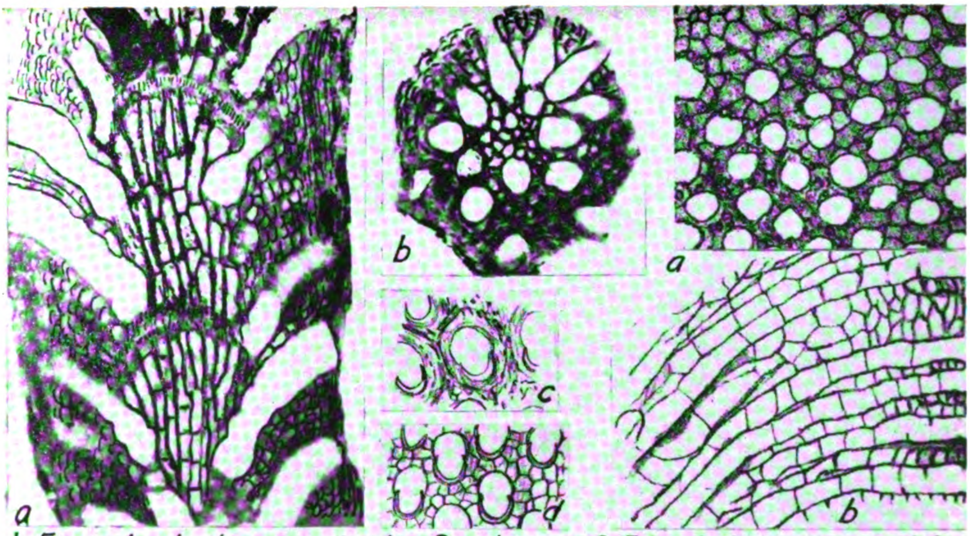
FIGURE | PAGE

1—*Fistulocladia typicalis* Bassler, genotype of *Fistulocladia*, from the Upper Permian at Noil Boewan, Timor (after Bassler). *a*, Longitudinal section (x20), showing narrow mesopore-like tubes in the axial part of branch and zooecial tubes lacking in diaphragms. *b*, Transverse section (x20), showing axial immature region and peripheral mature region. *c*, Tangential section (x20) near surface, showing prominent lunaria and dense interzooecial tissue. *d*, Tangential section (x20) deeper within branch, showing zooecial tubes and vesicles. 260

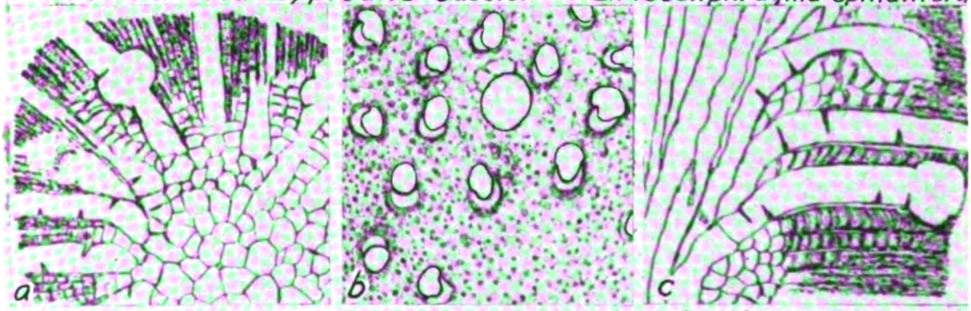
2—*Fistuliphragma spinulifera* (Rominger), genotype of *Fistuliphragma*, from the Traverse group, Middle Devonian, near Alpena, Mich. (after Ulrich). *a*, Tangential section (x20), showing weak or absent lunaria. *b*, Longitudinal section (x20), showing immature and mature regions, the latter containing hemiphragms. 261

3—*Cliotrypa ramosa* Ulrich and Bassler, genotype of *Cliotrypa*, from the New Providence shale, Lower Mississippian, at Kings Mountain, Ky. (drawings of the type specimen, after Bassler). *a*, Partial transverse section of ramose zoarium (x20), showing immature and mature zones, some zooecial tubes having local swellings that are interpreted as ooecia; hemiphragms present. *b*, Near-surface tangential section (x20), showing thickened lunaria at posterior edge of normal zooecial tubes and one enlarged tube, representing an ooecium or ovicell; interspaces dense, granular. *c*, Longitudinal section of part of branch (x20), showing ovicell expansions and well developed hemiphragms in zooecial tubes. 261

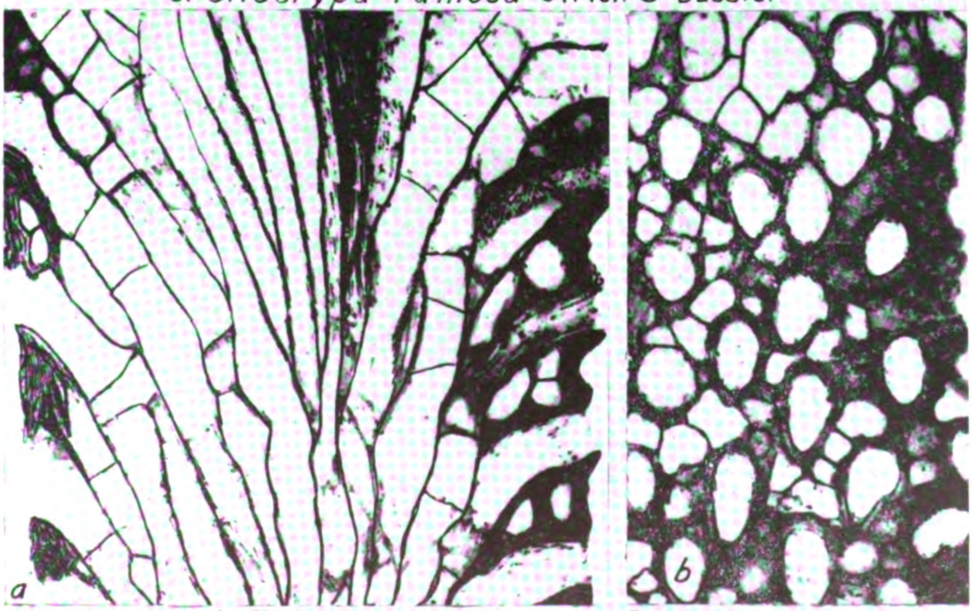
4—*Fistulotrypa ramosa* Bassler, genotype of *Fistulotrypa*, from the Upper Permian at Basleo, Timor (after Bassler). *a*, Longitudinal section (x20), showing thin-walled tubes of the axial region, lacking diaphragms, and the mature region of thickened interzooecial areas. *b*, Tangential section (x20), showing outer part of mature region at right and lower part of mature zone at left. 261



1. *Fistulocladia typicalis* Bassler 2. *Fistuliphragma spinulifera*



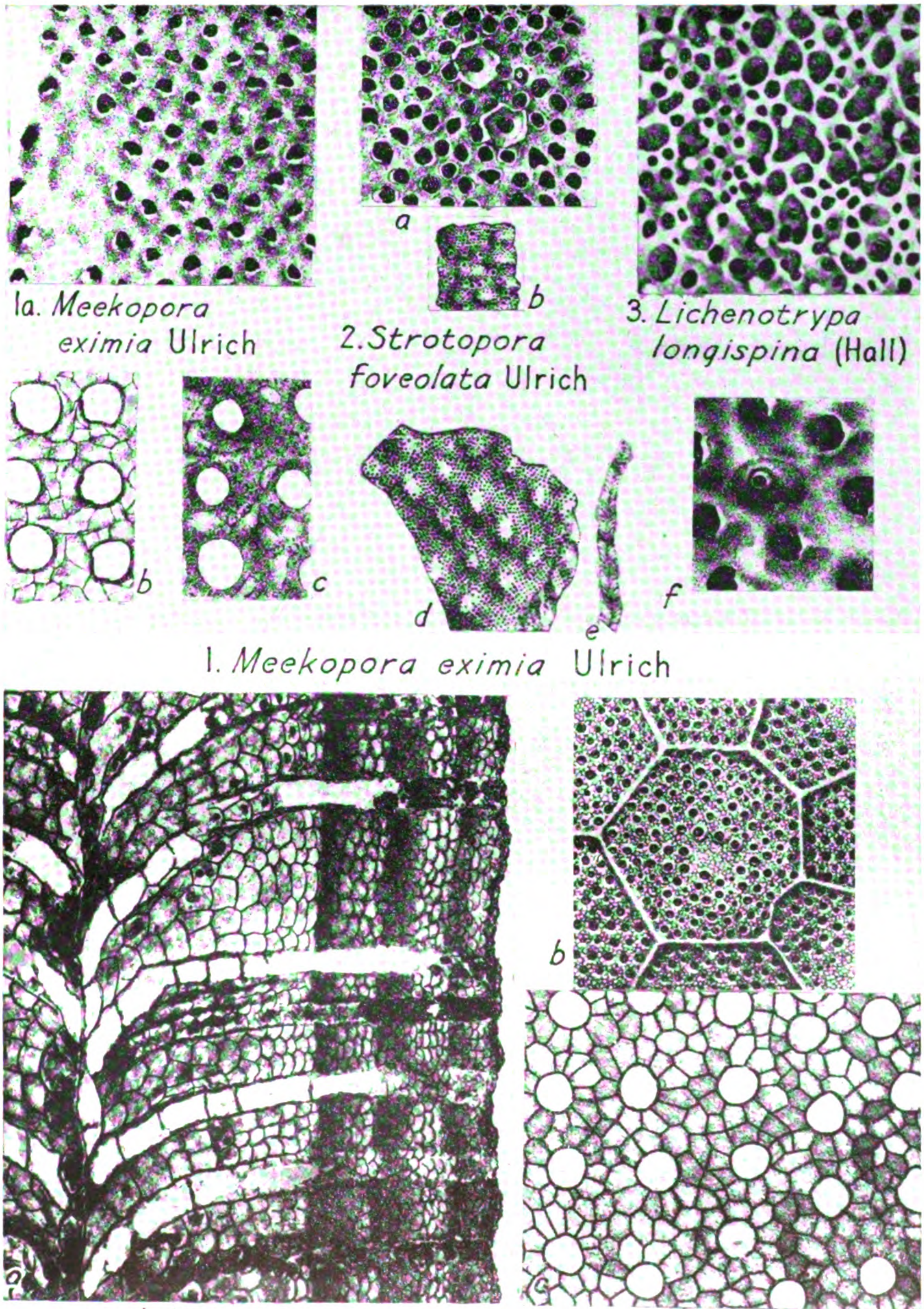
3. *Cliotrypa ramosa* Ulrich & Bassler



4. *Fistulotrypa ramosa* Bassler

Explanation of Plate 3

Figure	Page
1—*Meekopora eximia* Ulrich, genotype of *Meekopora*, from Chesterian rocks, Upper Mississippian, in Monroe County, Illinois (after Ulrich). *a*, Part of surface of zoarium (x10), showing prominent lunaria and a macula. *b*, Tangential section (x20) at intermediate depth, showing interzooecial vesicles. *c*, Tangential section (x20) near surface, showing dense interspaces between zooecia. *d*, Part of zoarium (x1) having well defined elongate maculae. *e*, Edge view of zoarium (x1), showing bifoliate structure. *f*, Part of surface (x20), showing at center an inferred ovicell.	263
2—*Strotopora foveolata* Ulrich, genotype of *Strotopora*, from the Keokuk limestone, Lower Mississippian, at Bentonsport, Ia. (after Ulrich). *a*, Portion of zoarium (x10), showing uneven apertures, elevated lunaria, and two broken ovicells. *b*, Part of zoarium (x1), showing monticules and enlarged apertures of ovicells.	262
3—*Lichenotrypa longispina* (Hall), genotype of *Lichenotrypa*, from the Onondaga limestone, Middle Devonian, at Falls of the Ohio, near Louisville, Ky. (after Hall). Surface of part of zoarium (enlarged), showing elevated irregular network and rounded protuberances of acanthopores.	259
4—*Hexagonella ramosa* Waagen and Wentzel, genotype of *Hexagonella*, from the Middle Productus limestone, Permian, at Khura, Salt Range, India (after Waagen and Wentzel). *a*, Longitudinal section (x20), showing median lamina at left, zooecial tubes and vesicular tissue. *b*, Part of zoarial surface (x5), showing polygonal ridges inclosing zooecia and a macula. *c*, Tangential section (x20), showing ovoid zooecial tubes, lacking lunaria, and walls of vesicles.	263



1a. *Meekopora eximia* Ulrich

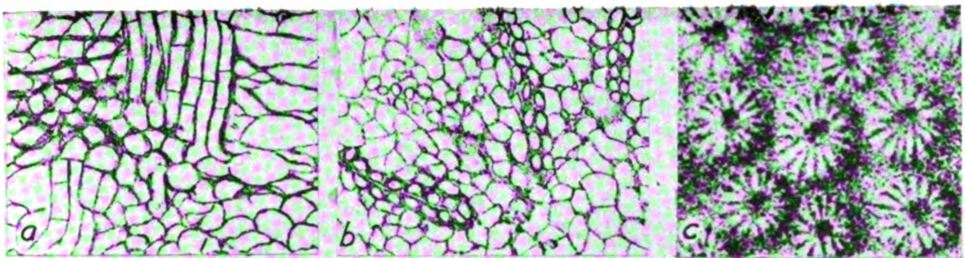
2. *Strotopora foveolata* Ulrich

3. *Lichenotrypa longispina* (Hall)

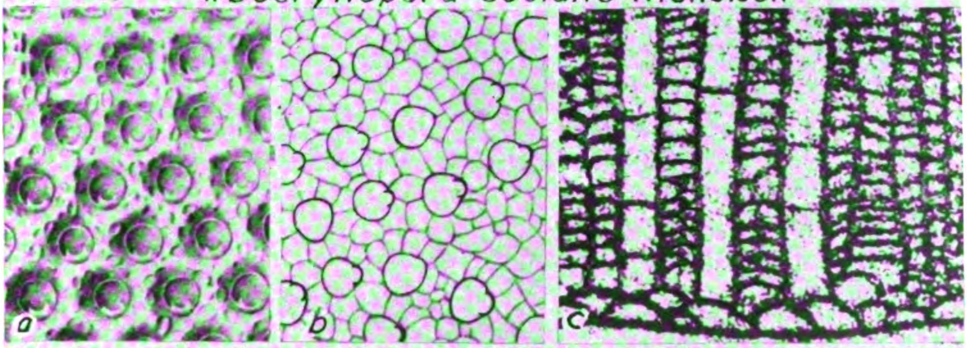
1. *Meekopora eximia* Ulrich

4. *Hexagonella ramosa* Waagen & Wentzel

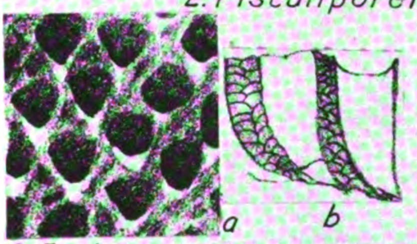
EXPLANATION OF PLATE 4



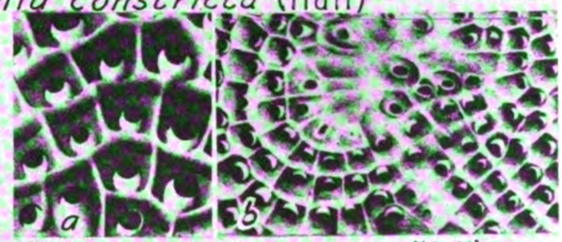
1. *Botryllopora socialis* Nicholson



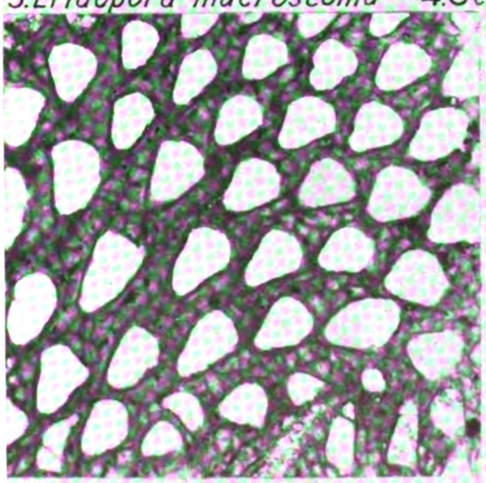
2. *Fistuliporella constricta* (Hall)



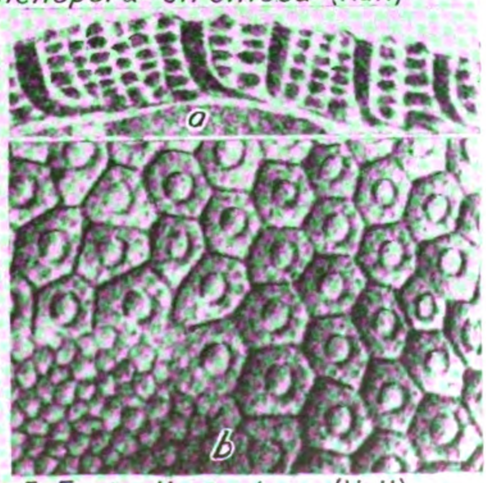
3. *Eridopora macrostoma*



4. *Selenopora circincta* (Hall)



3c. *Eridopora macrostoma* Ulr.



5. *Favicella inclusa* (Hall)

Explanation of Plate 5
(All figures x1)

Figure	Page
1—Triphyllotrypa passa Moore and Dudley, n. sp., the type specimen (Univ. Kansas no. 40431), from the Florena shale member, Beattie limestone, Lower Permian, SE sec. 19, T. 1 S., R. 15 E., Brown County, Kansas. *a*, Side view of zoarium. *b*, Basal view of zoarium, showing striated epitheca. c, Upper surface of zoarium, showing irregular protuberances.	293
2—Triphyllotrypa speciosa Moore and Dudley, n. sp., genotype of *Triphyllotrypa*, a specimen (Univ. Kansas no. 741418) from Leonardian beds at Clay Slide, 2 miles west of Iron Mountain, Glass Mountains, 7.5 miles N. 35° W. from Marathon, Tex.; side view showing the nodular form of growth.	291
3—Cyclotrypa carbonaria (Ulrich), a typical zoarium (Univ. Kansas no. 748934), from the Argentine limestone member, Wyandotte limestone, Missourian, at Wyandotte dam near Missouri river, north of Kansas City, Kan. *a*, Side view. *b*, Basal view.	269
4—Triphyllotrypa patentis Moore and Dudley, n. sp., the type specimen (Univ. Kansas no. 741423), from Leonardian beds at Clay Slide, 2 miles west of Iron Mountain, Glass Mountains, 7.5 miles N. 35° W. from Marathon, Tex.; side view of zoarium.	293
5—Cyclotrypa imula Moore and Dudley, n. sp., the type specimen (Univ. Kansas no. 798431), from the Deer Creek limestone, Virgilian, 3 miles east of Moline, Kan.; top view of zoarium.	281
6—Cyclotrypa beata Moore and Dudley, n. sp., the type specimen (Univ. Kansas no. 798631), from the Hughes Creek shale member, Foraker formation, Lower Permian, 0.5 mile northeast of Humboldt, Neb.; side view of zoarium, showing monticules.	288
7—Triphyllotrypa spissa Moore and Dudley, n. sp., the type specimen (Yale Univ. Peabody Mus. no. 123-36), from Leonardian limestone, Middle Permian, north of Leonard Mountain, Glass Mountains, 9.5 miles north of Marathon, Tex.; side view of zoarium.	295
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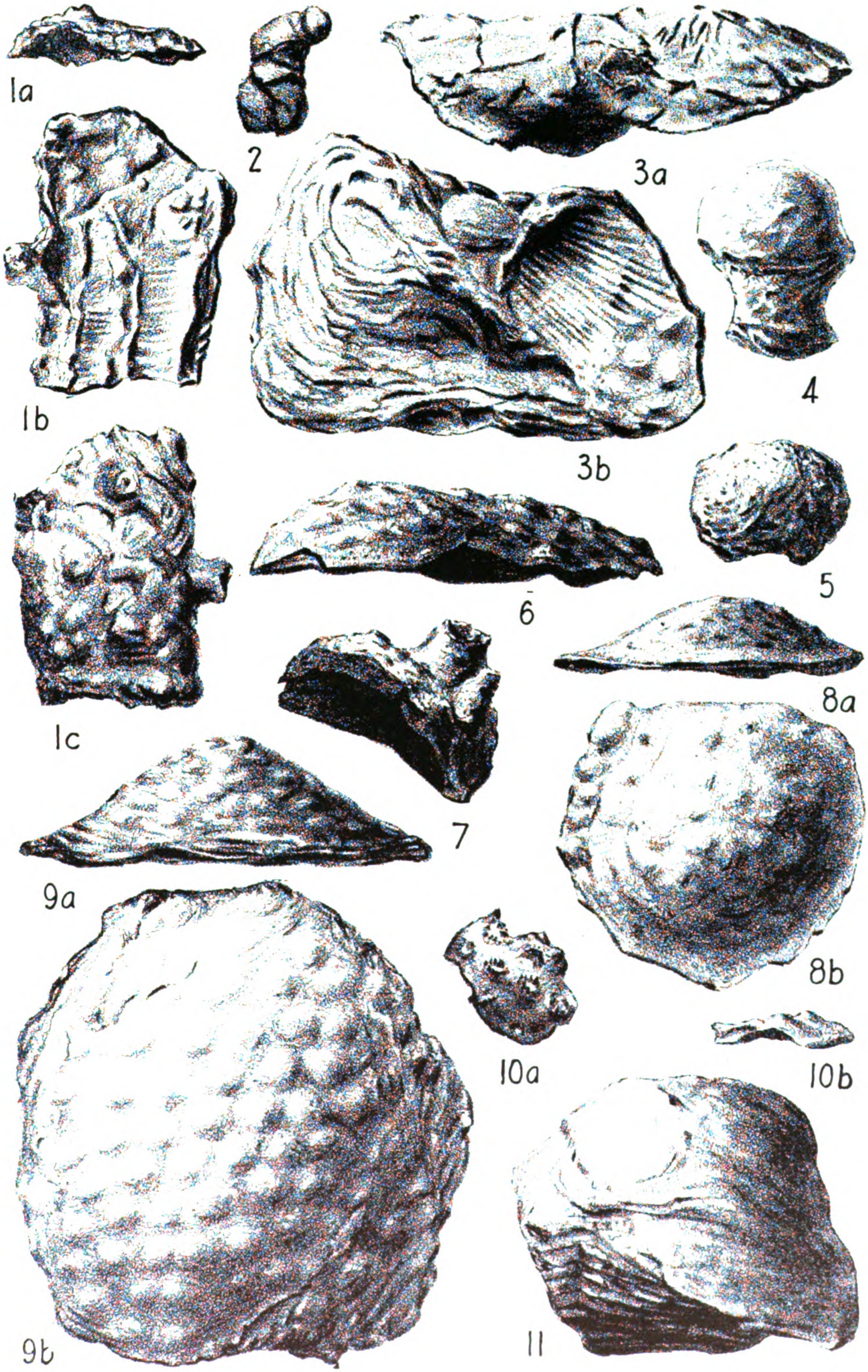
9—Cyclotrypa candida Moore and Dudley, n. sp., the type specimen (Univ. Kansas no. 485131), from the Coal Creek limestone member, Topeka limestone, Virgilian, northeast of Topeka, Kan. *a*, Side view of zoarium, showing low conical form. *b*, Top view of zoarium, showing subcircular outline and evenly spaced monticules.	281
10—Cyclotrypa matheri Moore and Dudley, n. sp., a typical specimen (Univ. Kansas no. 738532), from the Hale formation, Morrowan, at Greenleaf Lake, southeast of Braggs, Okla. *a*, Top view of zoarium, showing prominent depressed maculae. *b*, Side view of zoarium.	267
11—Cyclotrypa galerita Moore and Dudley, n. sp., the type specimen (Univ. Kansas no. 54-31), from the Hughes Creek shale member, Foraker formation, Lower Permian, 1 mile southeast of Bennett, Neb.; side view of zoarium, showing its massive subglobular form.	289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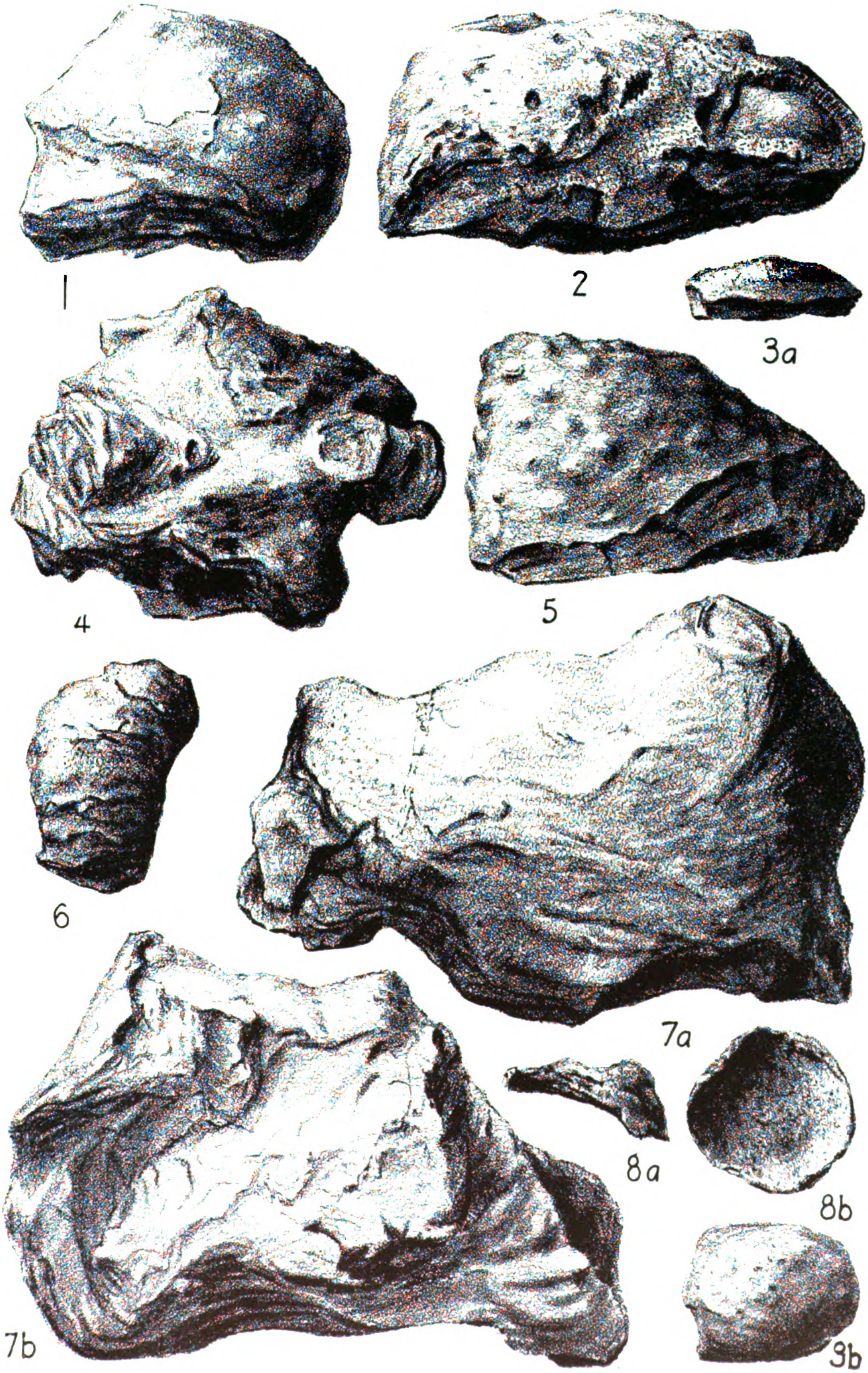
11

Explanation of Plate 6

(All figures x1)

Figure	Page
1—*Cyclotrypa idonea* Moore and Dudley, n. sp., the type specimen (Univ. Texas no. 12257-1), from the Thrifty formation, Virgilian, 3 miles north of Thrifty, Tex.; side view of zoarium, showing compact subhemispherical form that is common for this species.	285
2—*Cyclotrypa simplicis* Moore and Dudley, n. sp., the type specimen (Univ. Texas no. 3101), from the Gaptank formation, Pennsylvanian, 2 miles south of Gaptank, Pecos County, Texas, side view of zoarium.	286
3—*Cyclotrypa pelagia* Moore and Dudley, n. sp., a specimen (Univ. New Mexico coll.), from the upper Magdalena formation near Jemez Springs, N. M. *a*, Side view of zoarium. *b*, Top view.	284
4—*Cyclotrypa horridula* Moore and Dudley, n. sp., the type specimen (Univ. Kansas no. 219231), from the Atoka formation, Lampasan, 0.75 mile north of Clarita, Okla.; side view of zoarium, showing the very irregular form and size.	268
5, 7—*Cyclotrypa carbonaria* (Ulrich), from the Argentine limestone member, Wyandotte limestone, Missourian, at Wyandotte dam near Missouri river north of Kansas City, Kan. 5, Side view of a specimen (Univ. Kansas no. 748952), that differs from the ordinary examples of the species in having definite monticules. *7a*, Side view of a typical specimen (Univ. Kansas no. 74891), showing massive form and moderately large size. *7b*, Basal view of same specimen, showing edges of superposed laminae.	269
6—*Cyclotrypa zonata* (Girty), a typical specimen (Univ. Kansas no. 106), from the Oread limestone, 15 miles southwest of Baldwin, Kan.; side view of zoarium, showing nodular growth form.	276
8—*Cyclotrypa repentis* Moore and Dudley, n. sp., the type specimen (Univ. Kansas no. 461031), from the Plattsburg limestone, Missourian, 2.5 miles west of Neodesha, Kan. *a*, Side view of zoarium. *b*, Top view, showing concave surface.	275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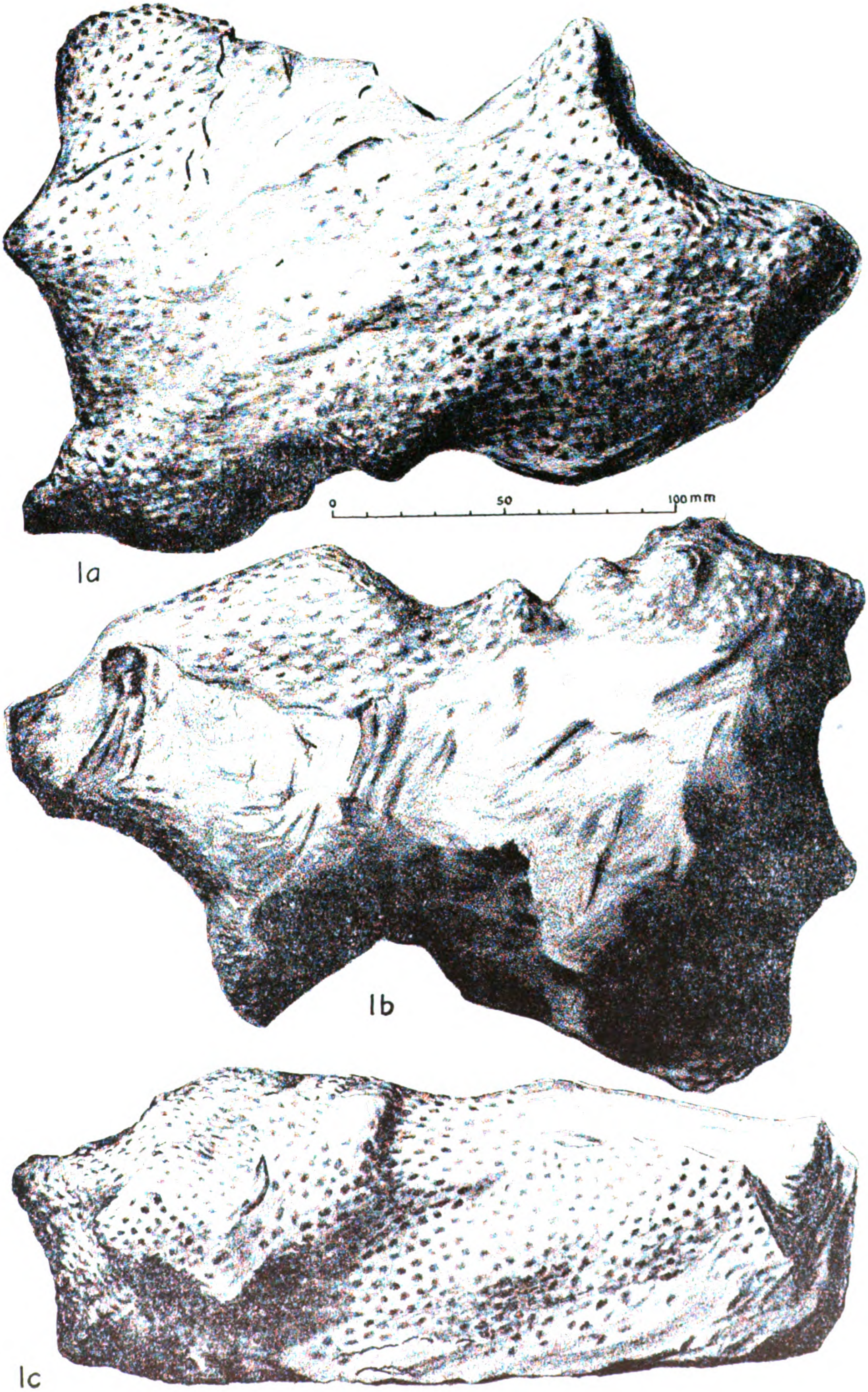
8b
9b

Explanation of Plate 7

(All figures x½)

FIGURE — PAGE

1—*Cyclotrypa acerba* Moore and Dudley, n. sp., the type specimen (Univ. Kansas no. 549931), from the Ladore shale, Missourian, Dyson Hollow, west of LaPlatte, Neb. *a*, Top view of zoarium, showing irregular massive form and very conspicuous maculae. *b*, Basal view. *c*, Side view. 272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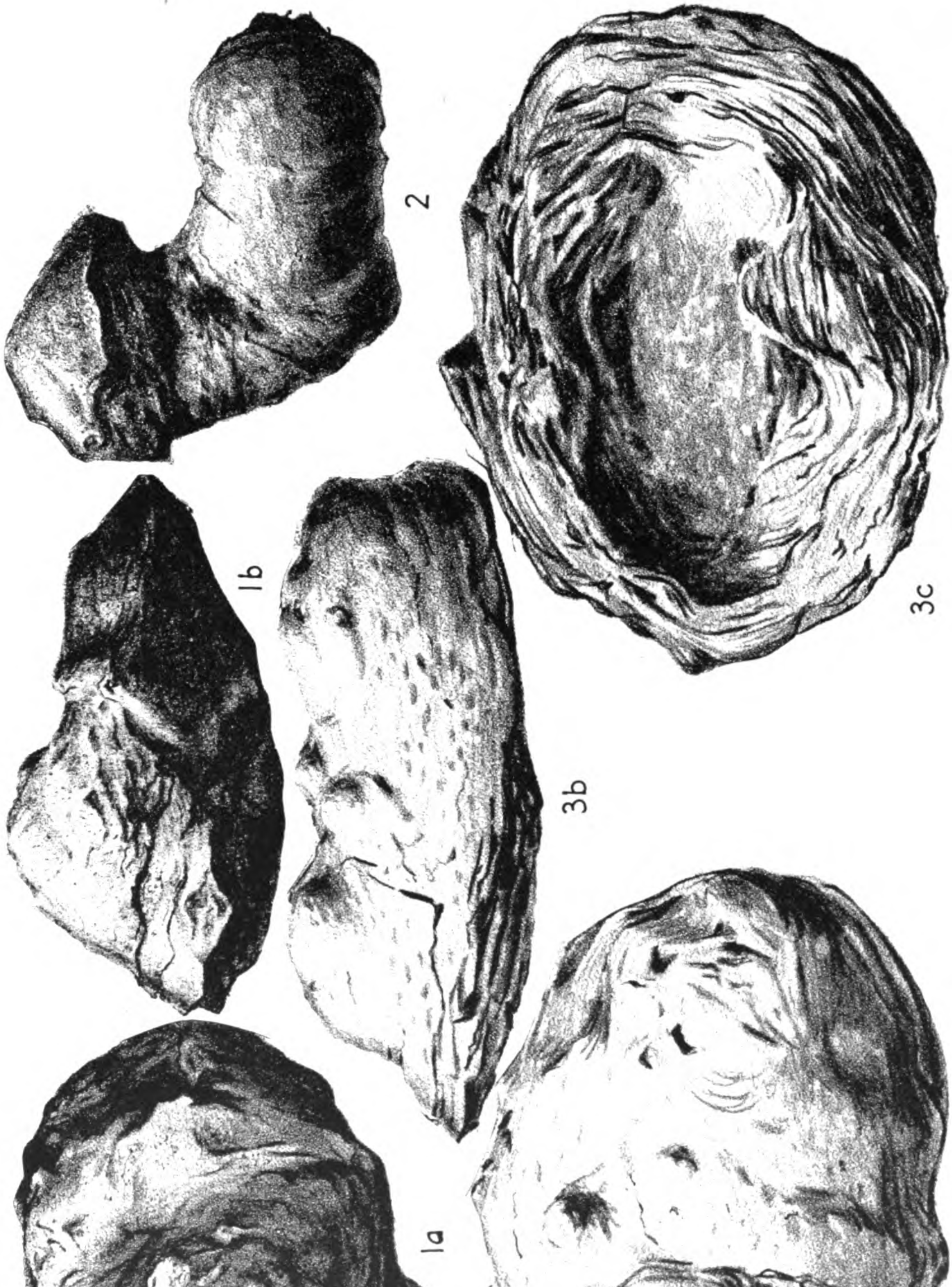
Explanation of Plate 8

(All figures x½)

Figure	Page
1—*Cyclotrypa bennetti* (Link), a typical specimen (Univ. Kansas no. 51-127a), from the Wayland shale, Virgilian, 5 miles west of Eastland, Tex. *a*, Top view of zoarium, showing characteristic irregular form and large low monticules. *b*, Side view.	283
2—*Cyclotrypa* sp., an undescribed form from the Graham formation, Virgilian, near Graham, Tex. (Univ. Texas no. 425330); side view of zoarium.	
3—*Cyclotrypa nebrascensis* (Condra), metatype (Univ. Kansas no. 311031), from the Bonner Springs shale member, Wyandotte limestone, Missourian, at Louisville, Neb. *a*, Top view of zoarium, showing irregular form. *b*, Side view. *c*, Basal view, showing loosely superposed laminae.	271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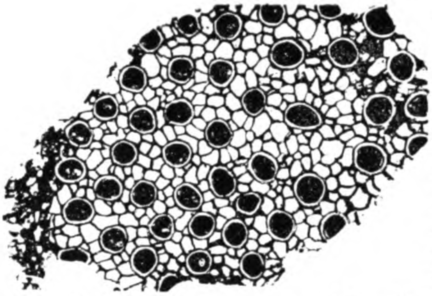
3a
3b
3c

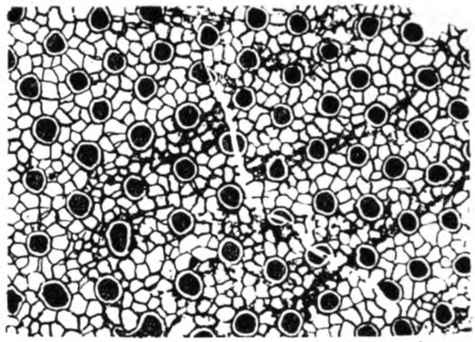
Explanation of Plate 9

(All figures are tangential sections, x10. Zooecial tubes marked with black, filling spaces almost to walls).

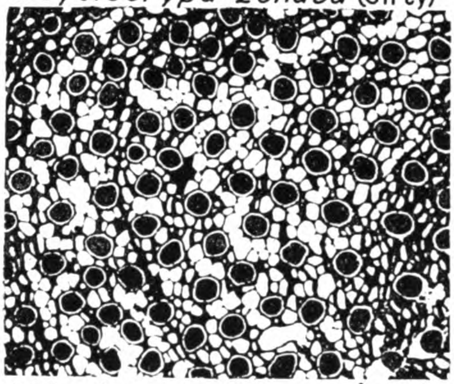
Figure	Page
1-3—*Cyclotrypa zonata* (Girty), from Missourian and Virgilian rocks of Missouri and Kansas. *1,* Specimen (Univ. Kansas no. 553531), from the Winterset limestone, Missourian, at Gallatin, Mo., showing somewhat irregular size and shape of zooecial tubes. *2,* Type specimen (Missouri Geol. Survey no. 2893), from the Plattsmouth limestone member, Oread limestone, Virgilian, northwest of Leavenworth, Kan. (after Girty). *3,* Specimen (Univ. Kansas no. 687831), from the Deer Creek limestone, Virgilian, 2 miles north of Oskaloosa, Kan., showing weak lunaria.	276
4—*Cyclotrypa matheri* Moore and Dudley, n. sp., section from the type specimen (Univ. Kansas no. 738531), Hale formation, Morrowan, southeast of Braggs, Okla., showing small zooecial tubes and fine vesicular structure.	267
5, 6—*Cyclotrypa candida* Moore and Dudley, n. sp. *5,* Section of specimen (Univ. Kansas no. 303231), from the Lecompton limestone, Virgilian, west of Lecompton, Kan., showing coarse vesicles and zooecial tubes somewhat larger and more closely spaced than average. *6,* Section from the type specimen (Univ. Kansas no. 485131), Coal Creek limestone member, Topeka limestone, Virgilian, northeast of Topeka, Kan.; a macula in upper part of area.	281



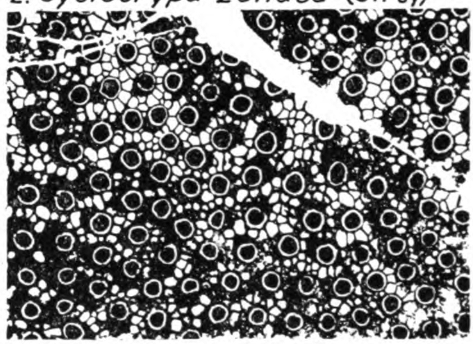
1. *Cyclotrypa zonata* (Girty)



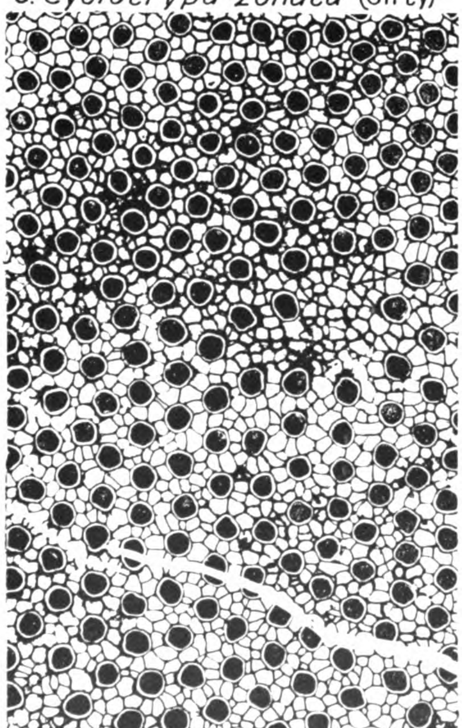
2. *Cyclotrypa zonata* (Girty)



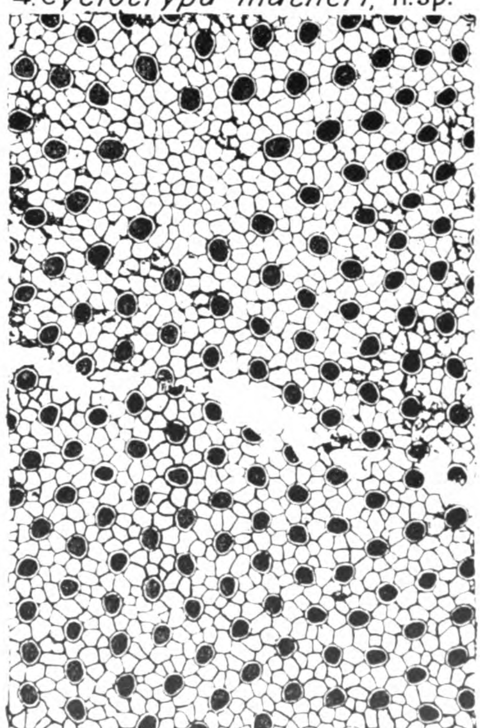
3. *Cyclotrypa zonata* (Girty)



4. *Cyclotrypa matheri*, n.sp.



5. *Cyclotrypa candida*, n.sp.

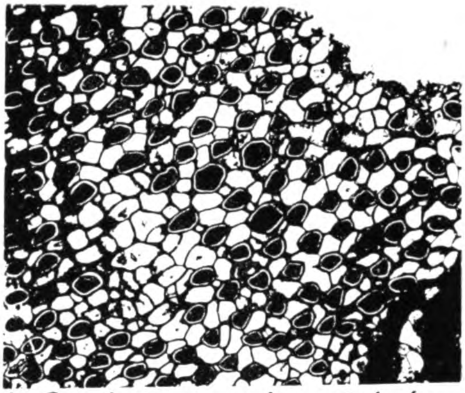


6. *Cyclotrypa candida*, n.sp.

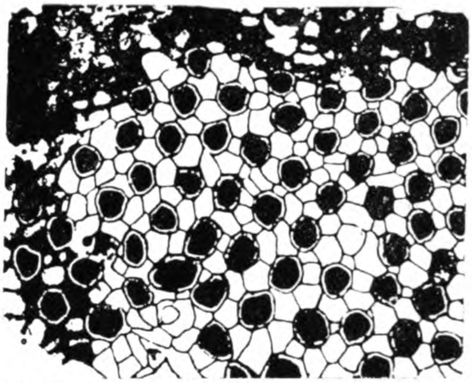
Explanation of Plate 10

(All figures are tangential sections, x10. Zooecial tubes marked with black, filling spaces almost to walls).

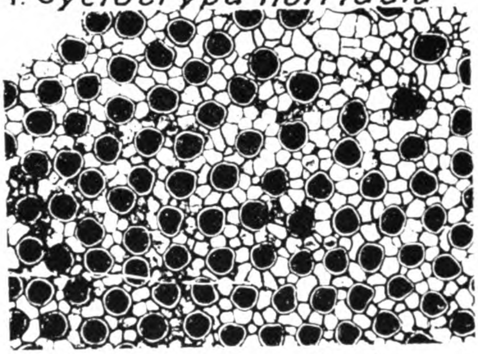
Figure	Page
1—*Cyclotrypa horridula* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 219231), from the Atoka formation, Lampasan, 0.75 mile north of Clarita, Okla., showing lunarial indentations of zooecial tubes and unusually coarse vesicular structure.	268
2—*Cyclotrypa repentis* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 461031), from the Plattsburg limestone, Missourian, 2.5 miles west of Neodesha, Kan., showing marked resemblance to *C. carbonaria.*	275
3—*Cyclotrypa pelagia* Moore and Dudley, n. sp., type specimen (Univ. New Mexico no. J-14), from the Magdalena limestone, Pennsylvanian, 175 to 275 feet below Abo sandstone, below Battleship Rock, near Jemez Springs, N. M., showing general similarity to *C. carbonaria* except for smaller vesicles.	284
4, 5—*Cyclotrypa nebrascensis* (Condra), specimens from the Missourian of Nebraska. 4, Metatype (Univ. Kansas no. 311031), from the Bonner Springs shale at Louisville, Neb., showing moderately small zooecial tubes and well marked lunaria. 5, Specimen (Univ. Kansas no. 531531), from the Stanton limestone west of Meadow, Neb.	271
6—*Cyclotrypa carbonaria* (Ulrich), specimen (Univ. Kansas no. 748931), from the Argentine limestone member, Wyandotte limestone, Missourian, at Wyandotte dam, north of Kansas City, Kan., showing very coarse vesicles and large zooecial tubes near macula.	269
7—*Cyclotrypa decora* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 685231), from the Stoner limestone member, Stanton limestone, Missourian, at Rock Lake, southeast of Ashland, Neb.; lunaria well defined.	275



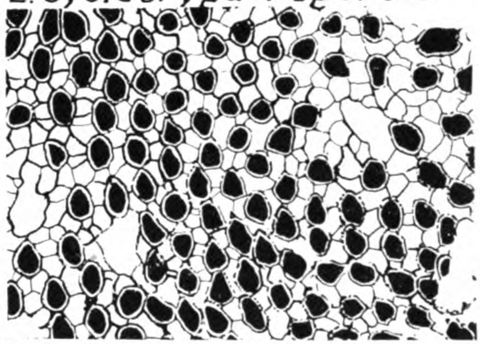
1. *Cyclotrypa horridula*



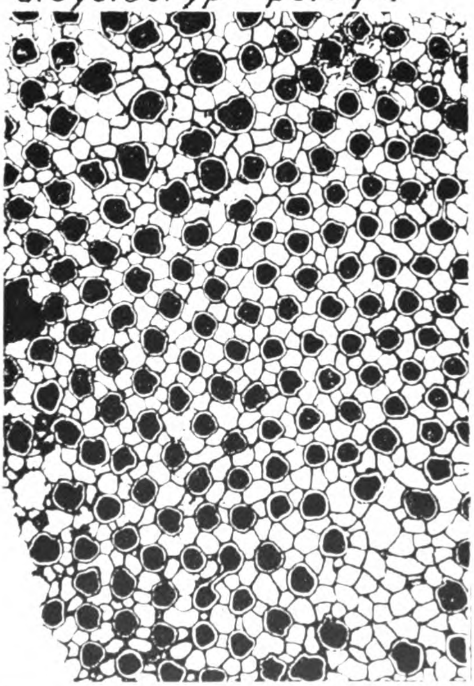
2. *Cyclotrypa repentis*



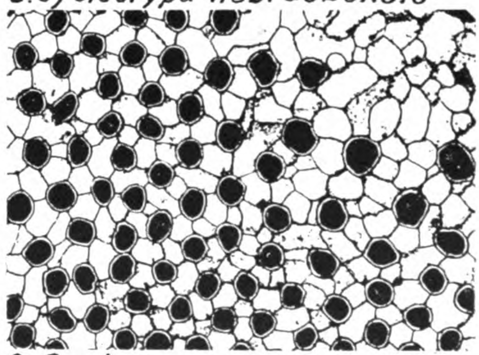
3. *Cyclotrypa pelagia*



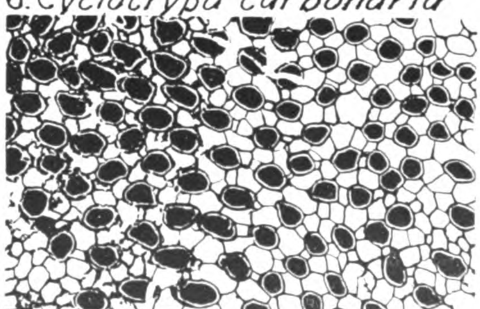
5. *Cyclotrypa nebrascensis*



7. *Cyclotrypa decora*



6. *Cyclotrypa carbonaria*

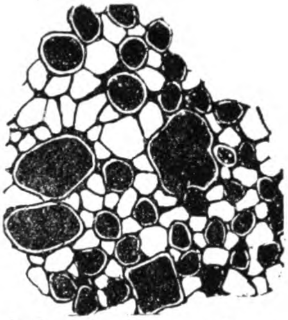


4. *Cyclotrypa nebrascensis*

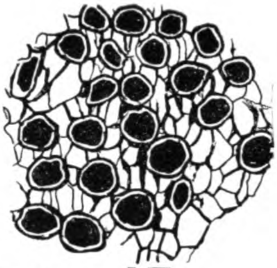
Explanation of Plate 11

(All figures tangential sections x10. Zooecial tubes marked with black, filling spaces almost to walls).

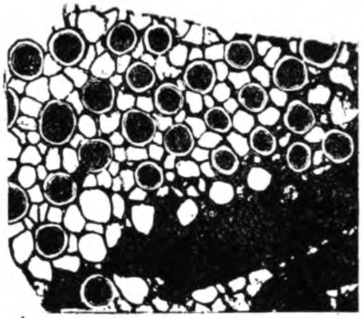
Figure	Page
1-3—*Cyclotrypa carbonaria* (Ulrich) from Missourian rocks. *1*, Type specimen (Univ. Kansas no. 79731), from fragment of type in U. S. National Museum, (?) Drum limestone at Kansas City, Mo., showing four excessively enlarged tubes, which do not have characters of ovicells (compare pl. 25, fig. 4). *2*, Type specimen (camera lucida drawing from section in U. S. National Museum, no. 43243). *3*, Specimen (Univ. Kansas no. 748932), from the Argentine limestone member, Wyandotte limestone, at Wyandotte dam north of Kansas City, Kan.	269
4—*Cyclotrypa tenuicula* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 216531), from the Dewey limestone, Missourian, 3 miles east of Dewey, Okla.	274
5—*Cyclotrypa acerba* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 549931), from the Ladore shale, Missourian, Dyson Hollow, west of LaPlatte, Neb., characterized by diminutive zooecial tubes and coarse vesicles.	272
6, 7—*Cyclotrypa nebrascensis* (Condra) from the Winterset limestone at Carlyle quarry, west of LaPlatte, Neb. *6*, Section (Univ. Kansas no. 552631), showing a macula. *7*, Specimen (Univ. Kansas no. 552632), showing normal characters of the species, lunaria clearly defined.	271
8—*Cyclotrypa procera* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 701131), from the Hertha limestone, Missourian, southeast of Princeton, Mo.; showing large, widely spaced zooecial tubes and coarse vesicles.	273



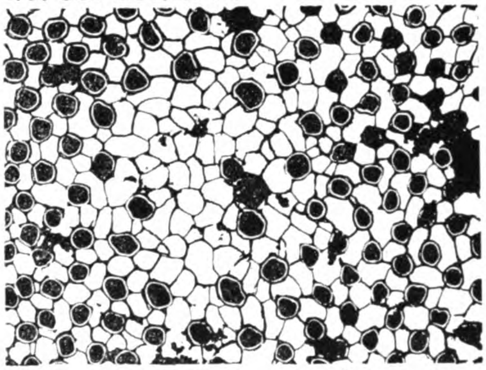
1. C. carbonaria



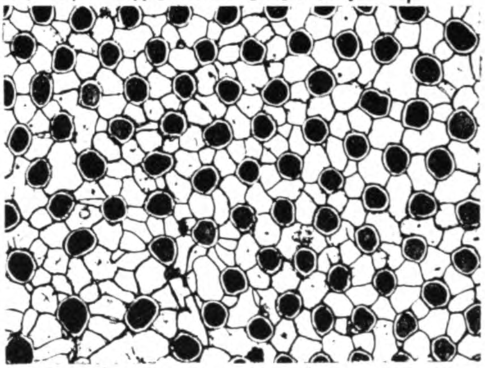
2. Cyclotrypa carbonaria (Ulr.)



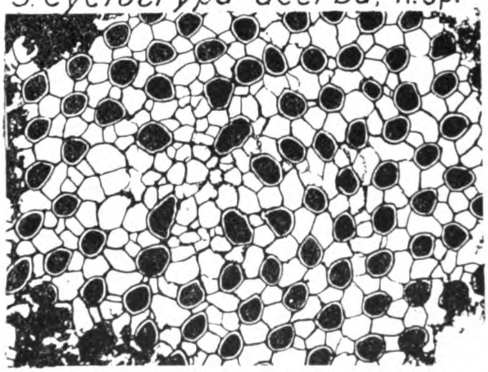
4. C. tenuicula, n. sp.



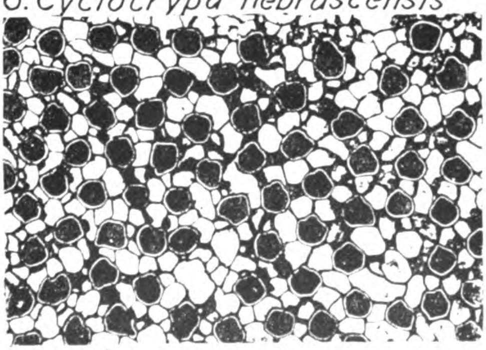
5. Cyclotrypa acerba, n. sp.



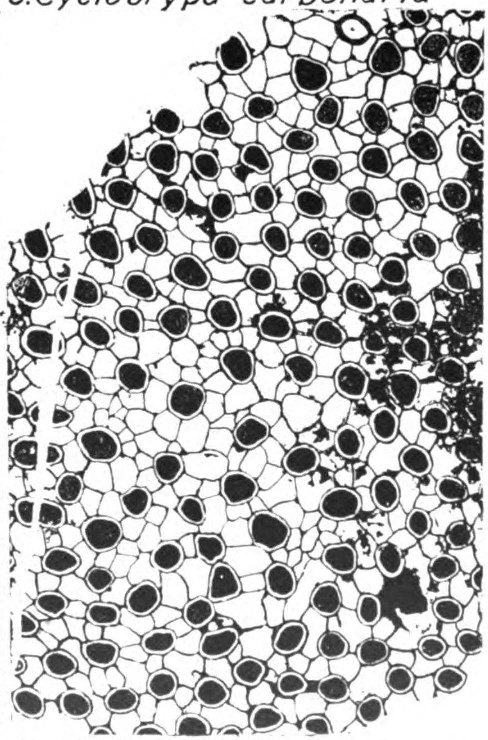
3. Cyclotrypa carbonaria



6. Cyclotrypa nebrascensis



7. Cyclotrypa nebrascensis



8 Cyclotrypa procera, n. sp.

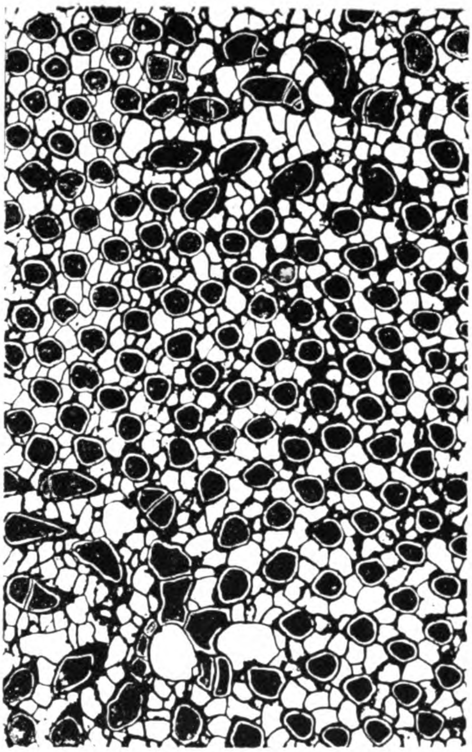
EXPLANATION OF PLATE 12

(All figures tangential sections x10. Zooecial tubes marked with black, filling spaces almost to walls).

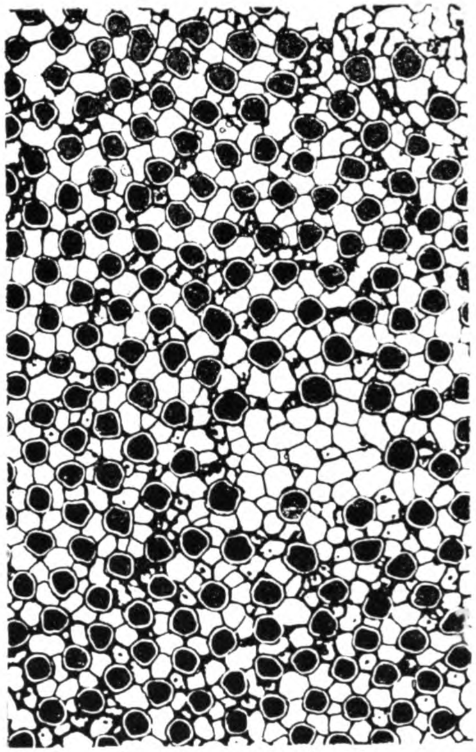
FIGURE — PAGE

1-3—*Cyclotrypa capacis* Moore and Dudley, n. sp., from Virgilian rocks of Kansas and Nebraska. *1*, Type specimen (Univ. Kansas no. 798031), from the Calhoun shale at the Sheldon quarry, Nehawka, Neb., showing maculae (upper right and lower left) surrounded by thick-walled oblique zooecia. *2*, Specimen (Univ. Kansas no. 798231), from the Topeka limestone 4½ miles northwest of Troy, Kan. *3*, Specimen (Univ. Kansas no. 798131), from the Reading limestone, in the SW sec. 25, T. 32 S., R. 8 E., west of Leeds, Kan. 278

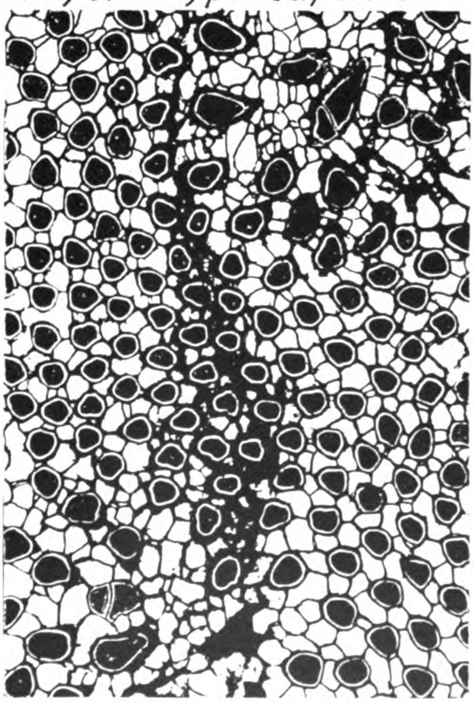
4—*Cyclotrypa abdita* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 798331), from the Clay Creek limestone member, Kanwaka shale, Virgilian, 2 miles west of Lecompton, Kan., showing resemblance to *C. capacis* but greater regularity of zooecia and vesicles; a macula occurs near center of area, adjoining zooecia being subcircular in plane of the section. 279



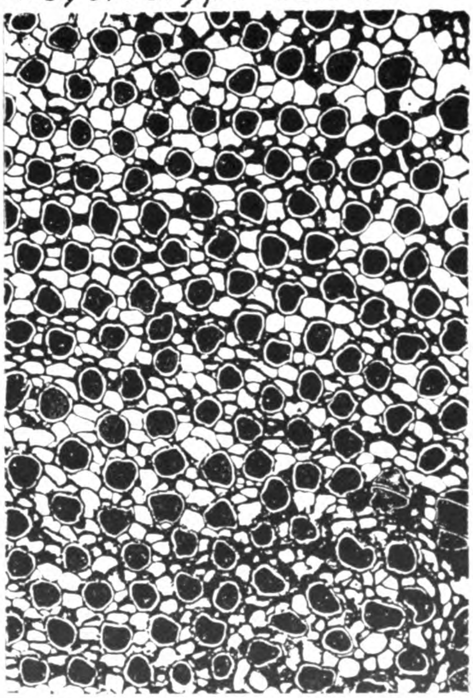
1. *Cyclotrypa capacis*



4. *Cyclotrypa abdita*



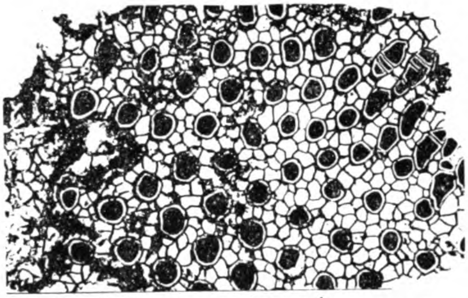
2. *Cyclotrypa capacis*



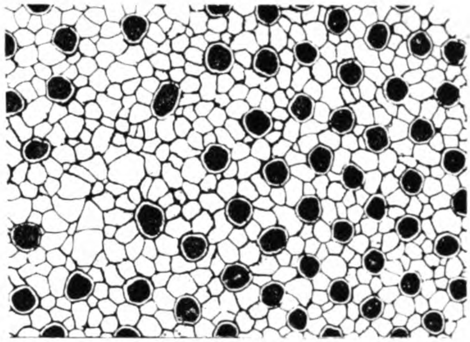
3. *Cyclotrypa capacis*

EXPLANATION OF PLATE 13

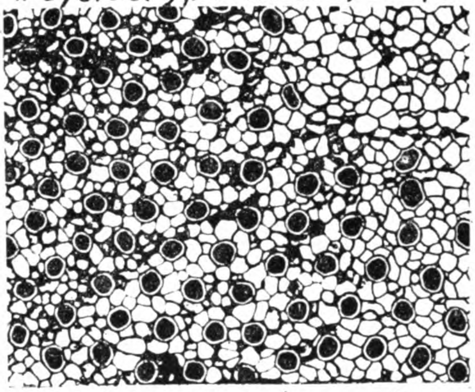
(All figures tangential sections x10. Zooecial tubes marked with black, filling spaces almost to walls)



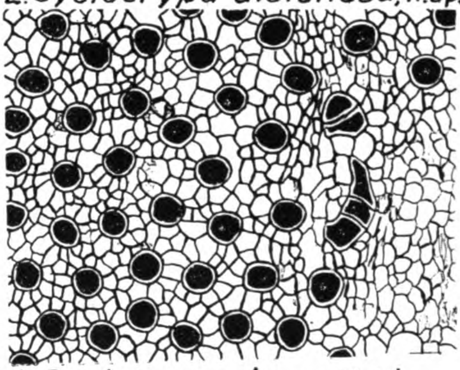
1. *Cyclotrypa imula*, n.sp.



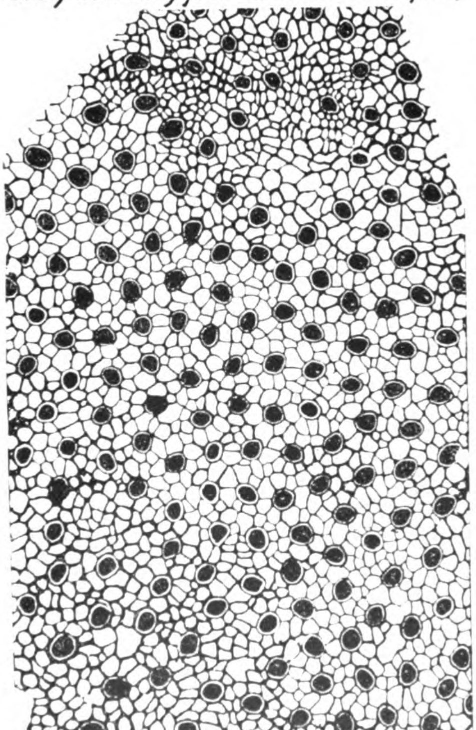
2. *Cyclotrypa disiuncta*, n.sp.



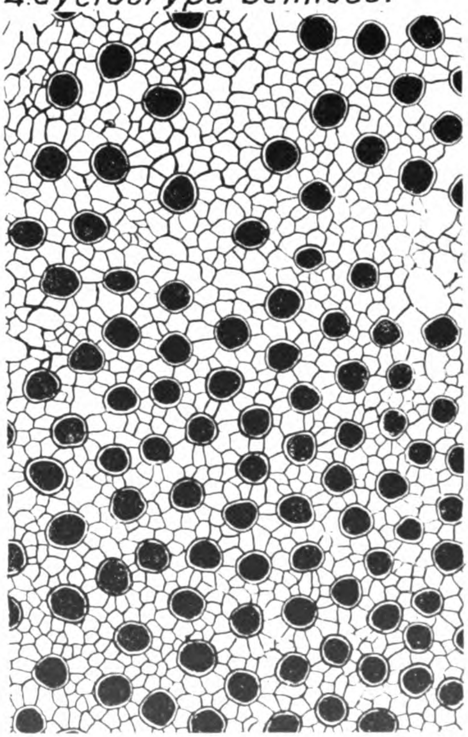
3. *Cyclotrypa abnormis*, n.sp



4. *Cyclotrypa bennetti*



6. *Cyclotrypa idonea*, n.sp.



5. *Cyclotrypa bennetti*

Explanation of Plate 14

(All figures tangential sections x10. Zooecial tubes marked with black, filling spaces almost to walls)

Figure — Page

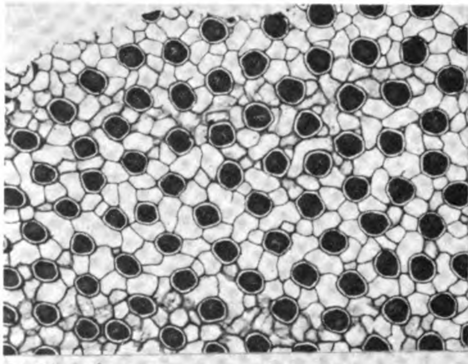
1, 2—*Cyclotrypa pelagia* Moore and Dudley, n. sp., from the Magdalena limestone, 100 to 600 feet below the Abo sandstone, near Jemez Springs, N. M. *1,* Specimen (Univ. Kansas no. 106431), having wider than average spacing of zooecial tubes, closely resembling *C. carbonaria*. *2,* Specimen (Univ. New Mexico no. J-36a), showing crowded zooecia. 284

3—*Cyclotrypa capacis* Moore and Dudley, n. sp., specimen (Univ. Kansas no. 99-31), from the Oread limestone, Snyderville quarry, west of Nehawka, Neb. 278

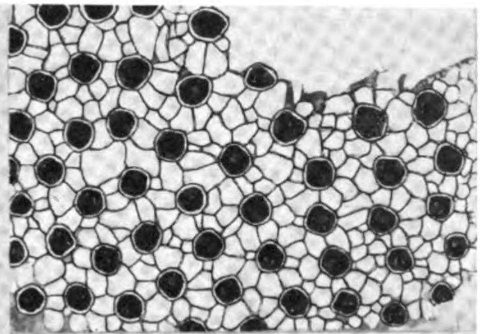
4—*Cyclotrypa torosa* Moore and Dudley, n. sp., type specimen (Yale Univ. Peabody Mus. no. 88-30), from *Uddenites* zone of Gaptank formation, at Wolfcamp, Glass Mountains, 12 miles N. 35° E. from Marathon, Tex., showing large zooecial tubes and vesicles. 286

5—*Cyclotrypa simplicis* Moore and Dudley, n. sp., type specimen (Univ. Texas no. 3101), from the Gaptank formation, 2 miles south of Gaptank, Pecos County, Texas, characterized by large nearly circular zooecial tubes and moderate-sized vesicles. 286

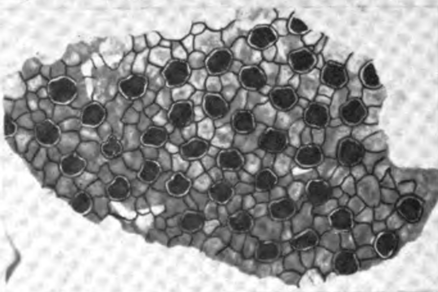
6—*Cyclotrypa hirta* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 741431), from Leonardian beds at Clay Slide, 2 miles west of Iron Mountain, Glass Mountains, 7.5 miles N. 30° W. from Marathon, Tex., showing mostly small size of zooecia; a macula, bordered by oblique zooecial tubes, is present in lower part of area... 289



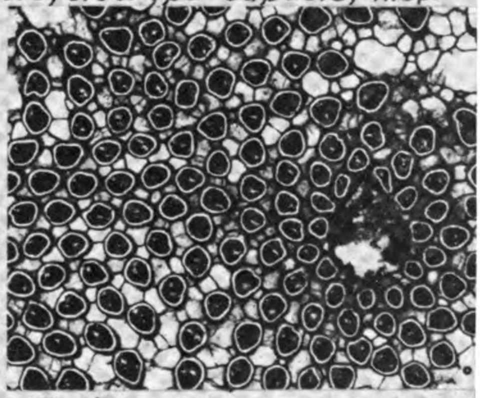
1. *Cyclotrypa pelagia*, n.sp.



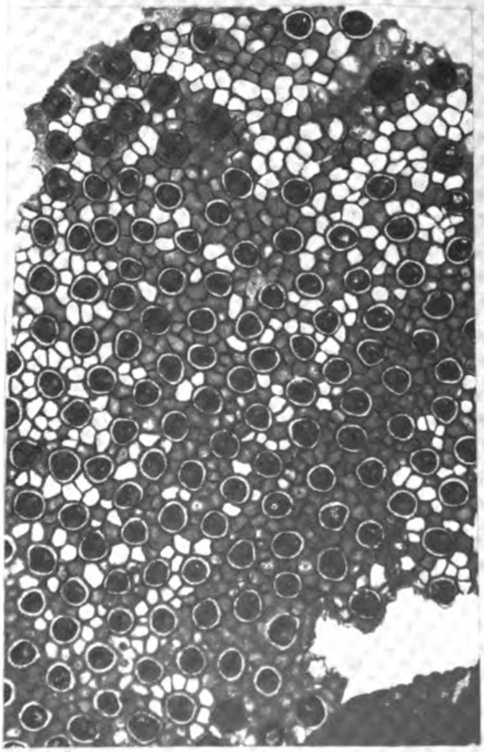
3. *Cyclotrypa capacis*, n.sp.



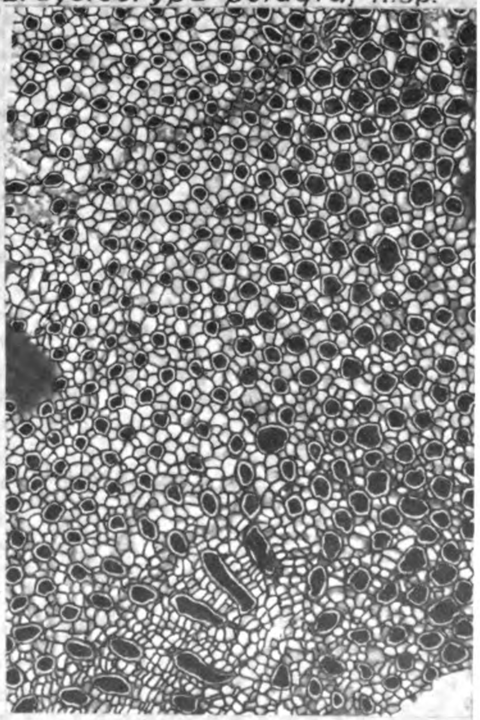
4. *Cyclotrypa torosa*, n.sp.



2. *Cyclotrypa pelagia*, n.sp.



5. *Cyclotrypa simplicis*, n.sp.

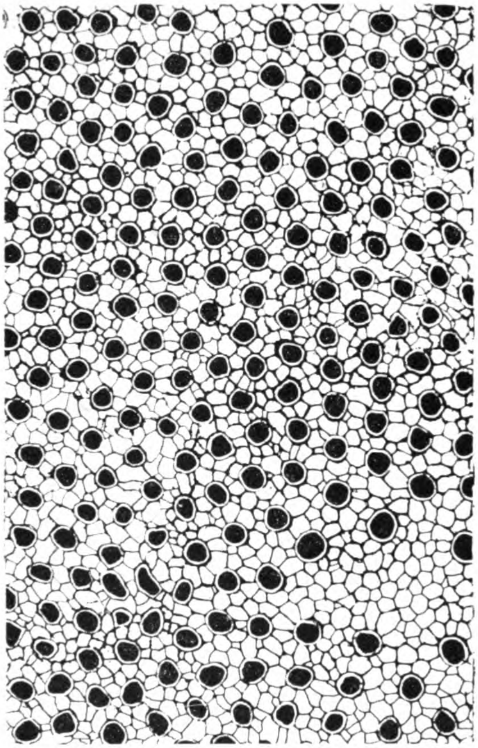


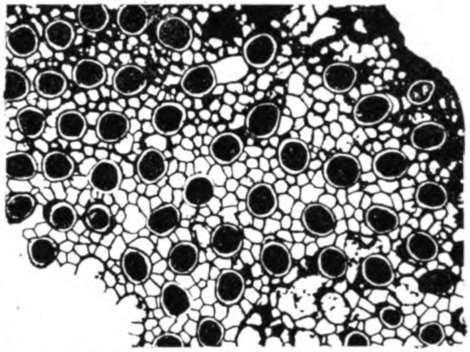
6. *Cyclotrypa hirta*, n.sp.

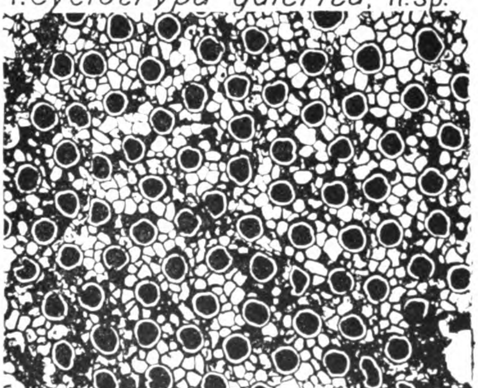
Explanation of Plate 15

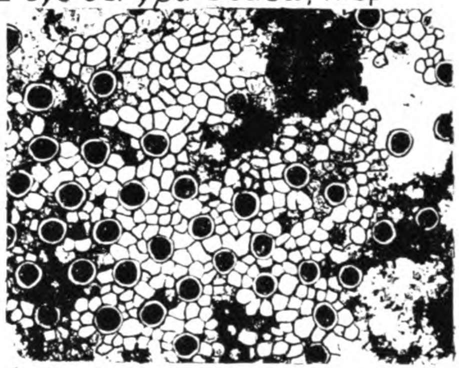
(All figures tangential sections x10. Zooecial tubes marked with black, filling spaces almost to walls)

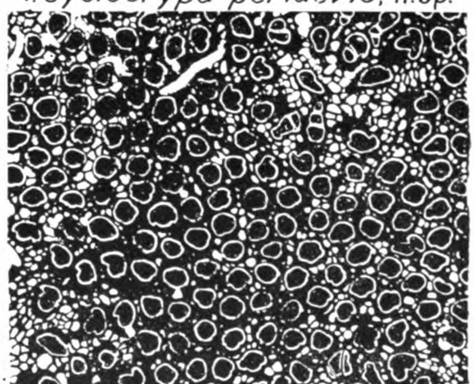
Figure	Page
1—*Cyclotrypa galerita* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 54-31), from the Hughes Creek shale member, Foraker formation, Lower Permian, 1 mile southeast of Bennett, Neb.	289
2, 3—*Cyclotrypa beata* Moore and Dudley, n. sp., specimens from the Hughes Creek shale member, Foraker formation, Lower Permian, in Kansas and Nebraska. *2*, Section of specimen (Univ. Kansas no. 693031), from 2 miles west of Zeandale, Riley County, Kansas, showing typical large zooecia and small vesicles but lunaria mostly indistinguishable. *3*, Type specimen (Univ. Kansas no. 798631), from 0.5 mile northeast of Humboldt, Neb., showing well defined lunaria; a macula at lower left.	288
4—*Cyclotrypa perlaevis* Moore and Dudley, n. sp., type specimen (Yale Univ. Peabody Mus. no. 89-30), from Wolfcampian beds at Wolfcamp, Glass Mountains, 12 miles N. 35° E. from Marathon, Tex., showing fairly large circular zooecial tubes lacking lunaria and moderately coarse vesicular tissue.	287
5—*Triphyllotrypa passa* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 40431), from the Florena shale member, Beattie limestone, Lower Permian, SE sec. 19, T. 1 S., R. 15 E., Brown County, Kansas. Variation in appearance of the zooecial tubes is noteworthy, some showing characteristic trilobate appearance that is seen in most representatives of the genus, others lacking this feature; three maculae, surrounded by obliquely disposed zooecia, are visible in the section.	293


1. *Cyclotrypa galerita*, n. sp.


2 *Cyclotrypa beata*, n. sp.

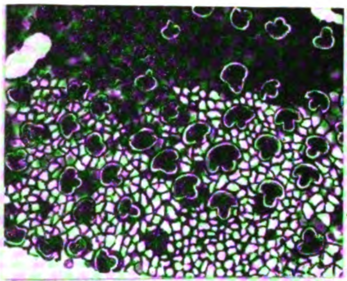

3. *Cyclotrypa beata*, n. sp.


4. *Cyclotrypa perlaevis*, n. sp.

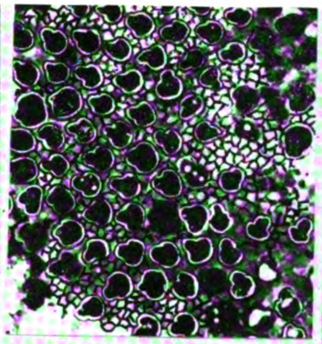

5. *Triphyllotrypa passa*, n. sp.

Explanation of Plate 16

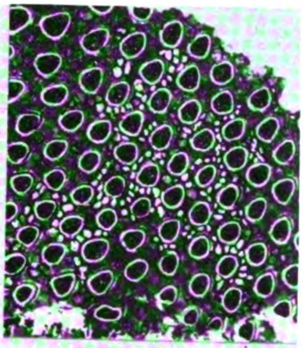
(All figures tangential sections x10. Zooecial tubes marked with black, filling spaces almost to walls)



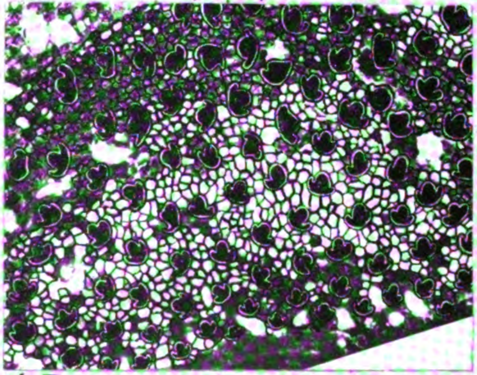
1. Triphyllotrypa abstrusa, n.sp.



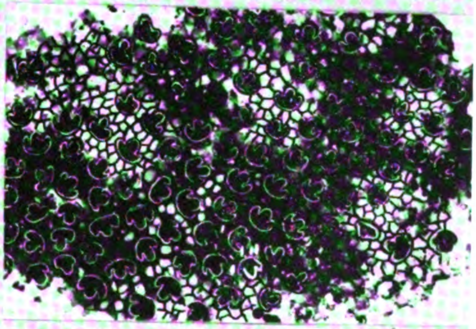
2. T. definita



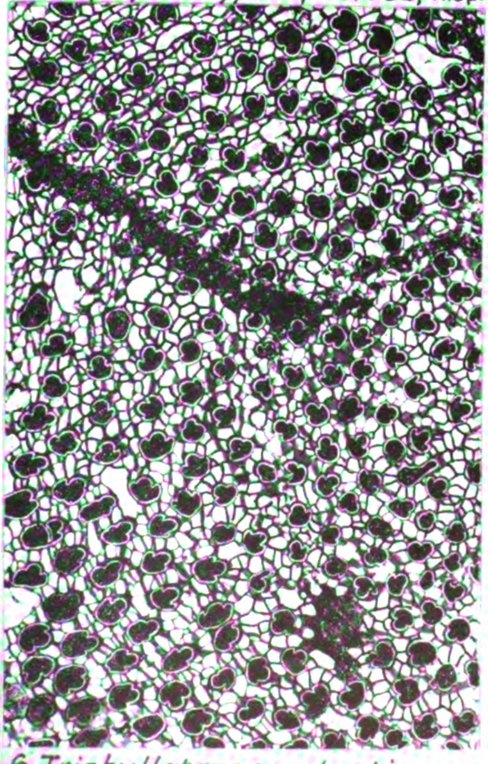
3. T. galeata, n.sp.



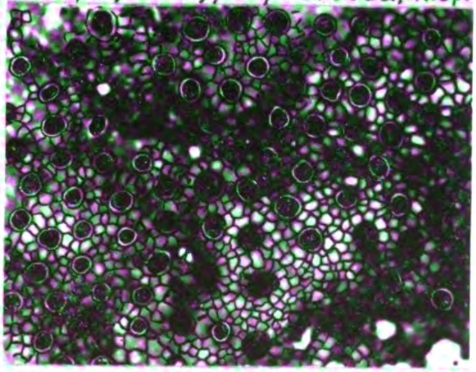
4. Triphyllotrypa speciosa, n.sp.



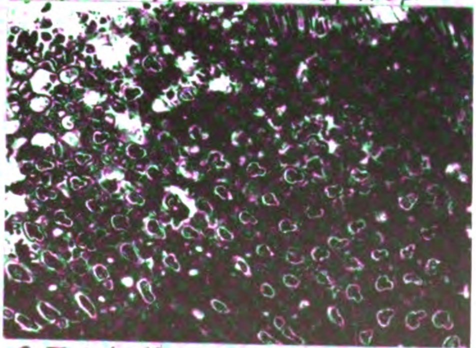
5. Triphyllotrypa proiecta, n.sp.



6. Triphyllotrypa patentis, n.sp.



7. Cyclotrypa debilis, n.sp.



8. Triphyllotrypa spissa, n.sp.

Explanation of Plate 17

(All figures tangential sections x20)

FIGURE PAGE

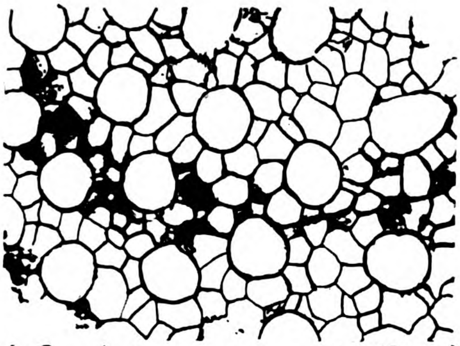
1, 5, 6—*Cyclotrypa zonata* (Girty). *1,* Specimen (Univ. Kansas no. 553531), from the Winterset limestone, Missourian, near Gallatin, Mo. *5,* Type specimen (Missouri Geol. Survey no. 2893), from the Oread limestone, Virgilian, northwest of Leavenworth, Kan. *6,* Specimen (Univ. Kansas no. 687831), from the Deer Creek limestone, Virgilian, 2 miles north of Oskaloosa, Kan. 276

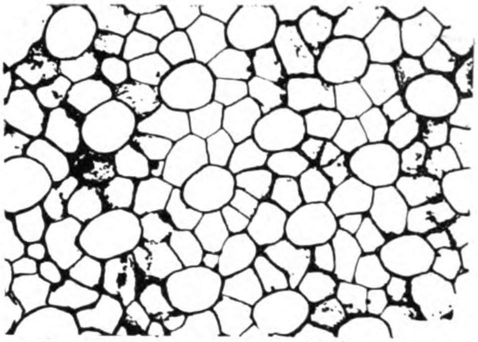
2, 3—*Cyclotrypa candida* Moore and Dudley, n. sp. *2,* Type specimen (Univ. Kansas no. 485131), from the Coal Creek limestone member, Topeka limestone, Virgilian, northeast of Topeka, Kan. *3,* Specimen (Univ. Kansas no. 303231), from the Lecompton limestone west of Lecompton, Kan. 281

4—*Cyclotrypa imula* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 798431), from the Deer Creek limestone, Virgilian, 3 miles east of Moline, Kan. 281

7—*Cyclotrypa matheri* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 738531), from the Hale formation, Morrowan, southeast of Braggs, Okla. 267

8—*Cyclotrypa abnormis* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 502631), from the Lecompton limestone, Virgilian, sec. 25, T. 14 S., R. 17 E., southwestern Douglas County, Kansas. 280


1. *Cyclotrypa zonata* (Girty)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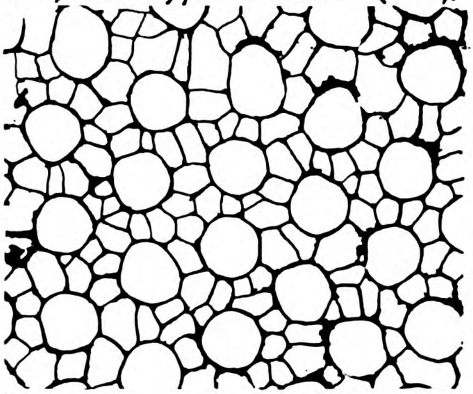
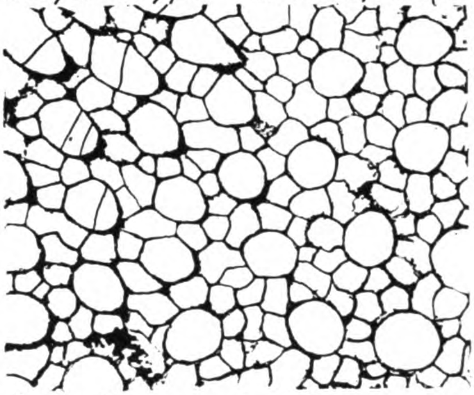

3. *Cyclotrypa candida*, n. sp.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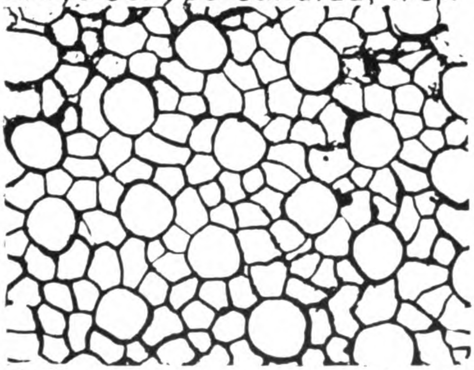
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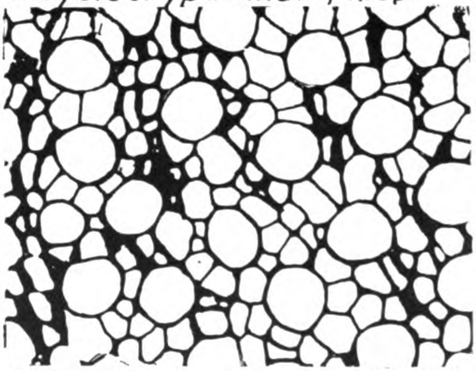
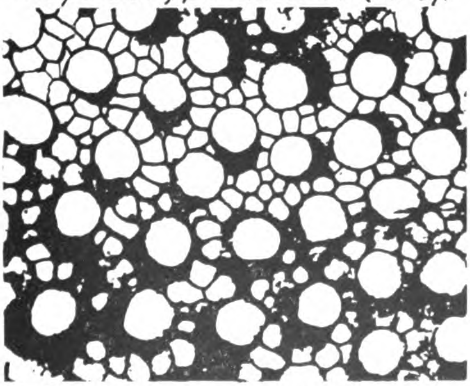
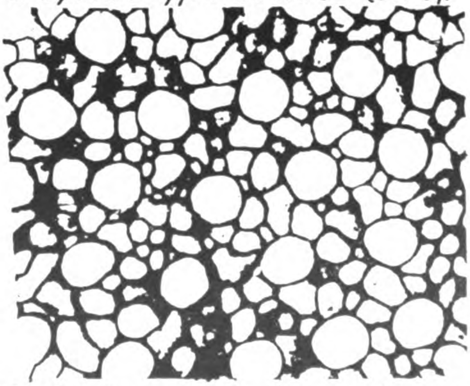

6. *Cyclotrypa zonata* (Girty)


7. *Cyclotrypa matheri* n. sp.


8. *Cyclotrypa abnormis* n. sp.

Explanation of Plate 18

(All figures tangential sections x20)

Figure	Page
1—*Cyclotrypa decora* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 685231), from the Stoner limestone member, Stanton limestone, Missourian, at Rock Lake, southeast of Ashland, Neb.	275
2-4—*Cyclotrypa pelagia* Moore and Dudley, n. sp. *2,* Specimen (Univ. New Mexico no. J-28), from the Magdalena limestone, ?Virgilian, about 75 feet below Abo sandstone, north fork of Jemez Creek, above Jemez Springs, N. M. *3,* Specimen (Univ. Kansas no. 106431), from the Magdalena limestone, Abo Canyon, N. M. *4,* Type specimen (Univ. New Mexico no. J-14), from the Magdalena limestone, 175 to 275 feet below Abo sandstone, below Battleship Rock, above Jemez Springs, N. M.	284
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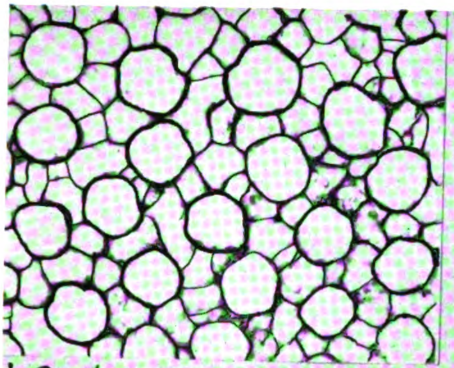
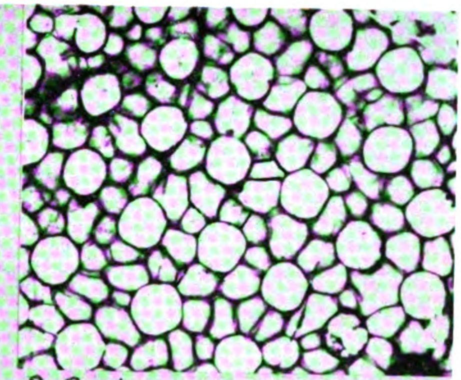
6—*Cyclotrypa carbonaria* (Ulrich), specimen (Univ. Kansas no. 748933), from the Argentine limestone member, Wyandotte limestone, Missourian, at Wyandotte dam, north of Kansas City, Kan.	269
7—*Cyclotrypa nebrascensis* (Condra), specimen (Univ. Kansas no. 531531), from the Stanton limestone, Missourian, west of Meadow, Neb.	271
8—*Cyclotrypa repentis* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 461031), from the Plattsburg limestone, Missourian, 2.5 miles west of Neodesha, Kan.	275



1. *Cyclotrypa decora*, n.sp.



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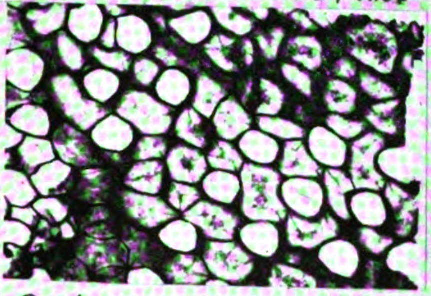
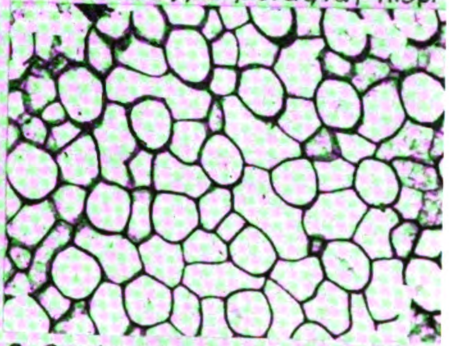
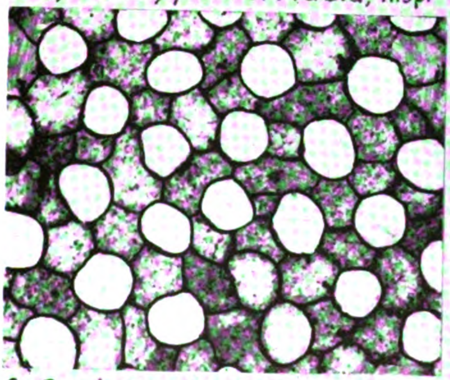


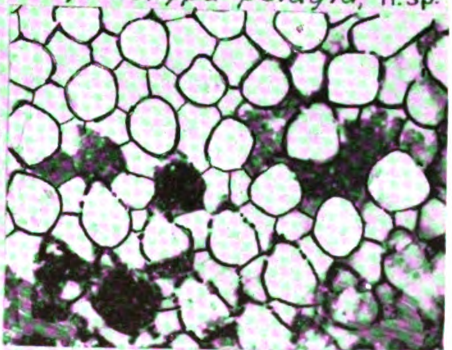
5. *Cyclotrypa horridula*, n.sp.



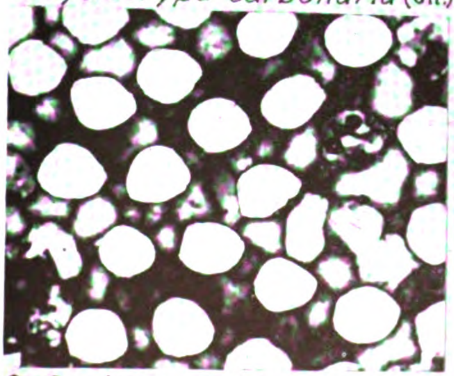
3. *Cyclotrypa pelagia*, n.sp.



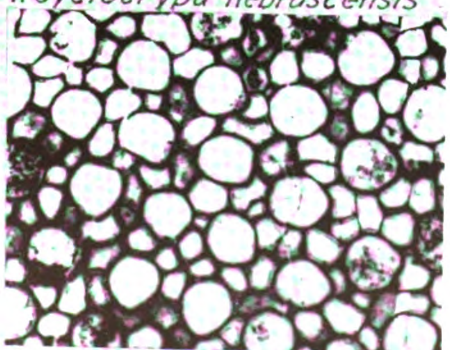
6. *Cyclotrypa carbonaria* (Ulr.)



7. *Cyclotrypa nebrascensis*



8. *Cyclotrypa repentis*, n.sp.



4. *Cyclotrypa pelagia*, n.sp.

Explanation of Plate 19

(All figures tangential sections x20)

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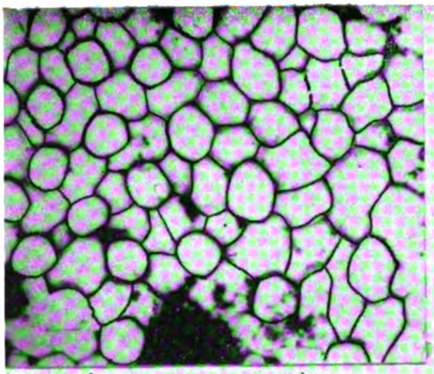
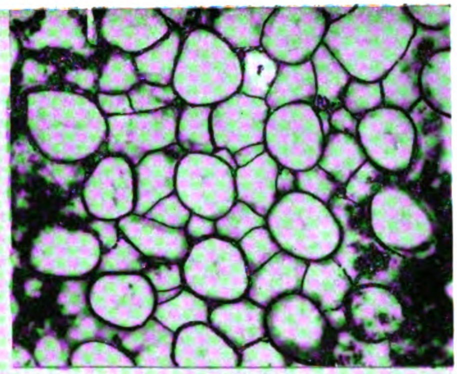
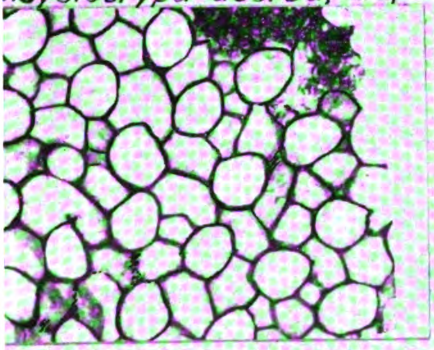

1. *Cyclotrypa acerba*, n. sp.


2. *Cyclotrypa procera*, n. sp.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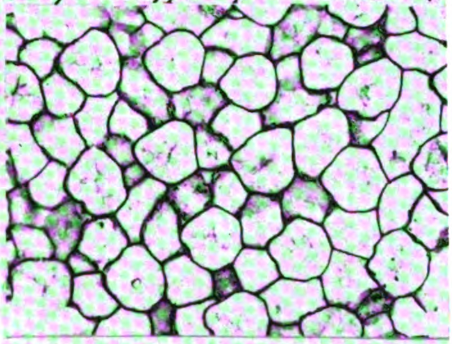
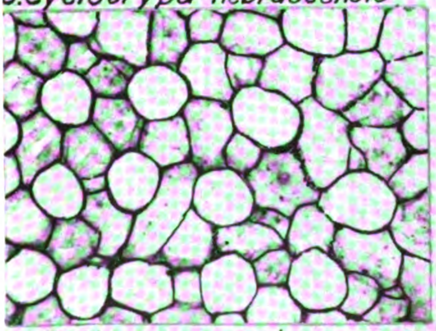
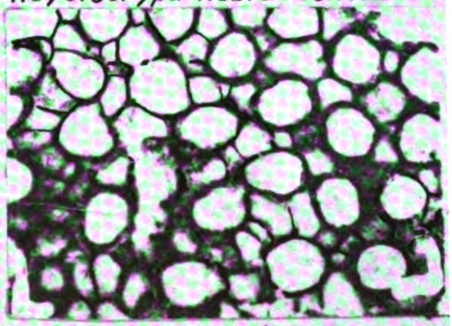
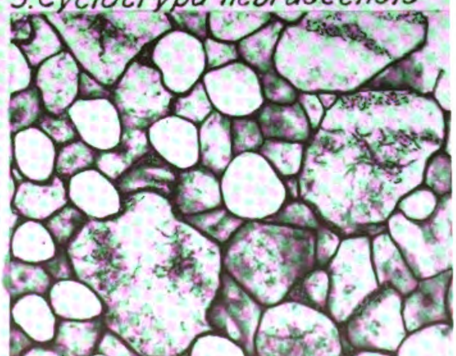

4. *Cyclotrypa nebrascensis*


6. *Cyclotrypa carbonaria*


5. *Cyclotrypa nebrascensis*


8. *Cyclotrypa tenuicula*, n. sp.


7. *Cyclotrypa carbonaria*

Explanation of Plate 20

(All figures tangential sections x20)

Figure	Page
1, 2—*Cyclotrypa beata* Moore and Dudley, n. sp., from the Hughes Creek shale member, Foraker formation, Lower Permian. *1*, Type specimen (Univ. Kansas no. 798631), from 0.5 mile northeast of Humboldt, Neb., showing lunarial thickening. *2*, Specimen (Univ. Kansas no. 693031), from 2 miles west of Zeandale, Riley County, Kansas	288
3—*Cyclotrypa disiuncta* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 798731), from the Wakarusa limestone, Virgilian, 2.5 miles northwest of Elk Creek, Neb.	283
4—*Cyclotrypa bennetti* (Link), specimen (Univ. Kansas no. 51-127a), from the Wayland shale, Virgilian, 5 miles west of Eastland, Tex., showing the characteristic large subcircular form of the zooecial tubes	283
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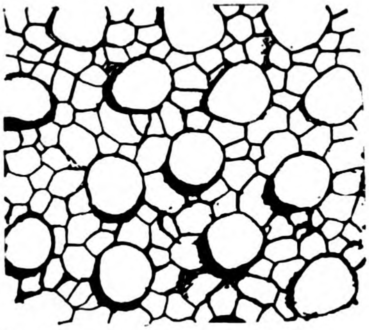
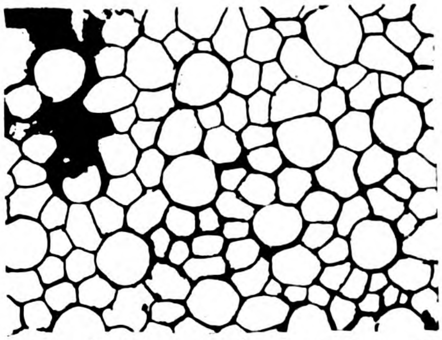
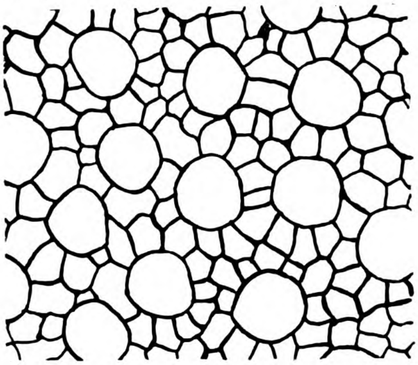


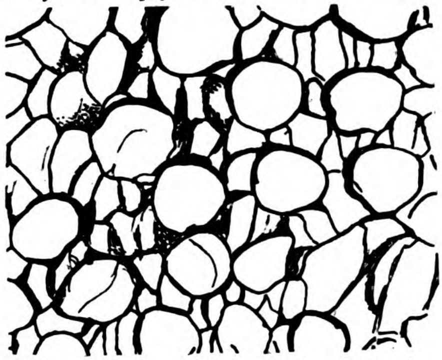
1. *Cyclotrypa beata*, n. sp.



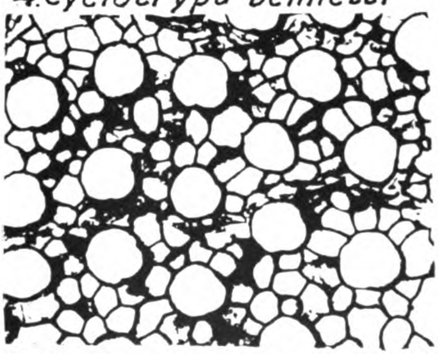
3. *Cyclotrypa disiuncta*, n. sp.



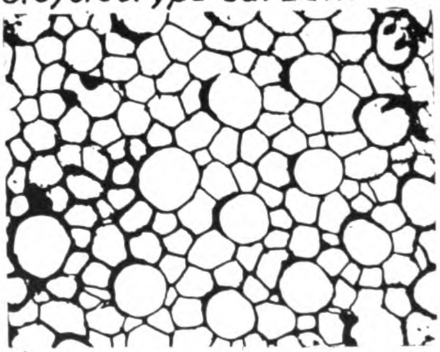
4. *Cyclotrypa bennetti*



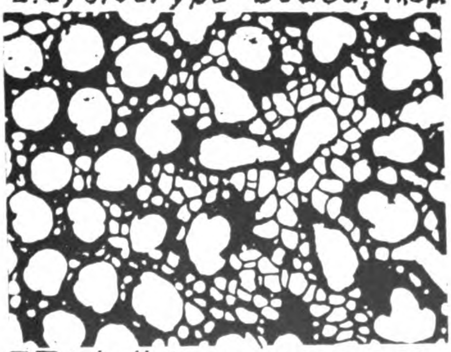
5. *Cyclotrypa carbonaria*



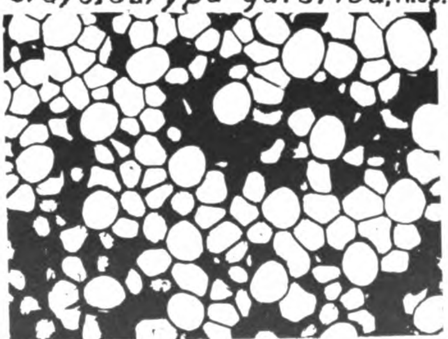
2. *Cyclotrypa beata*, n. sp.



6. *Cyclotrypa galerita*, n. sp.



7. *Triphyllotrypa passa*, n. sp.



8. *Cyclotrypa idonea*, n. sp.

Explanation of Plate 21

(All figures tangential sections x20)

Figure	Page
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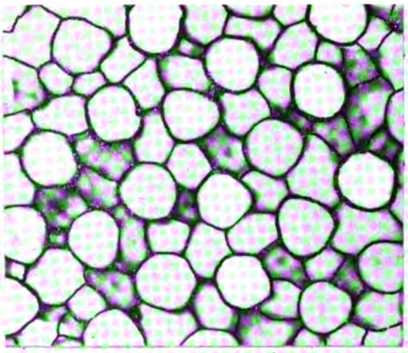
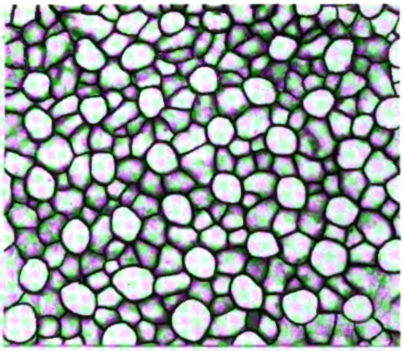
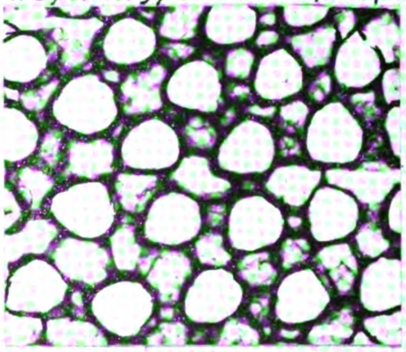


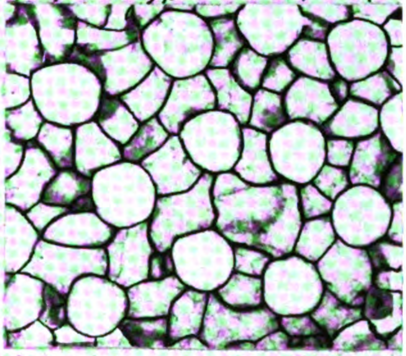
1. *Cyclotrypa abdita*, n.sp.



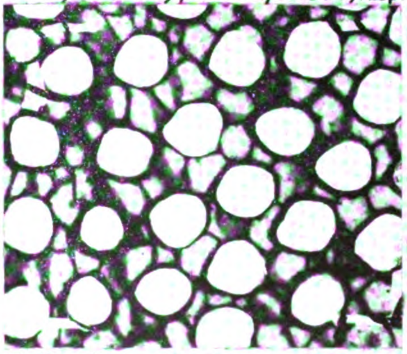
2. *Cyclotrypa hirta*, n.sp.



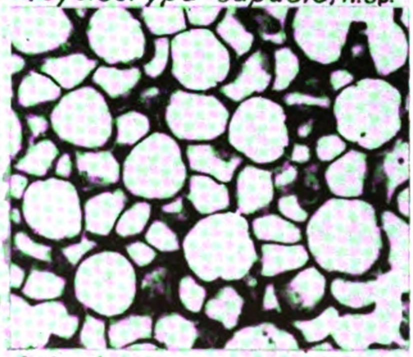
3. *Cyclotrypa capacis*, n.sp.



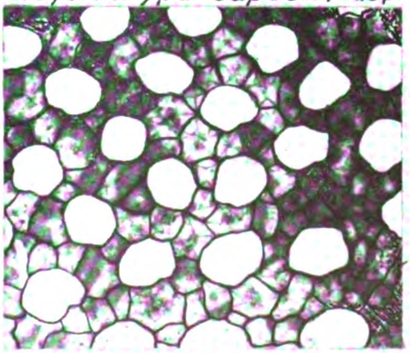
4. *Cyclotrypa capacis*, n.sp.



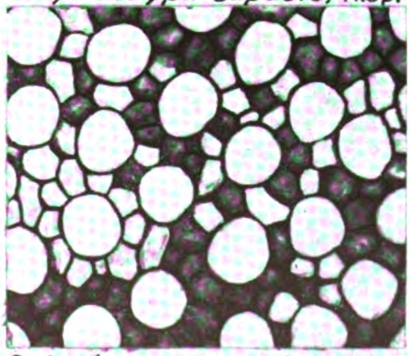
5. *Cyclotrypa capacis*, n.sp.



6. *Cyclotrypa capacis*, n.sp.



7. *Cyclotrypa torosa*, n.sp.



8. *Cyclotrypa simplicis*, n.sp.

Explanation of Plate 22

(All figures x20; all except figure 2 are tangential sections)

Figure	Page
1—*Cyclotrypa pelagia* Moore and Dudley, n. sp., specimen (Univ. New Mexico no. J-36), from the Magdalena limestone, Pennsylvanian, between 100 and 600 feet below the Abo sandstone, near Jemez Springs, N. M., showing zooecial tubes more closely spaced than typical for this species	284
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6—*Triphyllotrypa proiecta* Moore and Dudley, n. sp., type specimen (Yale Univ. Peabody Mus. no. 12-35), from Leonardian beds, south of Clay Slide, Glass Mountains, 7 miles N. 30° W. from Marathon, Tex., showing strongly developed pseudosepta	294
7—*Triphyllotrypa speciosa* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 741433), from Leonardian beds at Clay Slide, 2 miles west of Iron Mountain, Glass Mountains, 7.5 miles N. 30° W. from Marathon, Tex.	291
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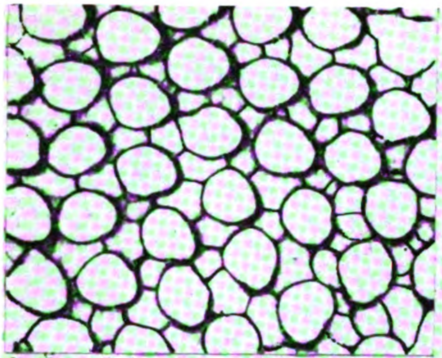
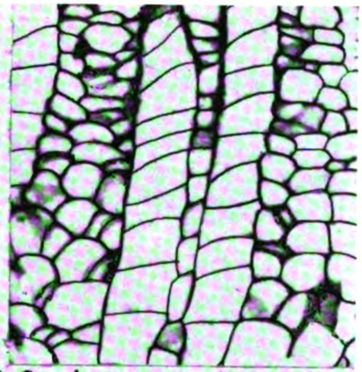
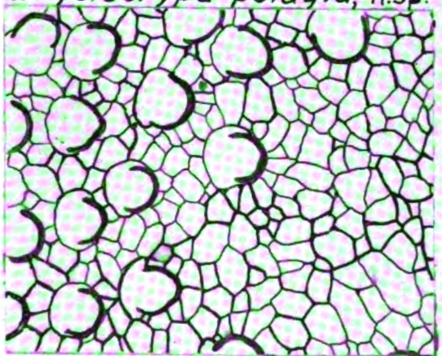


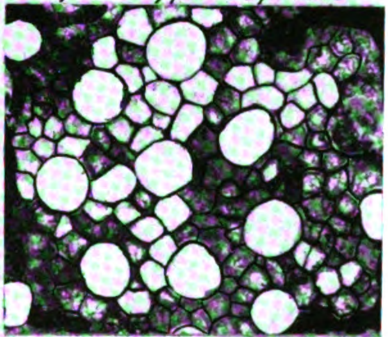
1. *Cyclotrypa pelagia*, n.sp.



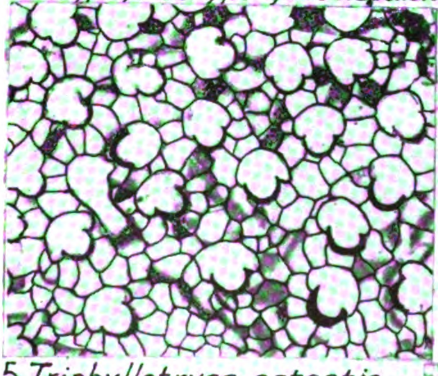
2. *Cyclotrypa capacis*



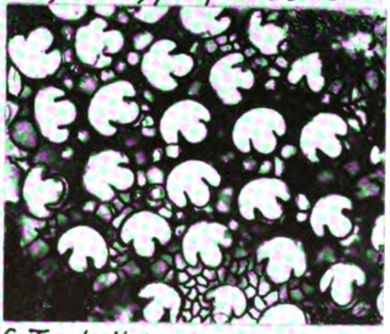
3. *Tryphyllotrypa guadalupensis*



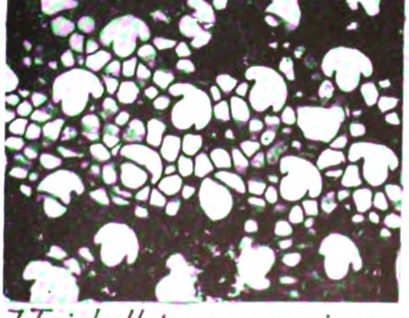
4. *Cyclotrypa perlaevis*



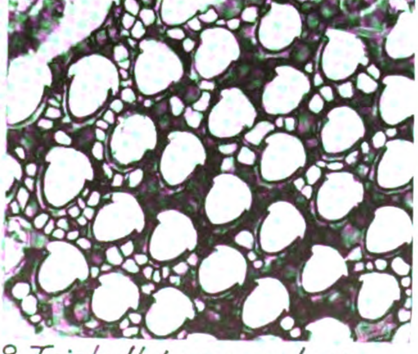
5. *Triphyllotrypa patentis*



6. *Triphyllotrypa proiecta*



7. *Triphyllotrypa speciosa*



8. *Triphyllotrypa galeata*

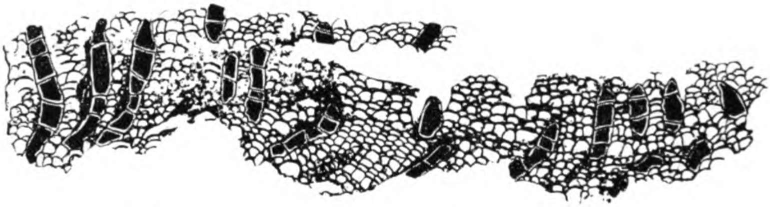
Explanation of Plate 23

(All figures longitudinal sections x10. Zooecial tubes marked with black, filling spaces almost to walls and diaphragms)

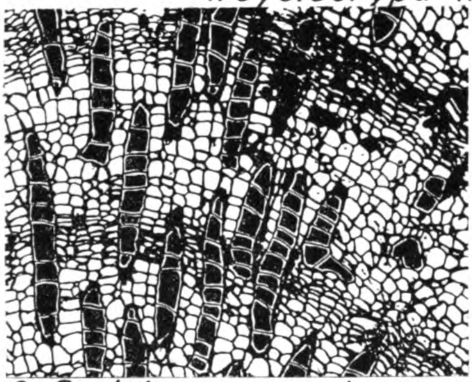
FIGURE PAGE

1—*Cyclotrypa matheri* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 738531), from the Hale formation, Morrowan, southeast of Braggs, Okla. 267

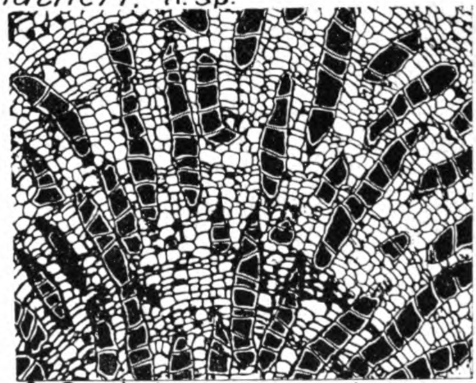
2-5—*Cyclotrypa zonata* (Girty). *2*, Specimen (Univ. Kansas no. 687831), from the Deer Creek limestone, Virgilian, 2 miles north of Oskaloosa, Kan. *3*, Specimen (Univ. Kansas no. 553531), from the Winterset limestone, Missourian, near Gallatin, Mo. *4*, Type specimen (Missouri Geol. Survey no. 2893), from the Plattsmouth limestone member, Oread limestone, Virgilian, northwest of Leavenworth, Kan. (after Girty, 1915, pl. 29, fig. 1). *5*, Specimen (Univ. Kansas no. 473631), from the Plattsmouth limestone member, Oread limestone, Virgilian, north of Baldwin, Kan. 276



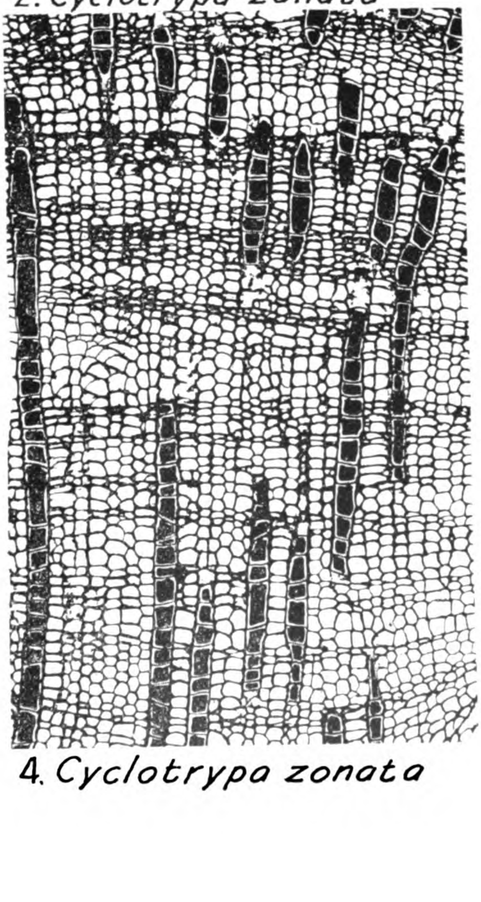
1. *Cyclotrypa matheri*, n. sp.



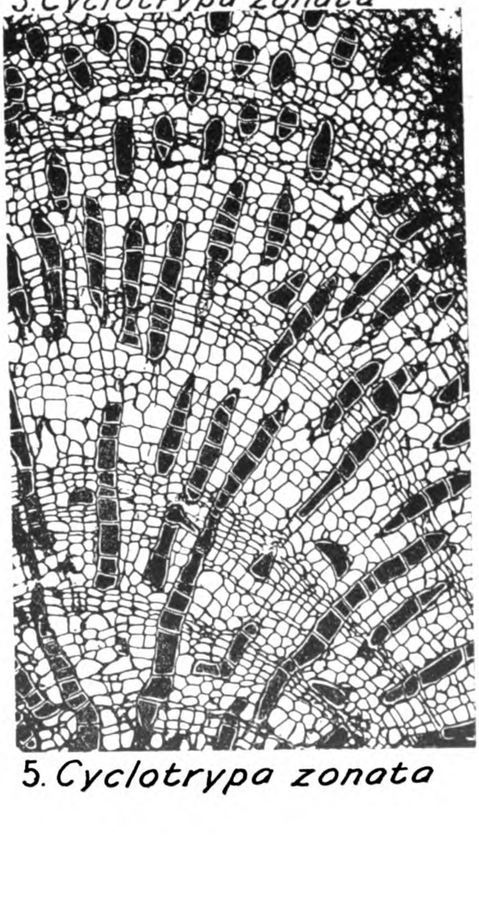
2. *Cyclotrypa zonata*



3. *Cyclotrypa zonata*



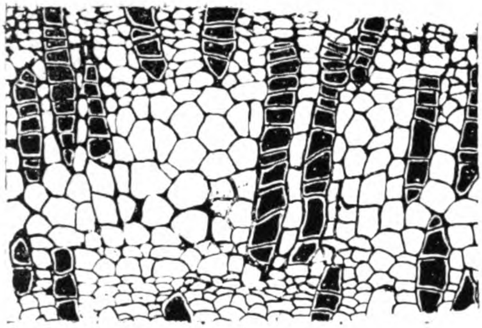
4. *Cyclotrypa zonata*



5. *Cyclotrypa zonata*

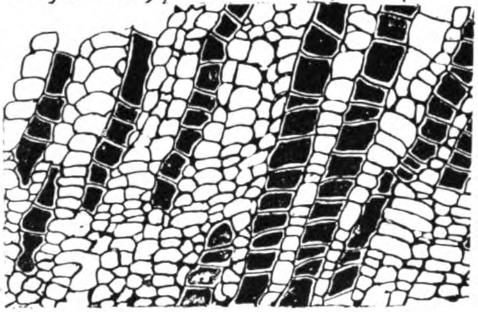
Explanation of Plate 24

(All figures longitudinal sections x10. Zooecial tubes marked with black, filling spaces almost to walls and diaphragms)



1. Cyclotrypa decora, n sp

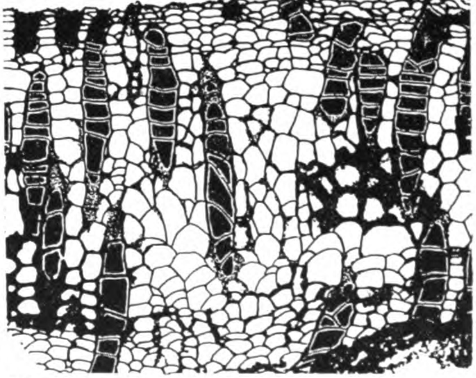
2. Cyclotrypa nebrascensis



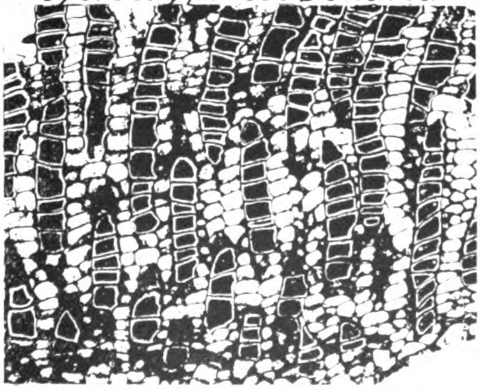
4. Cyclotrypa repentis, n.sp.

3. Cyclotrypa nebrascensis

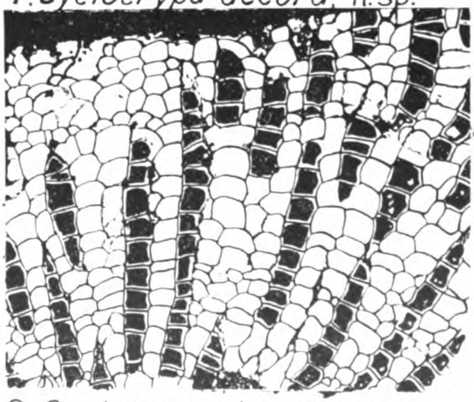
5. Cyclotrypa carbonaria



7. Cyclotrypa decora, n.sp.



6. Cyclotrypa carbonaria



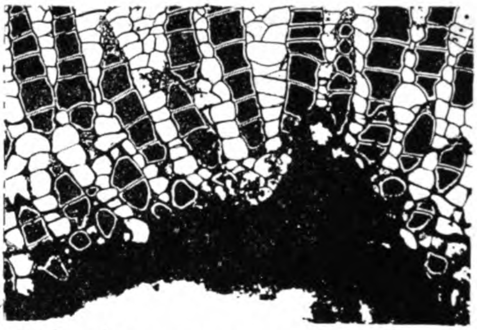
8 Cyclotrypa horridula, n.sp.

Explanation of Plate 25

(All figures longitudinal sections x10. Zooecial tubes marked with black, filling spaces almost to walls and diaphragms, except figure 4, which is unmarked.)

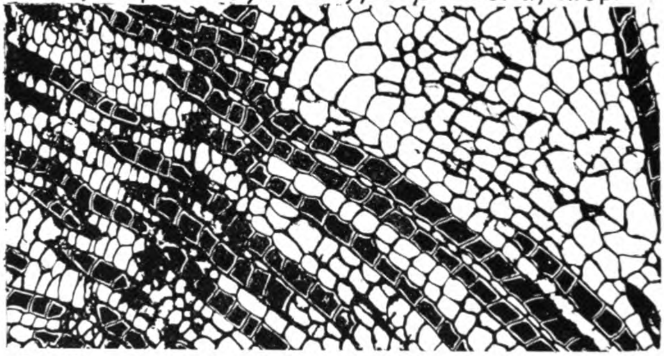
Figure	Page
1—*Cyclotrypa tenuicula* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 216531), from the Dewey limestone, Missourian, 3 miles east of Dewey, Okla., showing closely spaced diaphragms and relatively large zooecial tubes.	274
2—*Cyclotrypa procera* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 701131), from the Hertha limestone, Missourian, southeast of Princeton, Mo.	273
3—*Cyclotrypa acerba* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 549931), from the Ladore shale, Missourian, west of LaPlatte, Neb., showing resemblance to *C. nebrascensis*.	272
4-6—*Cyclotrypa carbonaria* (Ulrich), from Missourian rocks. *4*, Type specimen (U. S. Nat. Mus. no. 43243), from the (?) Drum limestone, Kansas City, Mo. (camera lucida drawing). *5*, Specimen (Univ. Kansas no. 748933), from the Argentine limestone member, Wyandotte limestone, at Wyandotte dam, north of Kansas City, Kan.*6*, Type specimen (Univ. Kansas no. 79731, section from fragment of type), showing projection of vesicles into the area of some zooecial tubes.	269
7, 8—*Cyclotrypa nebrascensis* (Condra), from the Winterset limestone, Missourian, at Carlyle quarry, west of LaPlatte, Neb. *7*, Specimen (Univ. Kansas no. 552631), showing typical characters. *8*, Specimen (Univ. Kansas no. 552632), showing a wider than average zooecium and irregularity of the anterior wall of some zooecial tubes made by projections of vesicles.	271

1. *Cyclotrypa tenuicula*, n.sp.

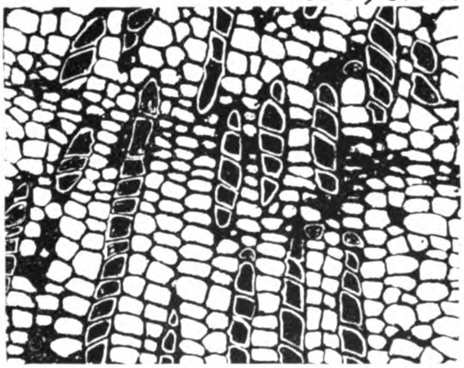


2. *Cyclotrypa procera*, n.sp.

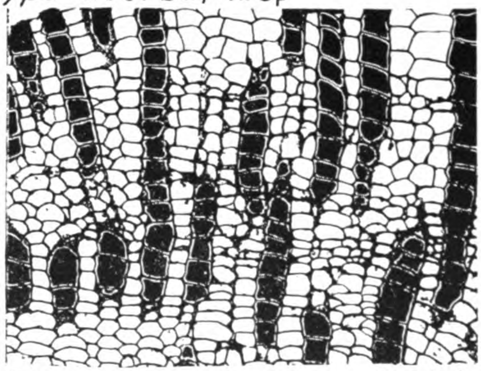
4. *Cyclotrypa carbonaria* (Ulr.)



3. *Cyclotrypa acerba*, n. sp

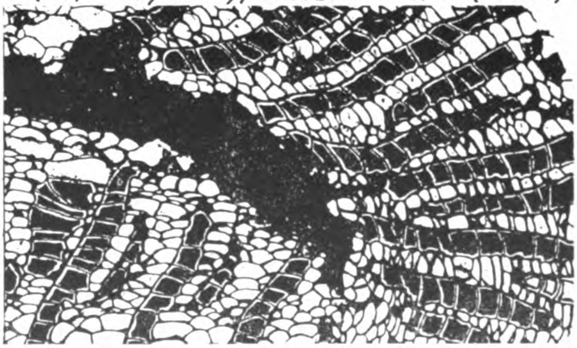


5. *Cyclotrypa carbonaria* (Ulr.)



7. *Cyclotrypa nebrascensis* (Condra)

6. *Cyclotrypa carbonaria*



8. *Cyclotrypa nebrascensis* (Condra)

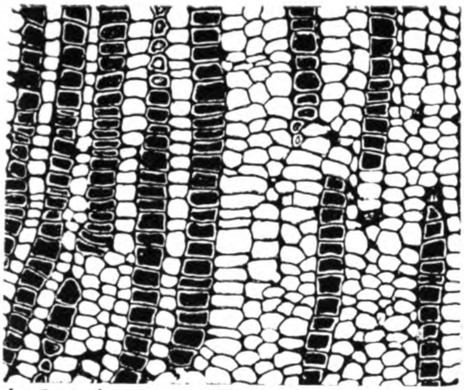
Explanation of Plate 26

(All figures longitudinal sections x10. Zooecial tubes marked with black, filling spaces almost to walls and diaphragms.)

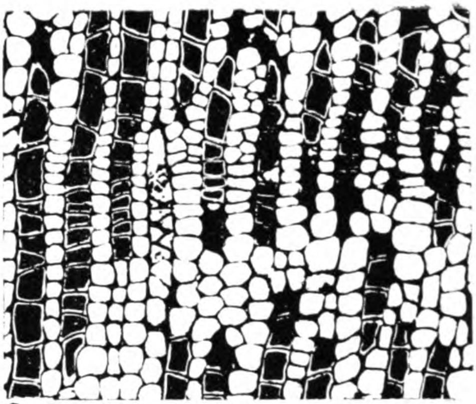
FIGURE PAGE

1—*Cyclotrypa abdita* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 798331), from the Clay Creek limestone member, Kanwaka shale, Virgilian, 2 miles west of Lecompton, Kan., showing closely spaced diaphragms and regular vesicular tissue. 279

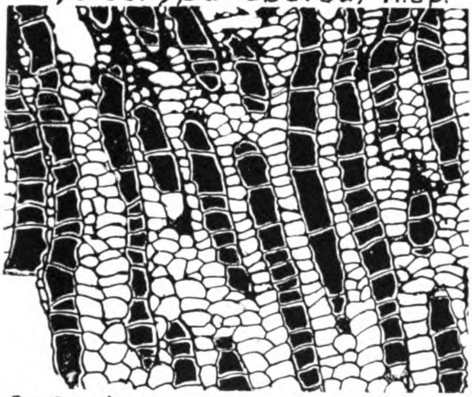
2-6—*Cyclotrypa capacis* Moore and Dudley, n. sp., from Virgilian rocks of Kansas and Nebraska. *2*, Type specimen (Univ. Kansas no. 798031), from the Calhoun shale, Sheldon quarry, Nehawka, Neb. *3*, Specimen (Univ. Kansas no. 798131), from the Reading limestone in the SW sec. 25, T. 32 S., R. 8 E., west of Leeds, Kan. *4*, Specimen (Univ. Kansas no. 798231), from the Topeka limestone, 4.5 miles northwest of Troy, Kan. *5*, Specimen (Univ. Kansas no. 99-31), from the Oread limestone, Snyderville quarry, west of Nehawka, Neb. *6*, Type specimen (Univ. Kansas no. 798031), showing another part of zoarium from that figured in *2*. 278



1. *Cyclotrypa abdita*, n. sp.

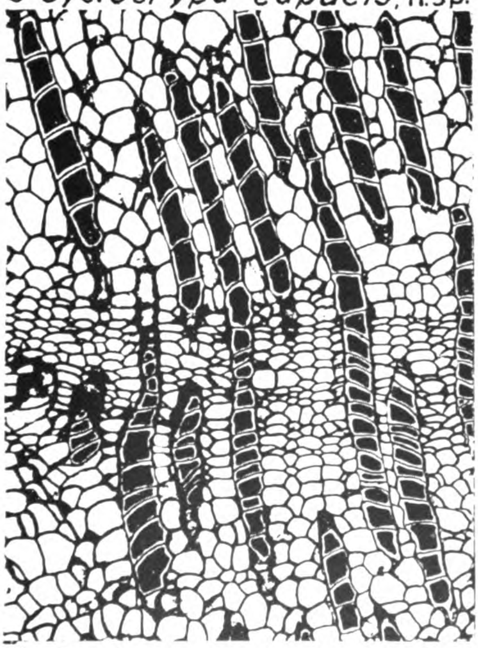


2. *Cyclotrypa capacis*, n. sp

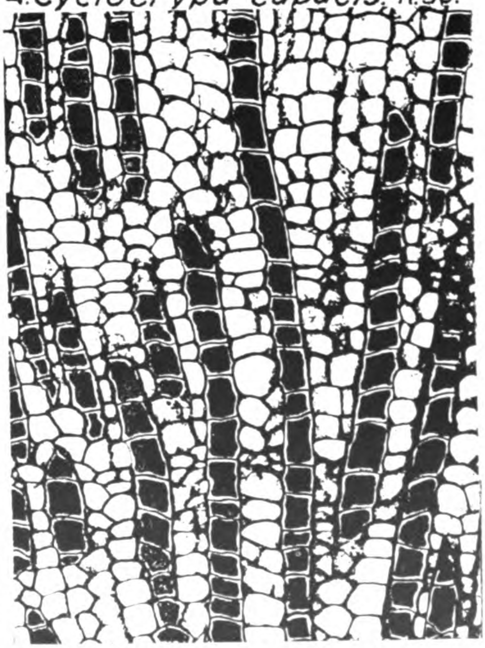


3. *Cyclotrypa capacis*, n. sp.

4. *Cyclotrypa capacis*, n. sp.



5. *Cyclotrypa capacis*, n. sp.

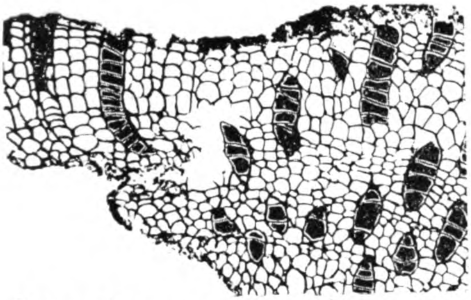


6. *Cyclotrypa capacis*, n. sp.

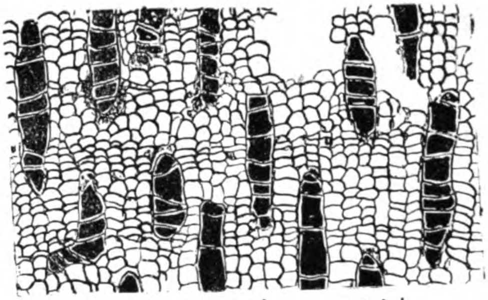
Explanation of Plate 27

(All figures longitudinal sections x10. Zooecial tubes marked with black, filling spaces almost to walls and diaphragms.)

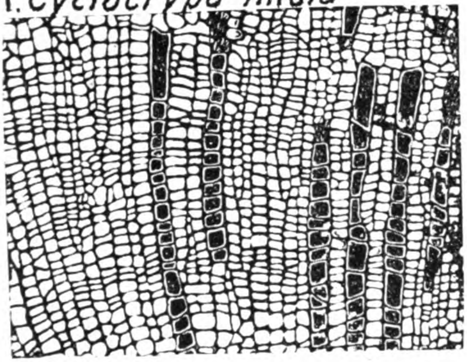
Figure		Page
1	*Cyclotrypa imula* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 798431), from the Deer Creek limestone, 3 miles east of Moline, Kan.	281
2, 3	*Cyclotrypa bennetti* (Link), from the Graham group, Virgilian, 5 miles west of Eastland, Tex. *2,* Specimen (Univ. Kansas no. 51-127a), from the Wayland shale; slightly oblique section. *3,* Type specimen (Univ. Chicago Walker Mus.), from Gunsight limestone ("Campophyllum bed").	283
4	*Cyclotrypa idonea* Moore and Dudley, n. sp., type specimen (Univ. Texas no. 12257-1), from the Thrifty formation, Virgilian, 3 miles north of Thrifty, Tex., showing slender zooecial tubes and regular series of vesicles; in this section it is somewhat difficult to distinguish the zooecia.	285
5, 6	*Cyclotrypa candida* Moore and Dudley, n. sp., from the Topeka limestone, Virgilian, of Kansas. *5,* Type specimen (Univ. Kansas no. 485131), from the Coal Creek limestone member, northeast of Topeka, Kan. *6,* Specimen (Univ. Kansas no. 291531), from 2 miles northwest of Winchester, Kan.	281
7	*Cyclotrypa disiuncta* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 798731), from the Wakarusa limestone, Virgilian, 2.5 miles northwest of Elk Creek, Neb.	283
8	*Cyclotrypa abnormis* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 502631), from the Lecompton limestone in sec. 25, T. 14 S., R. 17 E., Douglas County, Kansas.	280



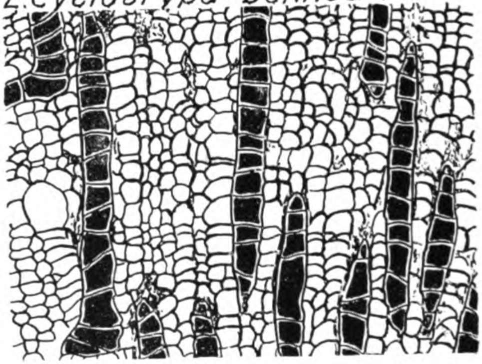
1. *Cyclotrypa imula*



2. *Cyclotrypa bennetti*

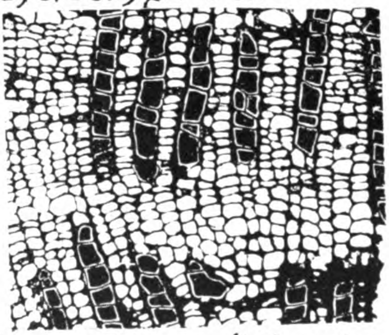


4. *Cyclotrypa idonea*

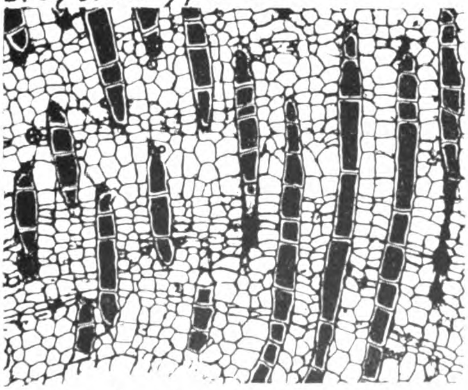


3. *Cyclotrypa bennetti*

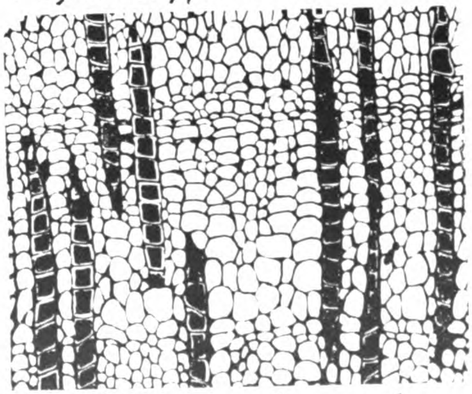
5. *Cyclotrypa candida*



7 *Cyclotrypa disiuncta*



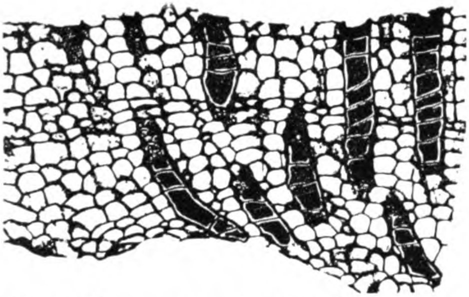
6. *Cyclotrypa candida*



8. *Cyclotrypa abnormis*

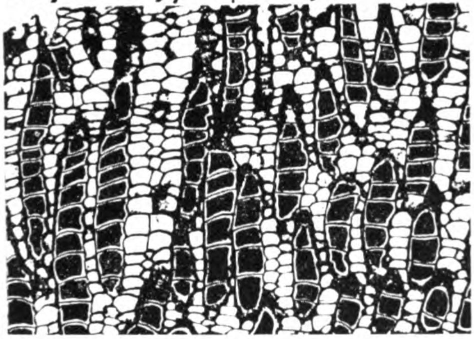
Explanation of Plate 28

(All figures longitudinal sections x10. Zooecial tubes marked with black, filling spaces almost to walls and diaphragms.)

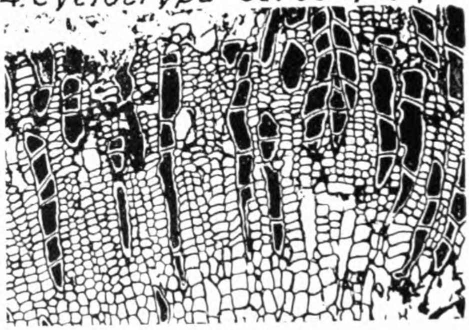


1. *Cyclotrypa pelagia*, n.sp.

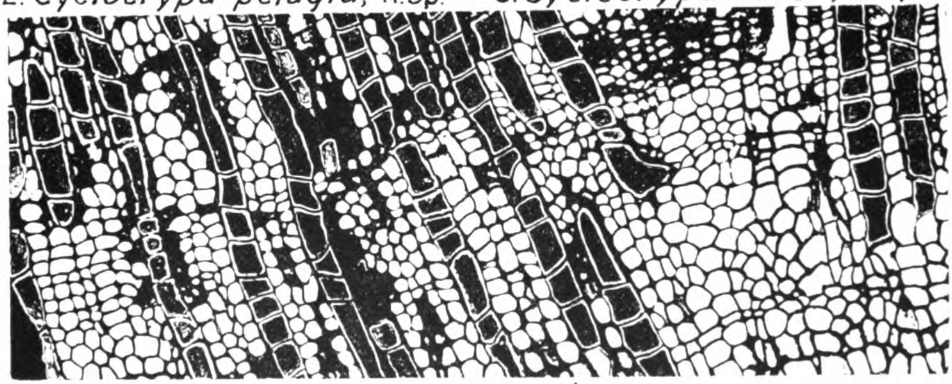
4. *Cyclotrypa torosa*, n.sp.



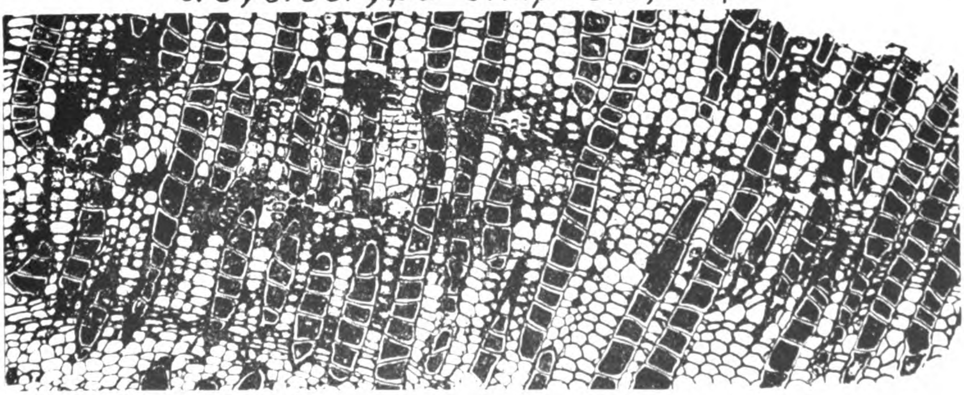
2. *Cyclotrypa pelagia*, n.sp.



5. *Cyclotrypa hirta*, n.sp.



6. *Cyclotrypa simplicis*, n.sp.

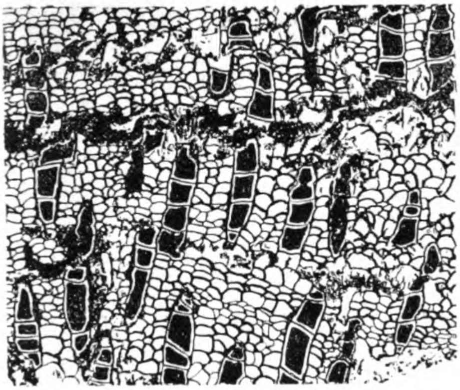


3. *Cyclotrypa pelagia*, n.sp.

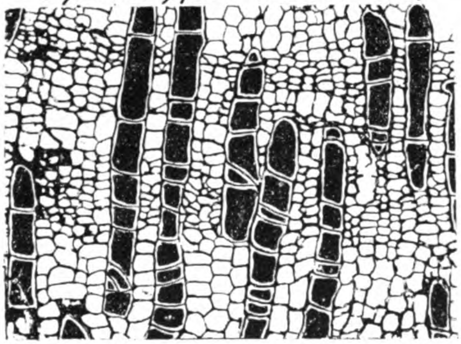
EXPLANATION OF PLATE 29

(All figures longitudinal sections x10. Zooecial tubes marked with black, filling spaces almost to walls and diaphragms.)

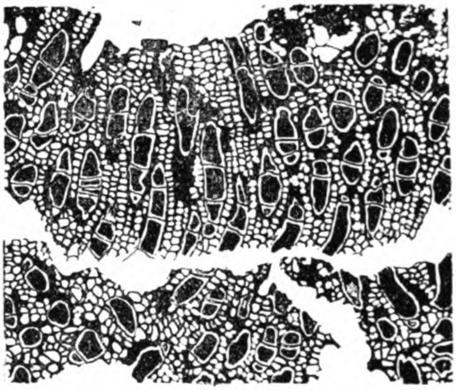
FIGURE	PAGE
1, 2—*Cyclotrypa beata* Moore and Dudley, n. sp., from the Hughes Creek shale member, Foraker formation, from Kansas and Nebraska. *1*, Type specimen (Univ. Kansas no. 798631), from 0.5 mile northeast of Humboldt, Neb. *2*, Specimen (Univ. Kansas no. 693031), from 2 miles west of Zeandale, Riley County, Kansas; vesicles larger than normal.	288
3—*Triphyllotrypa passa* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 40431), from the Florena shale member, Beattie limestone, in SE sec. 19, T. 1 S., R. 15 E., Brown County, Kansas, showing minute vesicles that characterize this species.	293
4—*Triphyllotrypa galeata* Moore and Dudley, n. sp., type specimen (Univ. Texas no. 6586), from the Delaware Mountain formation, Guadalupian, in Culberson County, Texas.	296
5—*Cyclotrypa galerita* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 54-31), from the Hughes Creek shale member, Foraker formation, Lower Permian, southeast of Bennett, Neb.	289
6—*Cyclotrypa perlaevis* Moore and Dudley, n. sp., type specimen (Yale Univ. Peabody Mus. no. 89-30), from Wolfcampian beds at Wolfcamp, Glass Mountains, 12 miles N. 35° E. from Marathon, Tex.	237



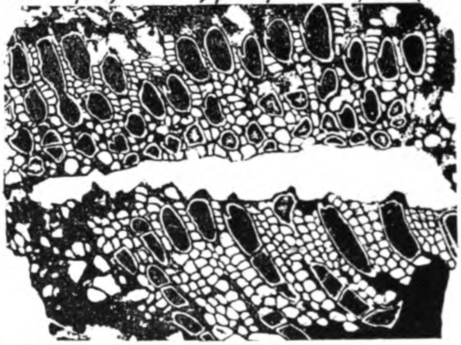
1. *Cyclotrypa beata*, n. sp.



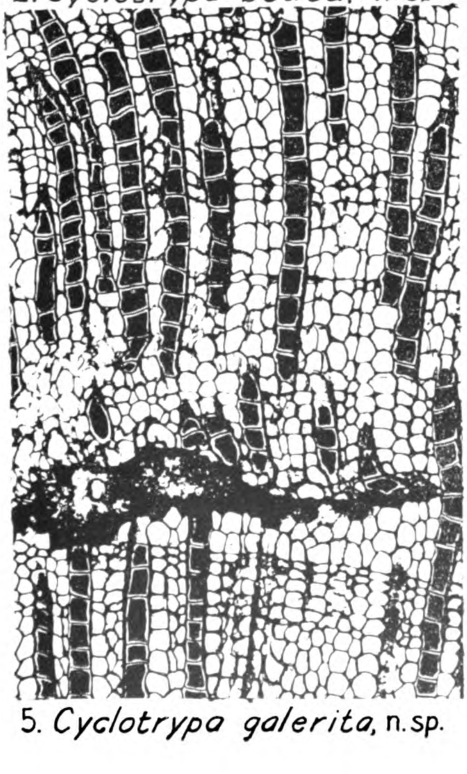
2. *Cyclotrypa beata*, n. sp.



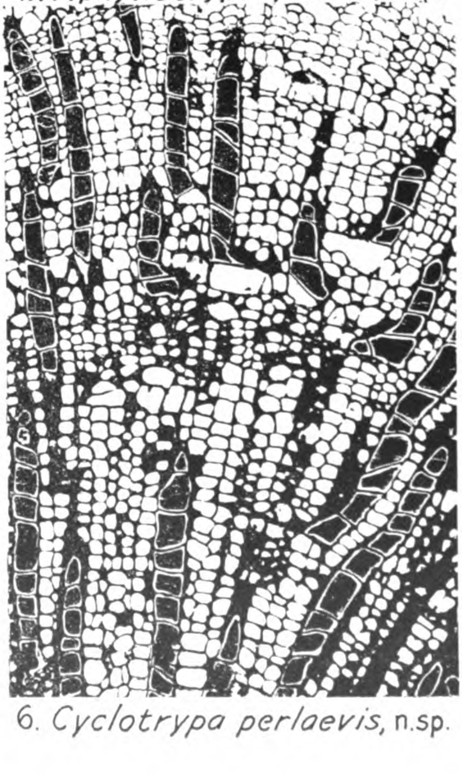
3. *Triphyllotrypa passa*, n. sp.



4. *Triphyllotrypa galeata*, n. sp.



5. *Cyclotrypa galerita*, n. sp.



6. *Cyclotrypa perlaevis*, n. sp.

EXPLANATION OF PLATE 30

(All figures longitudinal sections x10. Zooecial tubes marked with black, filling spaces almost to walls and diaphragms.)

FIGURE — PAGE

1—*Triphyllotrypa proiecta* Moore and Dudley, n. sp., type specimen (Yale Univ. Peabody Mus. no. 12-35), from Leonardian beds south of Clay Slide in the Glass Mountains, 7 miles N. 30° W. from Marathon, Tex. 294

2—*Triphyllotrypa abstrusa* Moore and Dudley, n. sp., type specimen (Univ. Texas no. T148-35), from the Word formation, Guadalupian, north of Word ranch, Glass Mountains, 14.5 miles northeast of Marathon, Tex. 297

3—*Triphyllotrypa guadalupensis* (Girty) (?), specimen from the "dark limestone" at Pine Spring, U. S. Geol. Survey. Sta. 2930, Guadalupian Mountains, Texas (after Girty, 1908, pl. 17, fig. 18). The identification is indicated as questionable because only the longitudinal section prepared by Girty seems to be available and because, patently, it represents a specimen other than that which yielded the tangential section (pl. 22, fig. 3 of this paper), which is designated by us as type... 297

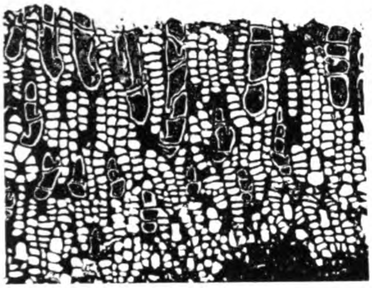
4—*Triphyllotrypa galeata* Moore and Dudley, n. sp., type specimen (Univ. Texas no. 6586), from the Delaware Mountain formation, Guadalupian, west of 6-Bar ranch, Culberson County, Texas. 296

5—*Triphyllotrypa patentis* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 741423), from Leonardian beds at Clay Slide, 2 miles west of Iron Mountain, Glass Mountains, 7.5 miles N. 30° W. from Marathon, Tex. 293

6—*Triphyllotrypa speciosa* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 741433), from Leonardian beds at Clay Slide, same locality as fig.5. 291

7—*Cyclotrypa debilis* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 53431), from the Word formation, Guadalupian, Hess canyon, Glass Mountains, 14 miles NNE of Marathon, Tex. 290

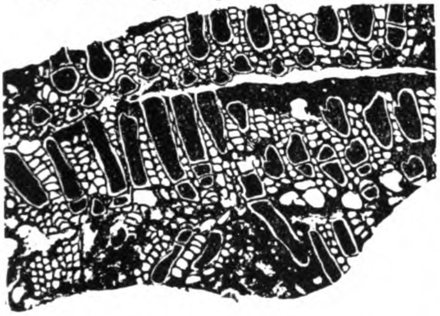
8—*Triphyllotrypa definita* Moore and Dudley, n. sp., type specimen (Yale Univ. Peabody Mus. no. 123-35), from Leonardian beds north of Leonard Mountain, Glass Mountains, 9.5 miles north of Marathon, Tex. 294



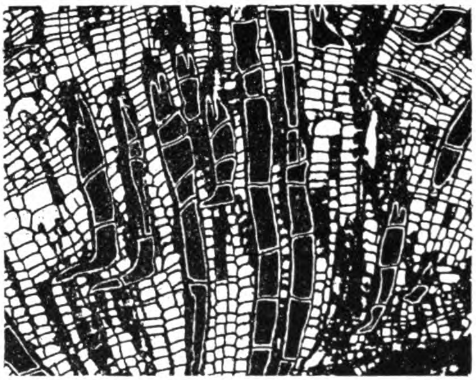
1.Triphyllotrypa proiecta

2.Triphyllotrypa abstrusa

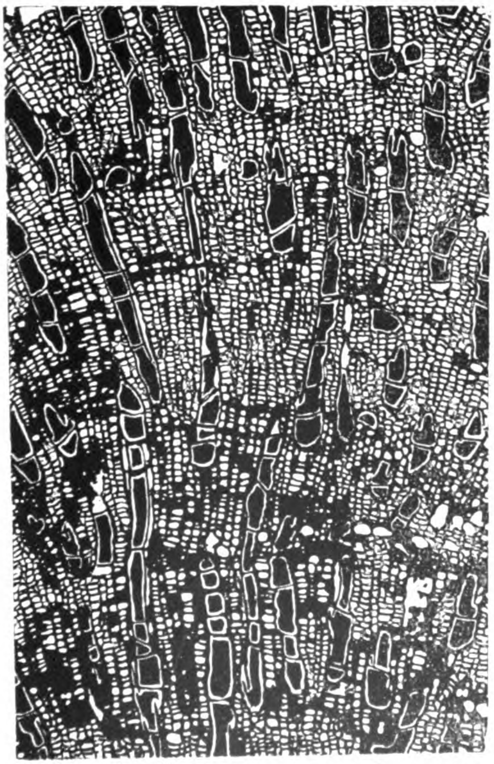
Triphyllo'a guad-
alupensis 3



4.Triphyllotrypa galeata

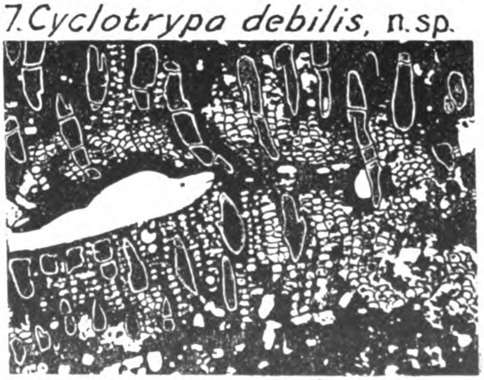


5.Triphyllotrypa patentis



6.Triphyllotrypa speciosa, n.sp.

7.Cyclotrypa debilis, n.sp.



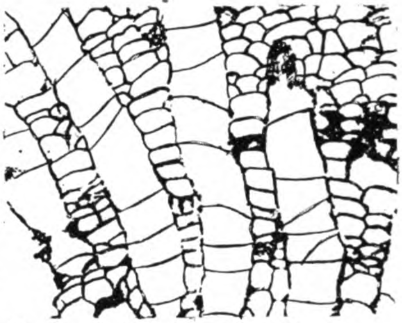
8.Triphyllotrypa definita, n.sp.

EXPLANATION OF PLATE 31

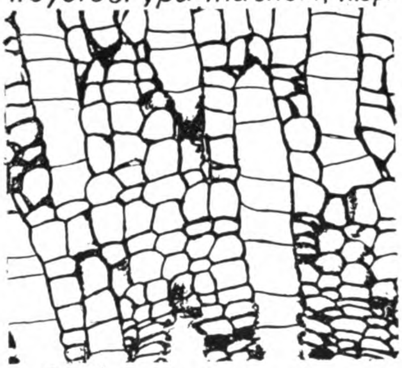
(All figures longitudinal sections x20.)

FIGURE		PAGE
1	*Cyclotrypa matheri* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 738531), from the Hale formation, Morrowan, southeast of Braggs, Okla.	267
2,3,5,8	*Cyclotrypa zonata* (Girty). *2,* Specimen (Univ. Kansas no. 553531), from the Winterset limestone, Missourian, near Gallatin, Mo. *3,* Specimen (Univ. Kansas no. 687831), from the Deer Creek limestone, Virgilian, 2 miles north of Oskaloosa, Kan. *5,* Specimen (Univ. Kansas no. 473631), from the Plattsmouth limestone member, Oread limestone, Virgilian, north of Baldwin, Kan. *8,* Type specimen (Missouri Geol. Survey no. 2893), from the Plattsmouth limestone member, Oread formation, Virgilian, northwest of Leavenworth, Kan. (photograph from thin section figured by Girty, 1915, pl. 29, fig. 1).	276
4, 7	*Cyclotrypa candida* Moore and Dudley, n. sp., from the Topeka limestone, Virgilian, of Kansas. *4,* Specimen (Univ. Kansas no. 291531), from 2 miles northwest of Winchester, Kan. *7,* Type specimen (Univ. Kansas no. 485131), from the Coal Creek limestone member, northeast of Topeka, Kan.	281
6	*Cyclotrypa abnormis* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 502631), from the Lecompton limestone, Virgilian, in sec. 25, T. 14 S., R. 17 E., Douglas County, Kansas.	280

1. *Cyclotrypa matheri*, n.sp.



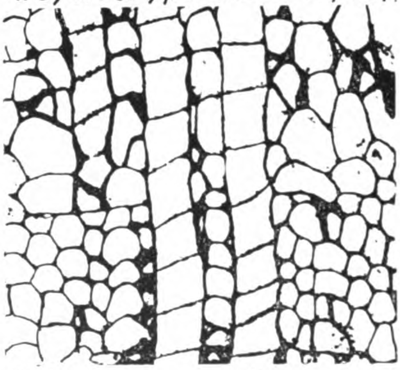
2. *Cyclotrypa zonata*



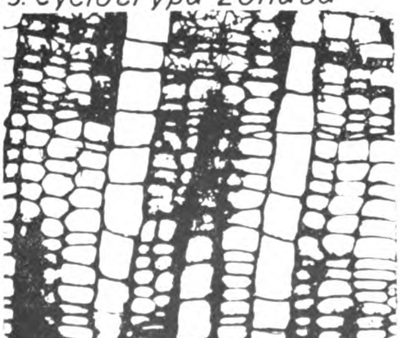
3. *Cyclotrypa zonata*

4. *Cyclotrypa candida*, n.sp.

5. *Cyclotrypa zonata*



6. *Cyclotrypa abnormis*



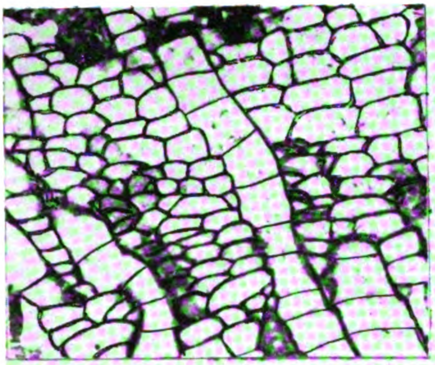
7 *Cyclotrypa candida*, n.sp.

8. *Cyclotrypa zonata*

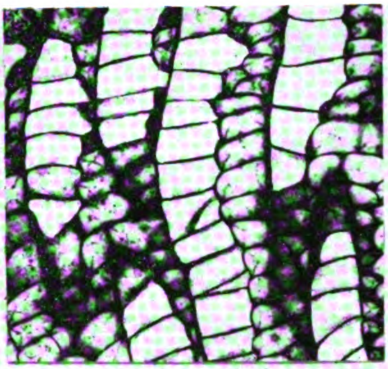
Explanation of Plate 32

(All figures longitudinal sections x20.)

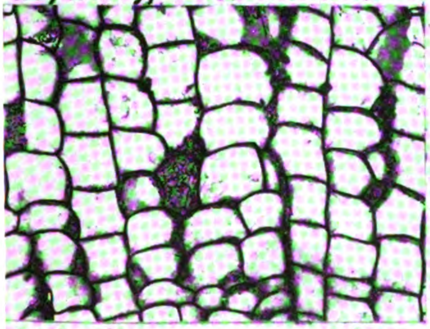
Figure	Page
1—*Cyclotrypa nebrascensis* (Condra), specimen (Univ. Kansas no. 531531), from the Stanton limestone, Missourian, west of Meadow, Neb., showing irregular anterior wall of zooecial tubes formed by projecting vesicles.	271
2—*Cyclotrypa carbonaria* (Ulrich), specimen (Univ. Kansas no. 748933), from the Argentine limestone member, Wyandotte limestone, Missourian, at Wyandotte dam, north of Kansas City, Kan., showing irregular anterior walls of zooecial tubes.	269
3—*Cyclotrypa horridula* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 219231), from the Atoka formation, Lampasan, 0.75 mile north of Clarita, Okla., showing zooecial tubes and series of vesicles that closely resemble one another.	268
4—*Cyclotrypa decora* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 685231), from the Stoner limestone member, Stanton limestone, Missourian, at Rock Lake, southeast of Ashland, Neb.	275
5-7—*Cyclotrypa pelagia* Moore and Dudley, n. sp., from the Magdalena limestone, Pennsylvanian, of New Mexico. 5, Type specimen (Univ. New Mexico no. J-14), from 175 to 275 feet below Abo sandstone, near Battleship Rock, above Jemez Springs, N. M. 6, Specimen (Univ. Kansas no. 106431), from Abo Canyon, N. M. 7, Specimen (Univ. New Mexico no. J-36), from 100 to 600 feet below Abo sandstone, near Jemez Springs, N. M.	284
8—*Cyclotrypa repentis* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 461031), from the Plattsburg limestone, Missourian, 2.5 miles west of Neodesha, Kan.	275



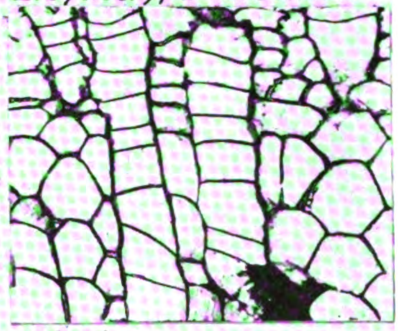
1. *Cyclotrypa nebrascensis*



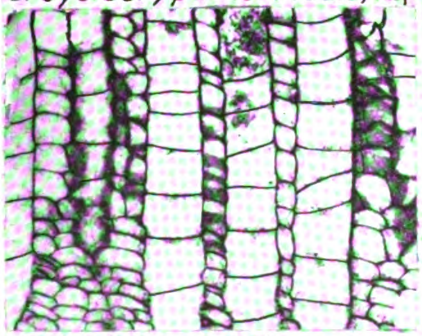
2. *Cyclotrypa carbonaria*



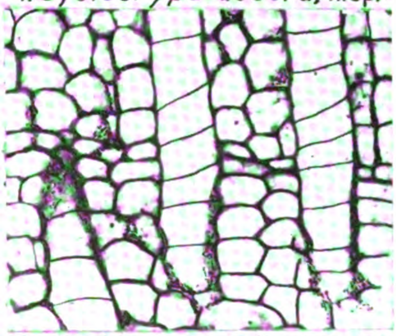
3. *Cyclotrypa horridula*, n.sp.



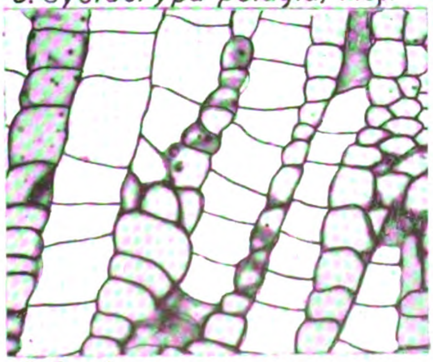
4. *Cyclotrypa decora*, n.sp.



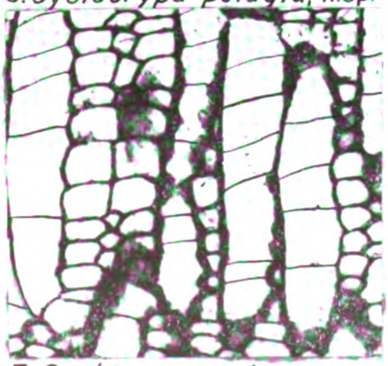
5. *Cyclotrypa pelagia*, n.sp.



6. *Cyclotrypa pelagia*, n.sp.



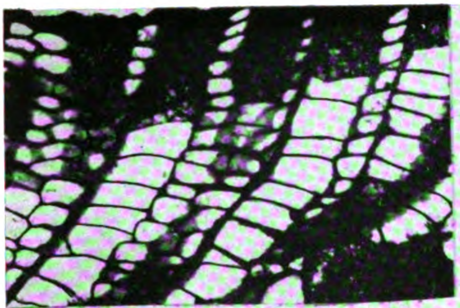
8. *Cyclotrypa repentis*, n.sp.



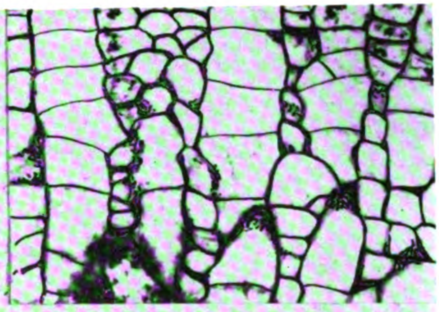
7. *Cyclotrypa pelagia*, n.sp.

Explanation of Plate 33

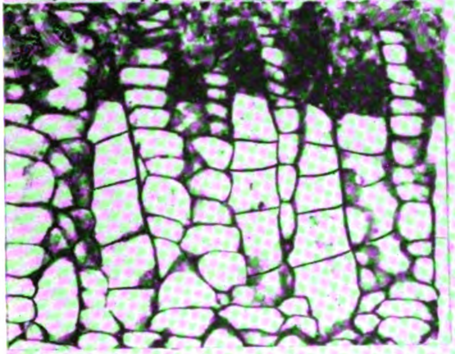
(All figures longitudinal sections x20.)



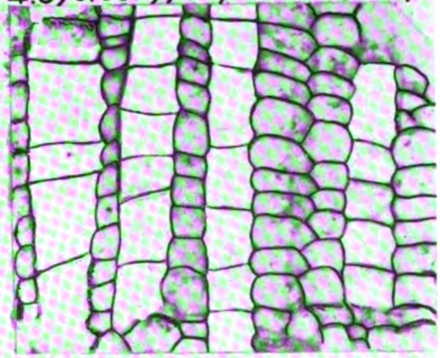
1. *Cyclotrypa nebrascensis*



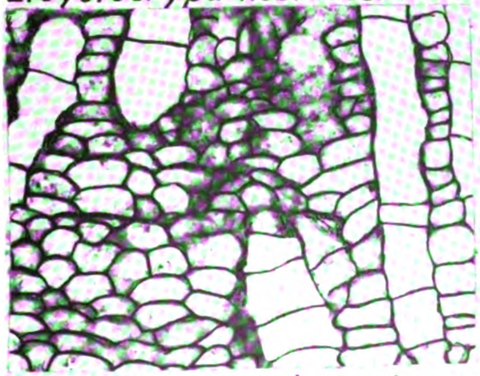
4. *Cyclotrypa procera*, n. sp.



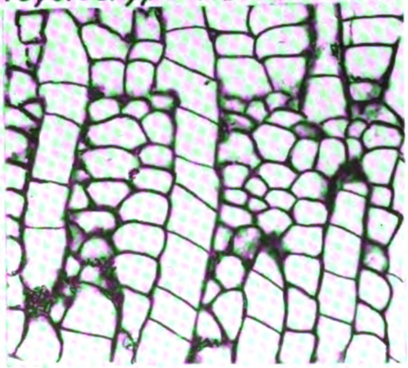
2. *Cyclotrypa nebrascensis*



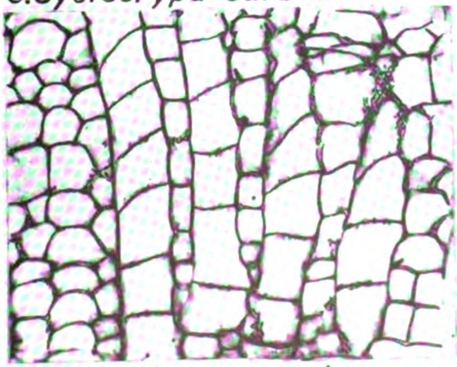
3. *Cyclotrypa nebrascensis*



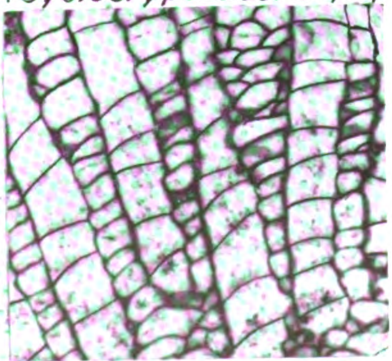
5. *Cyclotrypa carbonaria*



7. *Cyclotrypa acerba*, n. sp.



6. *Cyclotrypa carbonaria*



8. *Cyclotrypa tenuicula*, n. sp.

EXPLANATION OF PLATE 34

(All figures longitudinal sections x20.)

FIGURE PAGE

1—*Triphyllotrypa passa* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 40431), from the Florena shale member, Beattie limestone, Lower Permian, from SE sec. 19, T. 1 S., R. 15 E., Brown County, Kansas, showing minute uniform vesicles. 293

2—*Cyclotrypa imula* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 798431), from the Deer Creek limestone, Virgilian, 3 miles east of Moline, Kan. 281

3—*Cyclotrypa galerita* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 54-31), from the Hughes Creek shale member, Foraker formation, Lower Permian, 1 mile southeast of Bennett, Neb. 289

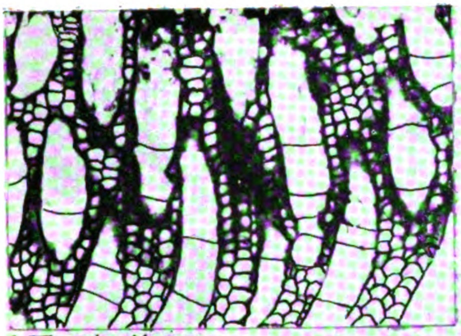
4—*Cyclotrypa beata* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 798631), from the Hughes Creek shale member, Foraker formation, Lower Permian, 0.5 mile northeast of Humboldt, Neb. 288

5—*Cyclotrypa carbonaria* (Ulrich), type specimen (U. S. Nat. Mus. no. 43243), from the (?) Drum limestone, Missourian, Kansas City, Mo. (camera lucida drawing of part of one of Ulrich's sections), showing an unusually large zooecium 269

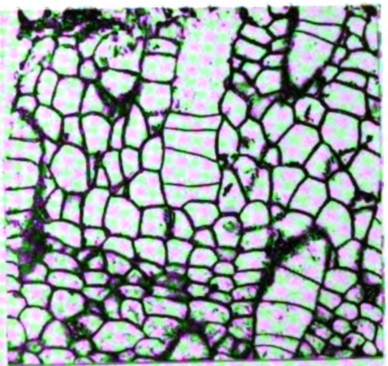
6—*Cyclotrypa idonea* Moore and Dudley, n. sp., type specimen (Univ. Texas no. 12257-1), from the Thrifty formation, Virgilian, 3 miles north of Thrifty, Tex. 285

7—*Cyclotrypa bennetti* (Link), specimen (Univ. Kansas no. 51-127a), from the Wayland shale, Virgilian, 5 miles west of Eastland, Tex. 283

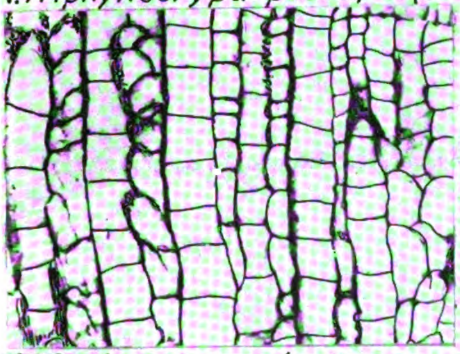
8—*Cyclotrypa disiuncta* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 798731), from the Wakarusa limestone, Virgilian, 2.5 miles northwest of Elk Creek, Neb. 283



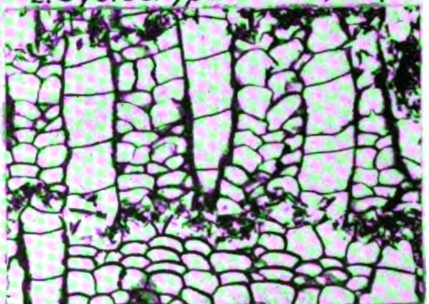
1. *Triphyllotrypa passa*, n.sp.



2. *Cyclotrypa imula*, n.sp.

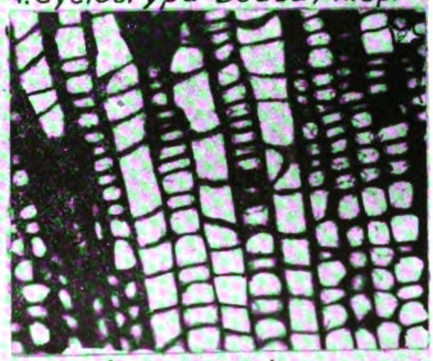


3. *Cyclotrypa galerita*, n.sp.

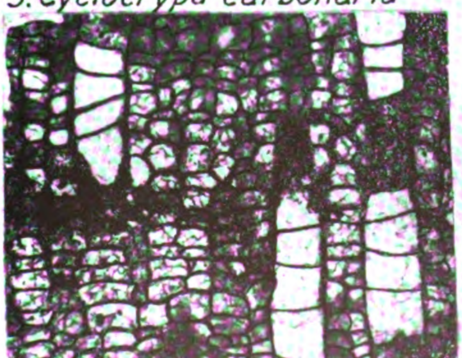


4. *Cyclotrypa beata*, n.sp.

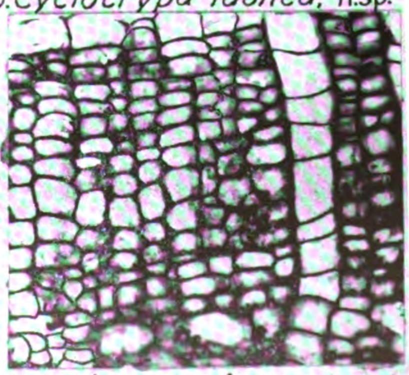
5. *Cyclotrypa carbonaria*



6. *Cyclotrypa idonea*, n.sp.



7. *Cyclotrypa bennetti* (Link)



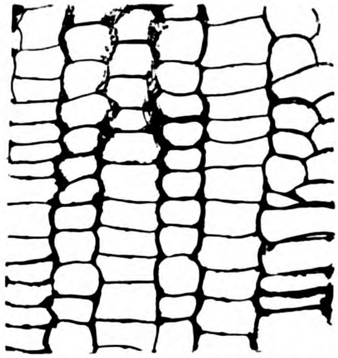
8. *Cyclotrypa disiuncta*, n.sp.

Explanation of Plate 35

(All figures longitudinal sections x20.)

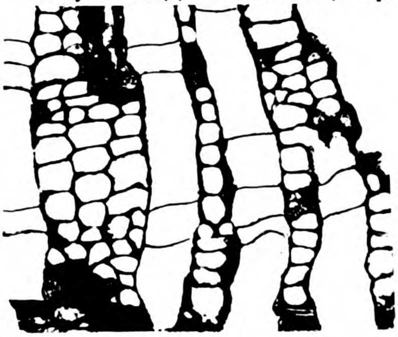
Figure		Page
1,3,6,8—	*Cyclotrypa capacis* Moore and Dudley, n. sp., from Virgilian rocks of Kansas and Nebraska. *1,* Specimen (Univ. Kansas no. 798231), from the Topeka limestone, 4.5 miles northwest of Troy, Kan., showing ragged anterior wall of zooecial tubes formed by projections of small vesicles. *3,* Type specimen (Univ. Kansas no. 798031), from the Calhoun shale, Sheldon quarry, Nehawka, Neb., showing large vesicles. *6,* Specimen (Univ. Kansas no 798131), from the Reading limestone in the SW sec. 25, T. 32 S., R. 8 E., west of Leeds, Kan. *8,* Part of the same section shown in fig. 1, showing variation in size of vesicles	278
2—	*Cyclotrypa abdita* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 798331), from the Clay Creek limestone member, Kanwaka shale, Virgilian, 2 miles west of Lecompton, Kan., showing characteristic regularity of diaphragms and vesicles.	279
4—	*Cyclotrypa torosa* Moore and Dudley, n. sp., type specimen (Yale Univ. Peabody Mus. no. 88-30), from the *Uddenites* zone, Gaptank formation, Pennsylvanian, at Wolfcamp, Glass Mountains, 12 miles N. 35° E. from Marathon, Tex.	286
5—	*Cyclotrypa hirta* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 741431), from Leonardian beds at Clay Slide, 2 miles west of Iron Mountain, Glass Mountains, 7.5 miles N. 30° W., from Marathon, Tex.	289
7—	*Cyclotrypa simplicis* Moore and Dudley, n. sp., type specimen (Univ. Texas no. 3101), from the Gaptank formation, Pennsylvanian, 2 miles south of Gaptank, Pecos County, Texas.	286

1. *Cyclotrypa capacis*, n. sp.

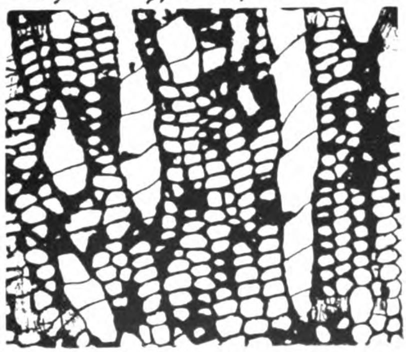


2. *Cyclotrypa abdita*, n. sp.

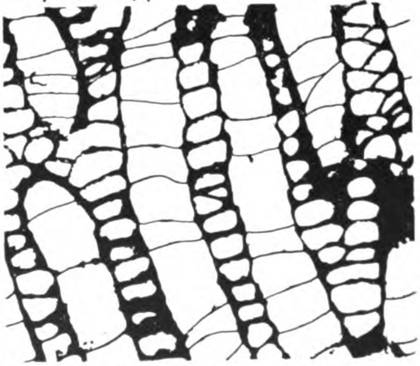
3. *Cyclotrypa capacis*, n. sp.



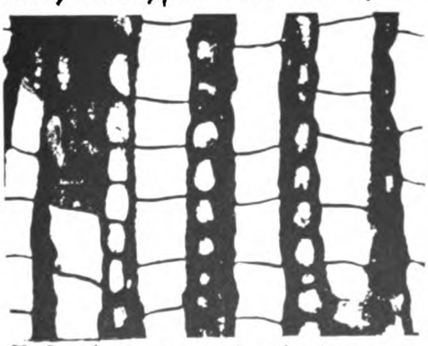
4. *Cyclotrypa torosa*, n. sp.



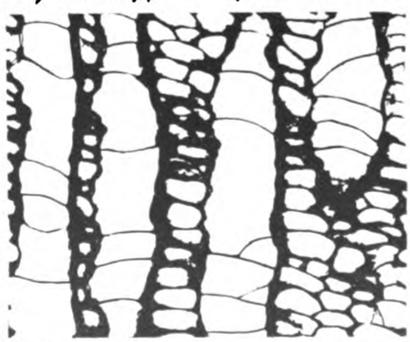
5. *Cyclotrypa hirta*, n. sp



6. *Cyclotrypa capacis*, n. sp.



7. *Cyclotrypa simplicis*, n. sp

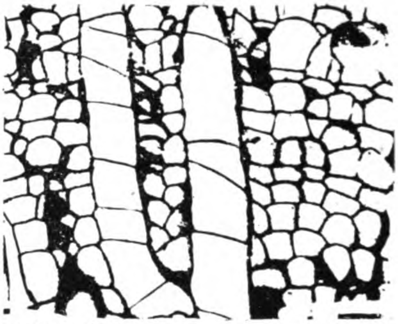


8. *Cyclotrypa capacis*, n. sp

Explanation of Plate 36

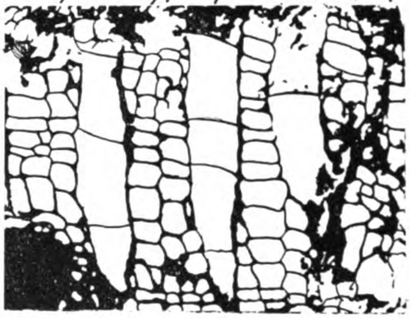
(All figures longitudinal sections x20.)

1. *Triphyllotrypa quadalupensis*

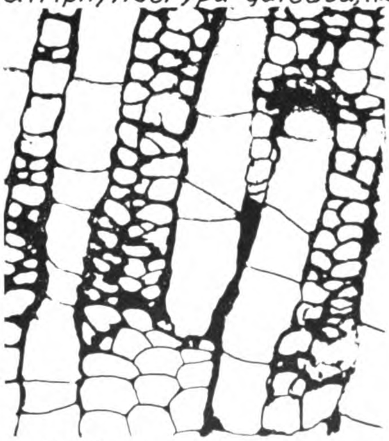


2. *Cyclotrypa perlaevis*, n.sp.

3. *Triphyllotrypa galeata*, n.sp.



4. *Triphyllotrypa patentis*



5. *Cyclotrypa beata*, n.sp.

6. *Triphyllotrypa proiecta*, n.sp.

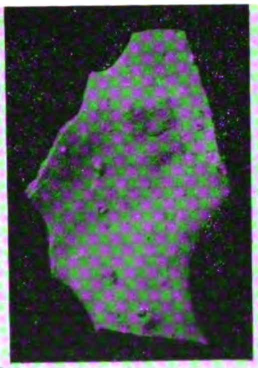
7. *Triphyllotrypa spissa*, n.sp.

8 *T speciosa*, n.sp.

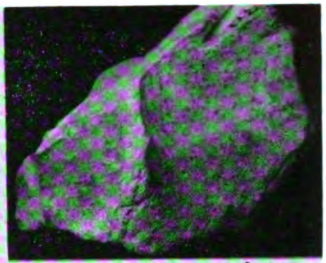
Explanation of Plate 37

(All figures show portions of zoaria x1.)

1.*Meekoporella repleta*

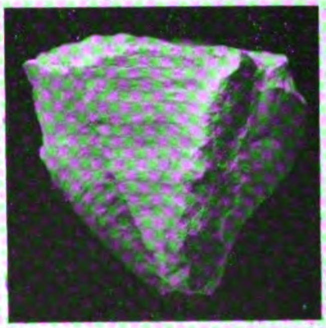


3.*Meekopora prosseri*

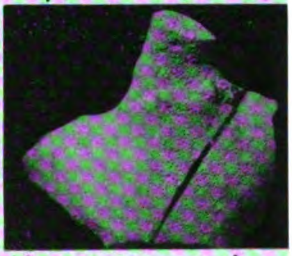


2.*Meekoporella repleta*

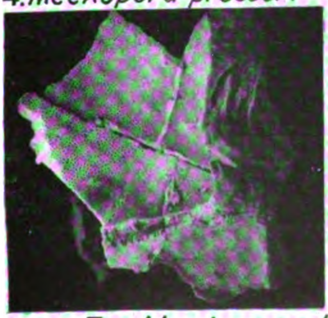
4.*Meekopora prosseri*



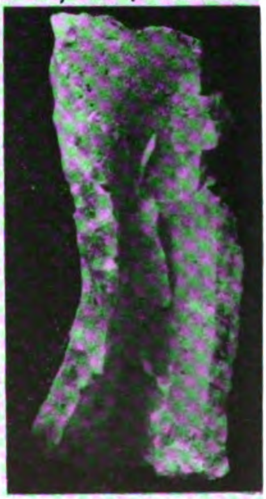
5.*Meekoporella dehiscens*



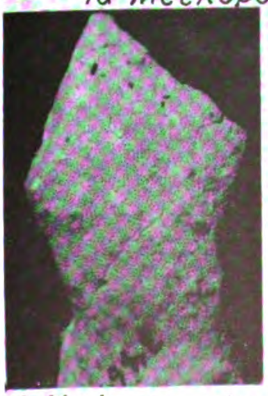
6.*Meekopora parilis*



7a *Meekoporella nexilis* 7b



8.*M. calamistrata*



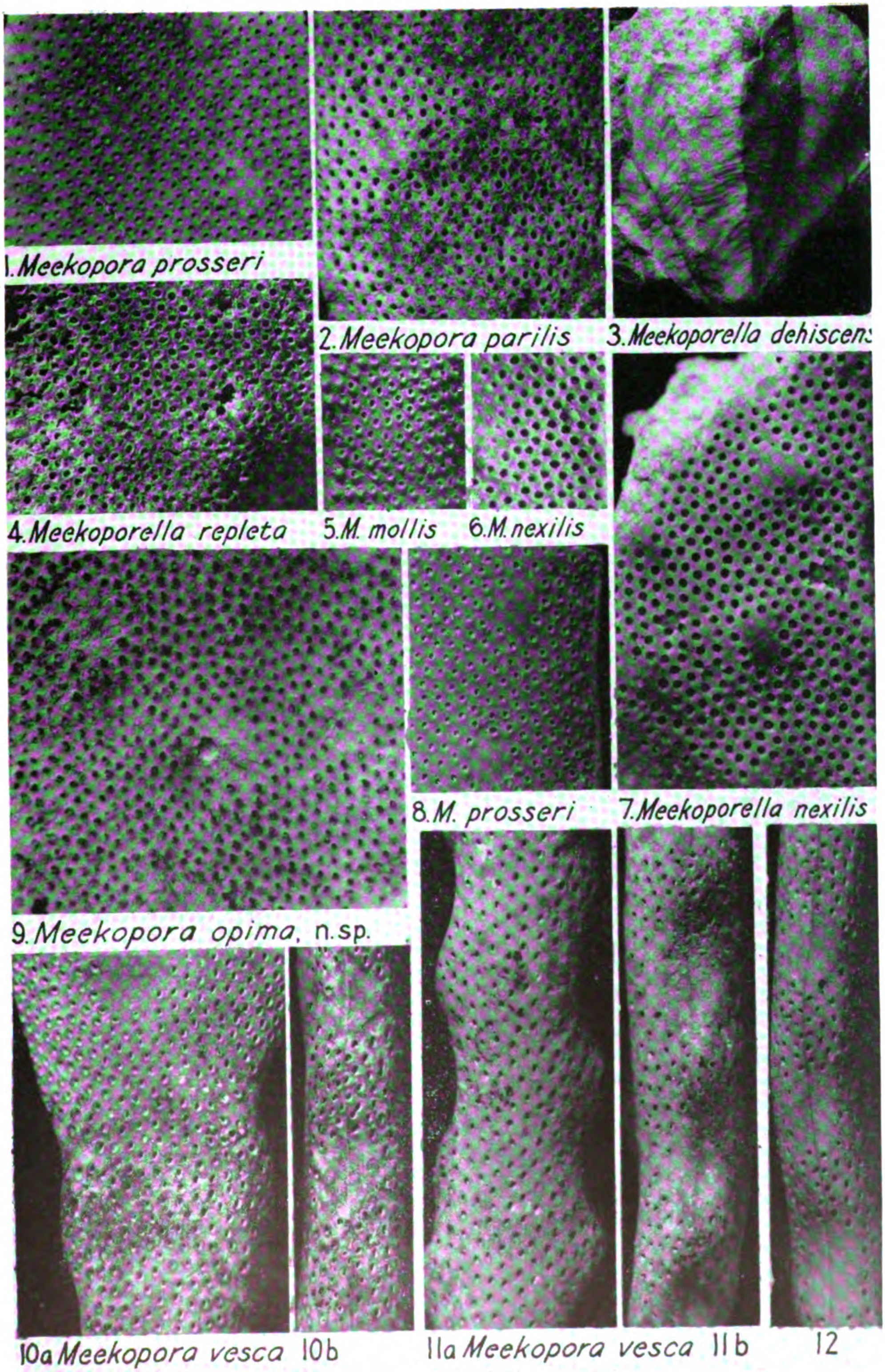
10.*Meekopora opima*

9. *Meekopora calamistrata*

Explanation of Plate 38

(*Surface views of portions of zoaria. All figures x5, except figure 3.*)

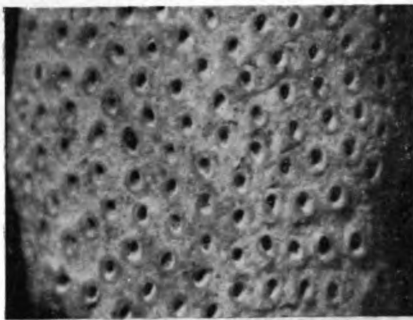
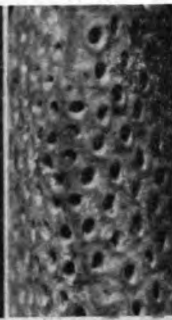
FIGURE		PAGE
1, 8	—*Meekopora prosseri* Ulrich, specimens from the Hughes Creek shale member, Foraker formation, Lower Permian, from southeast of Bennett, Neb. *1*, Specimen (Univ. Kansas no. 55473), showing maculae and peristomes. *8*, Another specimen (Univ. Kansas no. 55474)	299
2	—*Meekopora parilis* Moore and Dudley, n. sp., specimen from Wolfcampian beds at Wolfcamp, Glass Mountains, 12 miles N. 35° E. from Marathon, Tex.; the rims around some of the zooecial apertures are seemingly due to weathering	303
3	—*Meekoporella dehiscens* Moore and Dudley, n. sp., part of type specimen (Univ. Kansas no. 17439), from the Stanton limestone, 1 mile south of Fredonia, Kan. (x0.75). Three of several deep, angular cups that form the zoarium are shown, re-entrant angles at left and right of the 3-sided central mass (actually 6-sided) mark the contacts between adjacent divisions of the colony. The bifoliate layers split apart readily along the double median lamella, each half of which shows prominent striations running subparallel to the upper rim of the depressions	305
4	—*Meekoporella repleta* Moore and Dudley, n. sp., type specimen (Yale Univ. Peabody Mus. no 123-4), from Leonardian beds north of Leonard Mountain, Glass Mountains, 9.5 miles north of Marathon, Tex., showing circular apertures and thin peristomes	307
5	—*Meekopora mollis* Moore and Dudley, n. sp., specimen (Univ. Kansas no. 5997e), from the Brownville limestone, Virgilian, southwest of Strohm, Okla	300
6, 7	—*Meekoporella nexilis* Moore and Dudley, n. sp., type specimen (Yale Univ. Peabody Mus. no. 90-31), parts of surface showing subcircular apertures and raised maculae	306
9	—*Meekopora opima* Moore and Dudley, n. sp., part of specimen (Univ. Kansas no. 346932), from the Florena shale member, Beattie limestone, Lower Permian, 0.5 mile south of Dexter, Kansas	302
10-12	—*Meekopora vesca* Moore and Dudley, n. sp., specimens from the Gaptank formation, Pennsylvanian, at Gaptank, Pecos County, Texas. *10a*, Part of broad side of zoarium (Univ. Kansas no. 482731), showing peristomes surrounding small suboval apertures and maculae at top center and margins of branch. *10b*, Edge view of this specimen showing thin raised line marking position of median lamella and coalescent maculae of opposite zooecial layers, between which apertures closely abut the median lamella. *11a*, Face of another specimen (Univ. Kansas no. 766331), showing absence of maculae along middle of surface and indicating the sinuous margins of branch. *11b*, Edge view of this specimen, showing features comparable to those of *10b*. *12*, Edge view of a well preserved specimen (Univ. Kansas no. 454233)	301



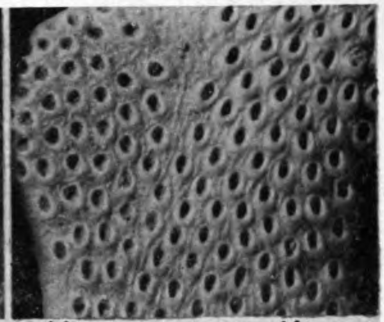
1. Meekopora prosseri
2. Meekopora parilis
3. Meekoporella dehiscens
4. Meekoporella repleta
5. M. mollis
6. M. nexilis
8. M. prosseri
7. Meekoporella nexilis
9. Meekopora opima, n. sp.
10a Meekopora vesca 10b
11a Meekopora vesca 11b
12

EXPLANATION OF PLATE 39

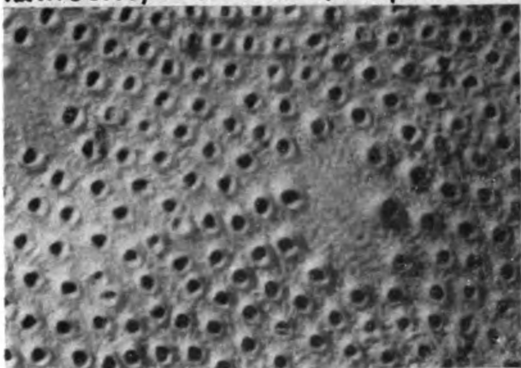
(*Surface views of portions of zoaria. All figures x10, except figures 7 and 8.*)

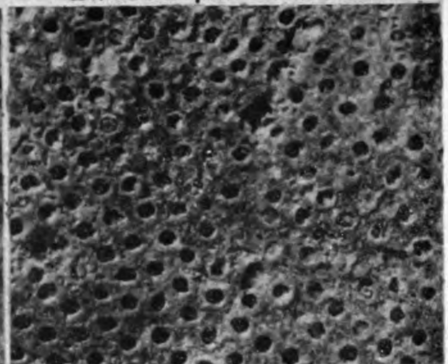
1a *Meekopora vesca*, n. sp. 1b



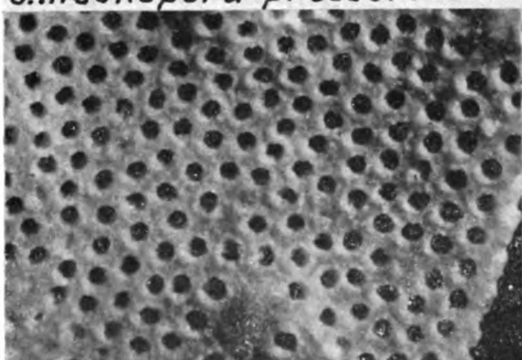
2. *Meekopora mollis*



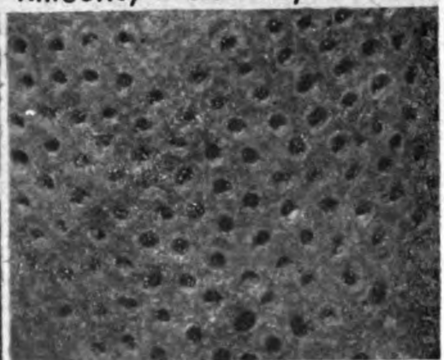
3. *Meekopora prosseri* Ulr.



4. *Meekoporella repleta*

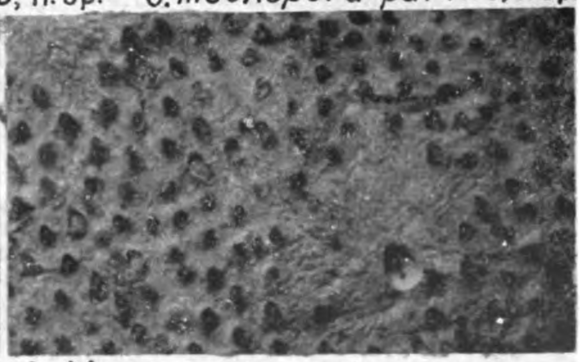


5. *Meekoporella nexilis*, n. sp.



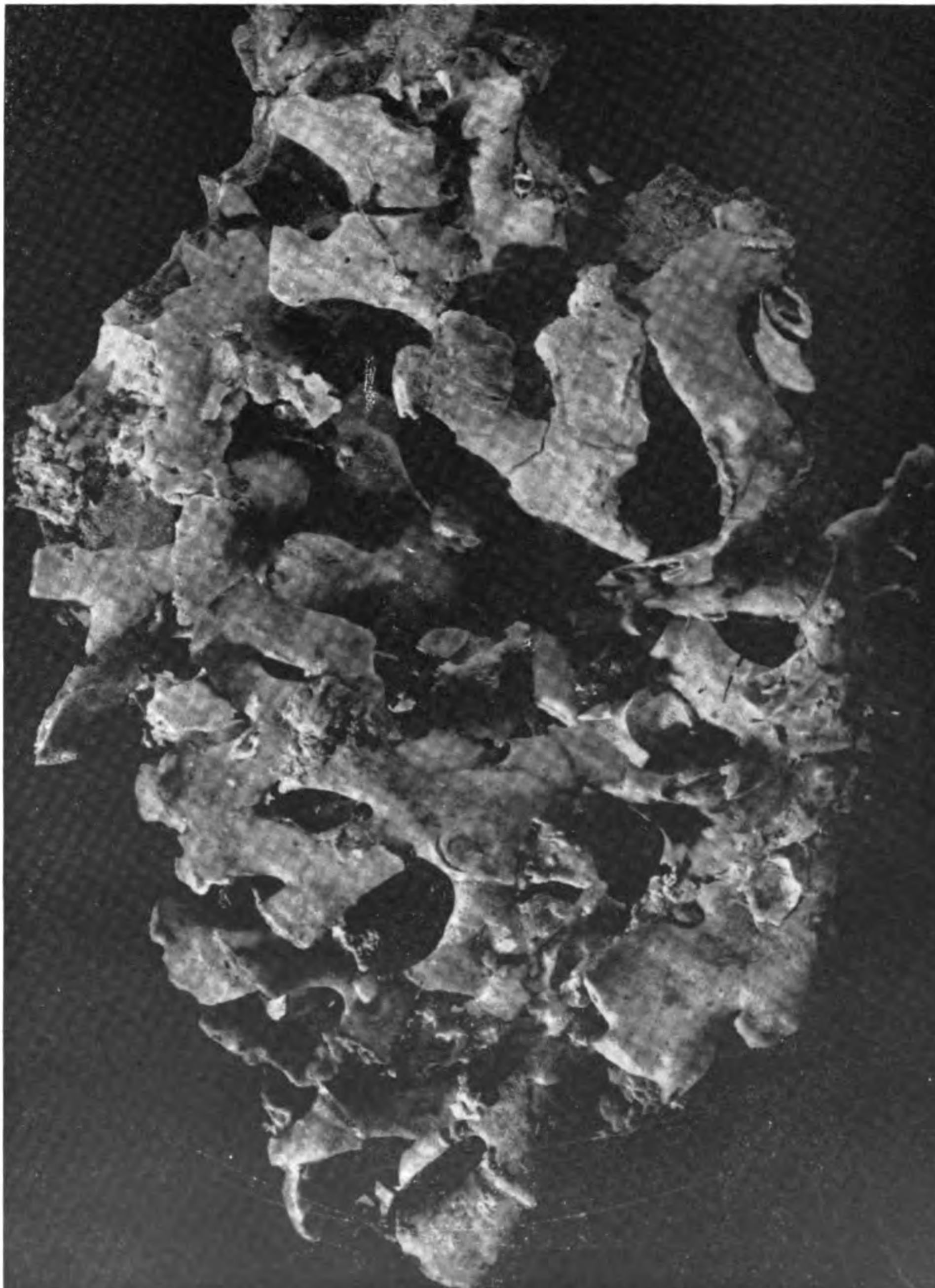
6. *Meekopora parilis*, n. sp.


7. *Meekopora mollis* 8.



9. *Meekopora opima*, n. sp.

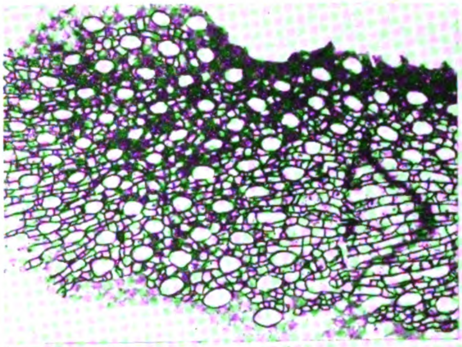
EXPLANATION OF PLATE 40



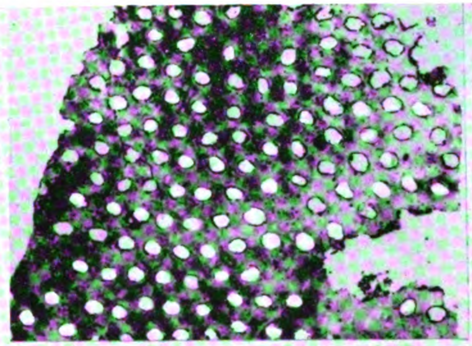
EXPLANATION OF PLATE 41

(All figures tangential sections x10.)

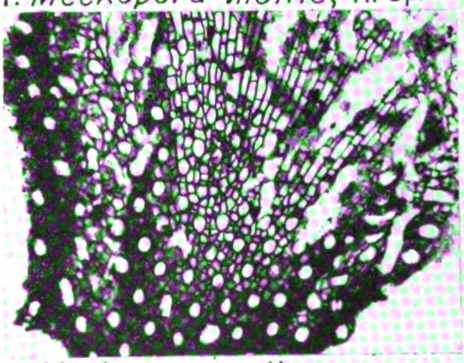
FIGURE		PAGE
1, 3	*Meekopora mollis* Moore and Dudley, n. sp. *1,* Specimen (Univ. Kansas no. 750319), from the Harpersville formation (Waldrip no. 1 limestone), Virgilian, 4 miles east of Santa Anna, Tex.; section cut only slightly below surface, yet showing strongly linear structure characteristic of immature zone next to median lamella. *3,* Type specimen (Univ. Kansas no. 217532), from the Brownville limestone, Virgilian, at Admire Junction, Lyon County, Kansas; section cut slightly oblique to surface, reaching nearly to median lamella in upper part of area	300
2	*Meekopora calamistrata* Moore and Dudley, n. sp., type specimen (Univ. Nebraska coll.), from the Kaibab limestone, Leonardian, on Kaibab Plateau, 2.5 miles east of Jacobs Lake, Grand Canyon region, Arizona, showing dense interzooecial areas.	304
4	*Meekopora vesca* Moore and Dudley, n. sp., specimen (Univ. Kansas no. 450933), from the Gaptank formation, Pennsylvanian, at Gaptank, Pecos County, Texas.	301
5, 6	*Meekopora parilis* Moore and Dudley, n. sp. *5,* Specimen (Univ. Kansas no. 741735), from Leonardian beds at Split Tank, 1 mile northeast of old Word ranch, Glass Mountains, 16 miles northeast of Marathon, Tex. *6,* Specimen (Yale Univ. Peabody Mus. no. 93-32), from Wolfcampian beds northeast of Wolfcamp, Glass Mountains, 12 miles N. 35° E. from Marathon, Tex.	303
7	*Meekopora prosseri* Ulrich, specimen (Univ. Kansas no. 554733), from the Hughes Creek shale member, Foraker formation, Lower Permian, southeast of Bennett, Neb.	299
8	*Meekopora opima* Moore and Dudley, n. sp., specimen (Univ. Kansas no. 554232), from the Florena shale member, Beattie limestone, Lower Permian, near Hooser, Kan.	302



1. *Meekopora mollis*, n. sp.

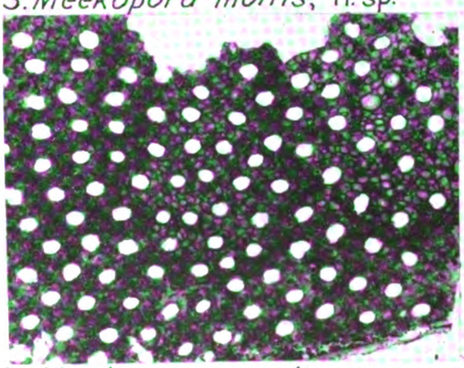


2. *Meekopora calamistrata*, n. sp.

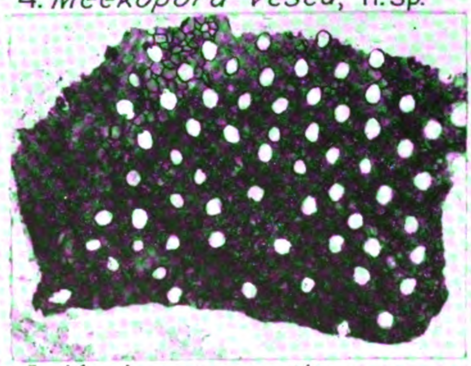


3. *Meekopora mollis*, n. sp.

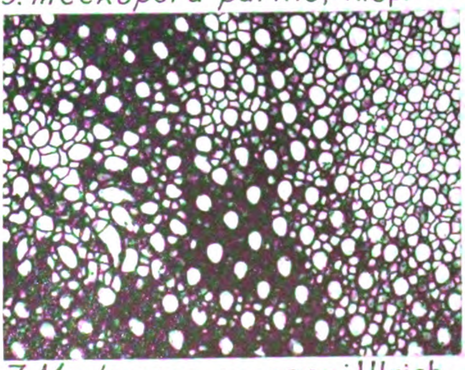
4. *Meekopora vesca*, n. sp.



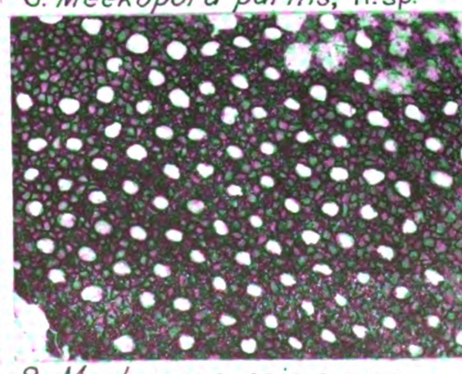
5. *Meekopora parilis*, n. sp.



6. *Meekopora parilis*, n. sp.



7. *Meekopora prosseri* Ulrich



8. *Meekopora opima*, n. sp.

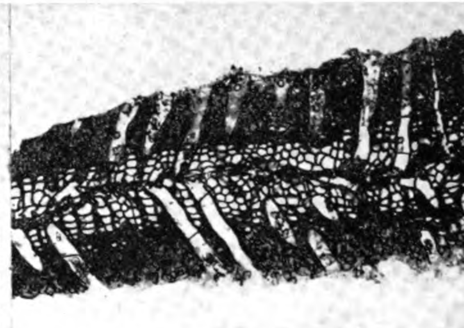
Explanation of Plate 42

(All figures longitudinal sections x10)

Figure		Page
1-3	—*Meekopora prosseri* Ulrich, from Lower Permian rocks of Nebraska and Texas. *1*, Specimen (Univ. Kansas no. 750532), from shale below Saddle Creek limestone, 7 miles north of Fife, Tex. *2*, Specimen (Univ. Kansas no. 554733), from the Hughes Creek shale member, Foraker formation, southeast of Bennett, Neb.; section cut parallel to direction of growth of zooecial tubes, showing clearly the recumbent portion of tubes next to median lamella and oblique attitude of zooecia in mature region. *3*, Another specimen (Univ. Kansas no. 31933), from the Hughes Creek shale southeast of Unadilla, Neb., showing stereome-filled interzooecial areas near surfaces.	**299**
4, 7	—*Meekopora parilis* Moore and Dudley, n. sp., from Wolfcampian beds near Wolfcamp, Glass Mountains, 12 miles N. 35° E. from Marathon, Tex. *4*, Specimen (Yale Univ. Peabody Mus. no. 87-31), from 1 mile northwest of Wolfcamp, showing long erect zooecial tubes. *7*, Specimen (Yale Univ. Peabody Mus. no. 93-36), from northeast of Wolfcamp, section not quite extending to surfaces.	**303**
5, 6, 8	—*Meekopora opima* Moore and Dudley, n. sp. *5*, Specimen (Yale Univ. Peabody Mus. no. 3478-3), from the Drum limestone, Missourian, Kansas City, Mo.; doubtfully referred to this species. *6*, Specimen (Univ. Kansas no. 22332), from the Florena shale member, Beattie limestone, Lower Permian, west of Cottonwood Falls, Kan. *8*, Type specimen (Univ. Kansas no. 346931), showing long erect zooecial tubes and common diaphragms, from the Florena shale 0.5 mile south of Dexter, Kan.	**302**

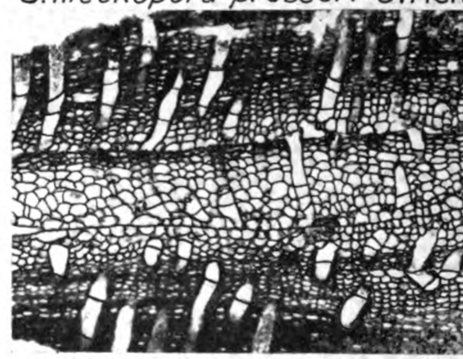
1. *Meekopora prosseri* Ulrich

2. *Meekopora prosseri* Ulrich

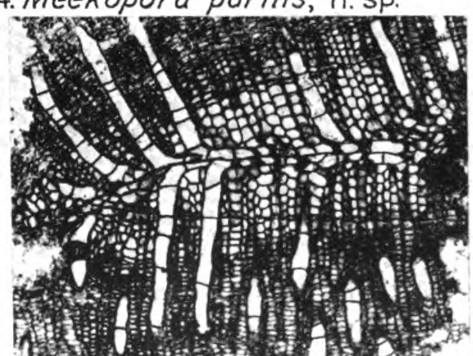


3. *Meekopora prosseri* Ulrich

4. *Meekopora parilis*, n. sp.

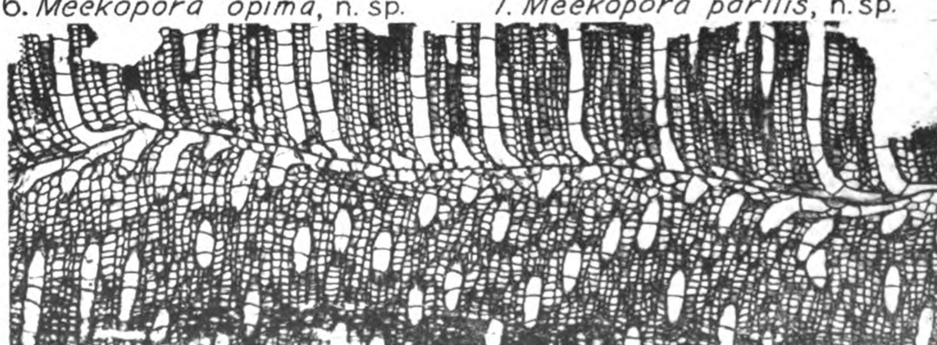


5. *Meekopora opima*, n. sp.



6. *Meekopora opima*, n. sp.

7. *Meekopora parilis*, n. sp.

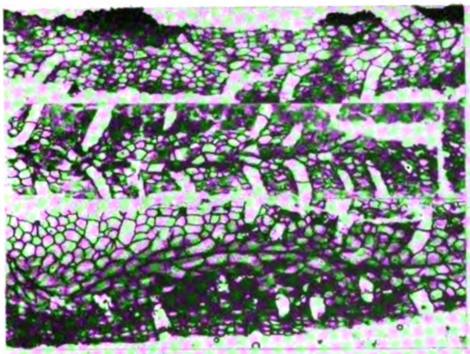


8. *Meekopora opima*, n. sp.

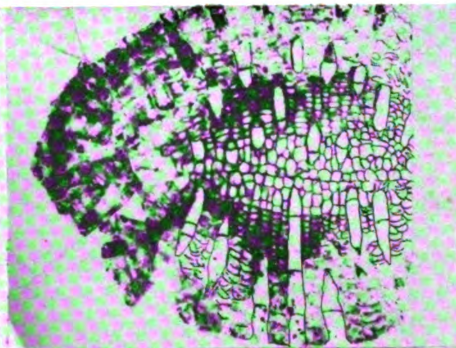
Explanation of Plate 43

(All figures x10.)

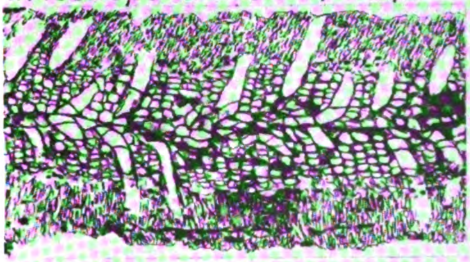
Figure	Page
1—*Meekopora mollis* Moore and Dudley, n. sp., longitudinal sections of three specimens (type in center, University Kansas no. 217532), from the Brownville limestone, Virgilian, near Admire Junction, Lyon County, Kansas.	300
2, *4*—*Meekopora parilis* Moore and Dudley, n. sp. *2*, Transverse section of zoarium (Yale Univ. Peabody Mus. no. 53-31), from the Word formation, Guadalupian, 1.5 miles southwest of Sullivan Peak, Glass Mountains, 5.5 miles east of Altuda, Tex. *4*, Longitudinal section of specimen (Univ. Kansas no. 741736), from Leonardian limestone at Split Tank, 1 mile northeast of old Word ranch, 16 miles northeast of Marathon, Tex.	303
3—*Meekopora vesca* Moore and Dudley, n. sp., longitudinal section of type specimen (Univ. Kansas no. 559235), from the Gaptank formation, Pennsylvanian, at Gaptank, Pecos County, Texas.	301
5, 7—*Meekoporella repleta* Moore and Dudley, n. sp. 5, Tangential section of specimen (Yale Univ. Peabody Mus. no. 46-36), from the Word formation, Guadalupian, Glass Mountains, north of Marathon, Tex. 7, Tangential section of type specimen (Yale Univ. Peabody Mus. no. 123-4), from Leonardian beds north of Leonard Mountain, Glass Mountains, 9.5 miles north of Marathon, Tex.	307
6—*Meekopora calamistrata* Moore and Dudley, n. sp., longitudinal section of type specimen (Nebraska Geol. Survey coll.), from the Kaibab limestone, Leonardian, on Kaibab Plateau, 2.5 miles east of Jacobs Lake, Grand Canyon region, Arizona.	304
8—*Meekoporella dehiscens* Moore and Dudley, n. sp., tangential section of specimen (Univ. Kansas no. 17437), from the Stanton limestone, Missourian, 1 mile south of Fredonia, Kan.	305



1. *Meekopora mollis*, n. sp.

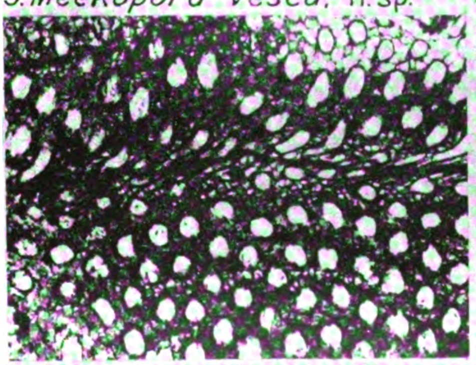


2. *Meekopora parilis*, n. sp.

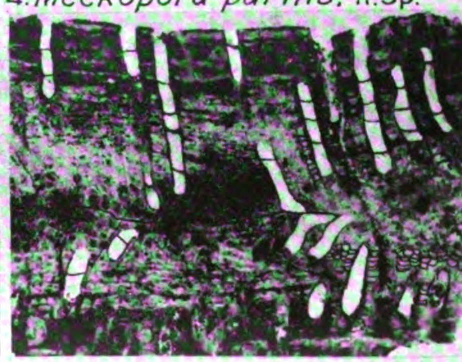


3. *Meekopora vesca*, n. sp.

4. *Meekopora parilis*, n. sp.

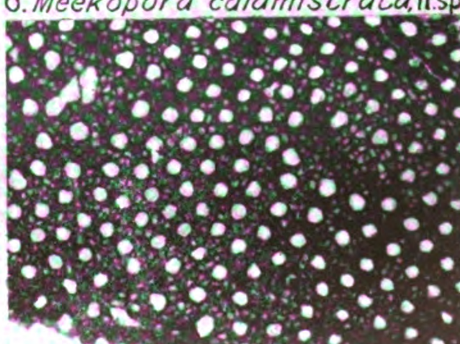


5. *Meekoporella repleta*, n. sp.



6. *Meekopora calamistrata*, n. sp.

7. *Meekoporella repleta*, n. sp.

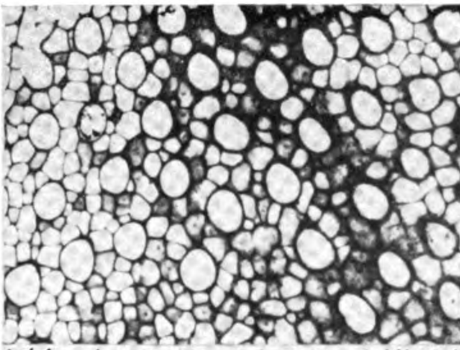


8. *Meekoporella dehiscens*

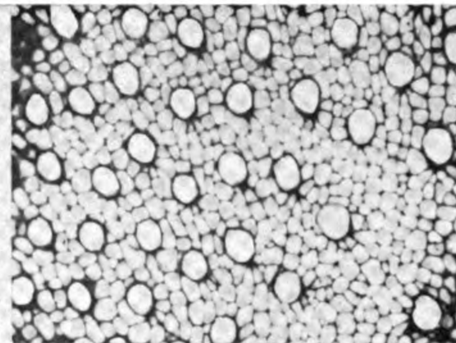
Explanation of Plate 44

(All figures tangential sections x20.)

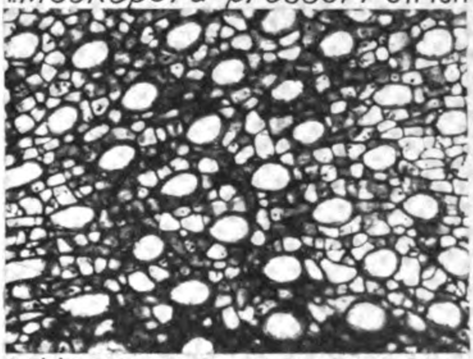
Figure	Page
1, 2—*Meekopora prosseri* Ulrich, from the Hughes Creek shale member, Foraker formation, in Nebraska. *1*, Specimen (Univ. Kansas no. 554733), from southeast of Bennett, Neb. *2*, Specimen (Univ. Kansas no. 544630), from south of Humboldt, Neb.	299
3, 4—*Meekopora mollis* Moore and Dudley, n. sp. 3, Specimen (Univ. Kansas no. 750319), from the Harpersville formation (Waldrip limestone no. 1), Virgilian, 4 miles east of Santa Anna, Tex. *4*, Specimen (Univ. Kansas no. 217532), from the Brownville limestone, Virgilian, at Admire Junction, Kan.	300
5, 7—*Meekopora parilis* Moore and Dudley, n. sp. 5, Specimen (Yale Univ. Peabody Mus. no. 93-32), from Wolfcampian beds northeast of Wolfcamp, Glass Mountains, 12 miles N. 35° E. from Marathon, Tex. 7, Specimen (Univ. Kansas no. 741735), from Leonardian limestone at Split Tank, 1 mile northeast of old Word ranch, 16 miles northeast of Marathon, Tex.	303
6—*Meekopora opima* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 346931), from the Florena shale member, Beattie limestone, Lower Permian, 0.5 mile south of Dexter, Kan.	302
8—*Meekopora vesca* Moore and Dudley, n. sp., specimen (Univ. Kansas no. 450933), from the Gaptank formation, Pennsylvanian, at Gaptank, Pecos County, Texas.	301



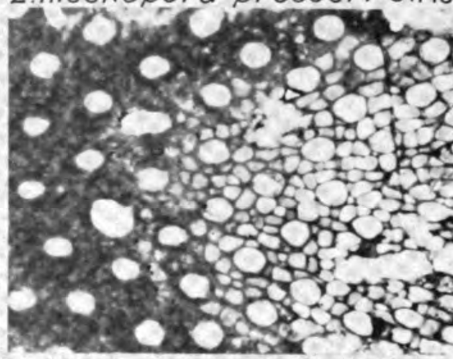
1. *Meekopora prosseri* Ulrich



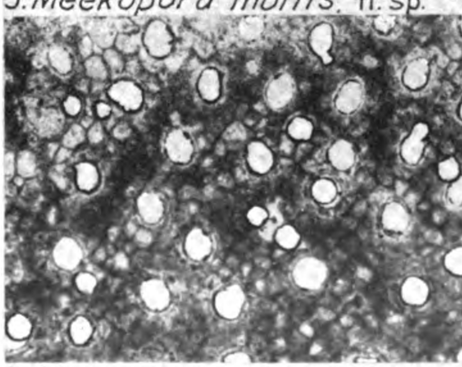
2. *Meekopora prosseri* Ulrich



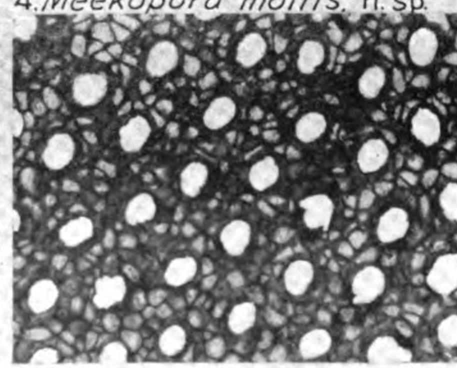
3. *Meekopora mollis*, n. sp.



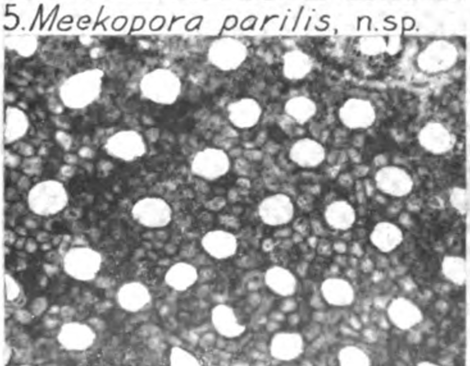
4. *Meekopora mollis*, n. sp.



5. *Meekopora parilis*, n. sp.



6. *Meekopora opima*, n. sp.



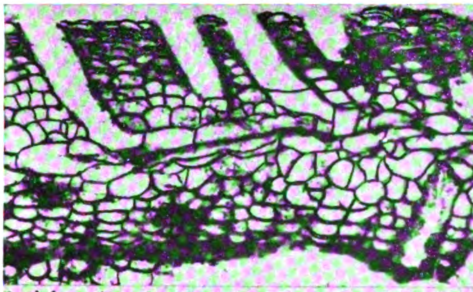
7. *Meekopora parilis*, n. sp.

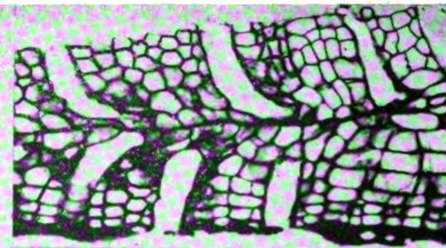
8. *Meekopora vesca*, n. sp.

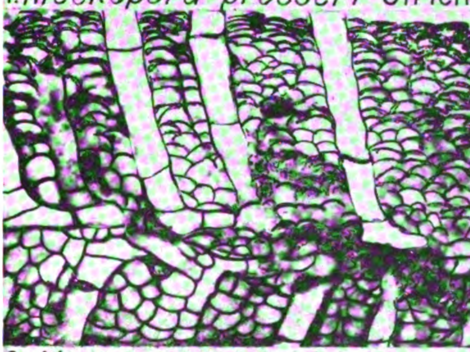
EXPLANATION OF PLATE 45

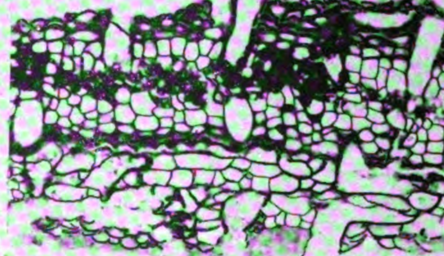
(All figures longitudinal sections x20.)

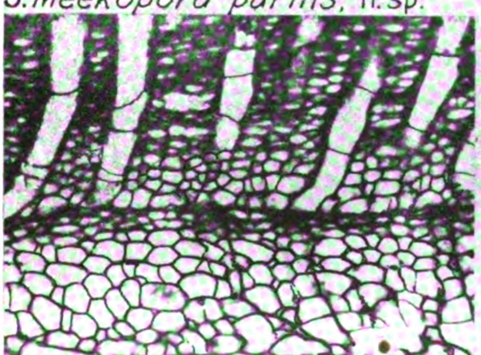
FIGURE	PAGE
1,2,4—*Meekopora prosseri* Ulrich. *1*, Specimen (Univ. Kansas no. 554733), from the Hughes Creek shale member, Foraker formation, Lower Permian, southeast of Bennett, Neb. *2*, Specimen (Univ. Kansas no. 750532), from shale below Saddle Creek limestone, Lower Permian, 7 miles north of Fife, Tex. *4*, Specimen (Univ. Kansas no. 553230), from the Chanute shale, Missourian, on Turkey Creek, Kansas City, Mo.	299
3, 8—*Meekopora parilis* Moore and Dudley, n. sp. *3*, Specimen (Yale Univ. Peabody Mus. no. 87-31), from Wolfcampian beds 1 mile northwest of Wolfcamp, Glass Mountains, 12.5 miles N. 32° E. from Marathon, Tex. *8*, Specimen (Yale Univ. Peabody Mus. no. 53), from the Word formation, Guadalupian, 1.5 miles southwest of Sullivan Peak, 5.5 miles east of Altuda, Tex.	303
5-7—*Meekopora opima* Moore and Dudley, n. sp. *5*, Specimen (Yale Univ. Peabody Mus. no. 3478-3), from the Drum limestone, Missourian, Kansas City, Mo.; doubtfully referred to this species. *6*, Specimen (Univ. Kansas no. 554232), from the Florena shale member, Beattie formation, Lower Permian, near Hooser, Kan. *7*, Type specimen (Univ. Kansas no. 346931), from the Florena shale, 0.5 mile south of Dexter, Kan., transverse section of branch.	302


1. *Meekopora prosseri* Ulrich

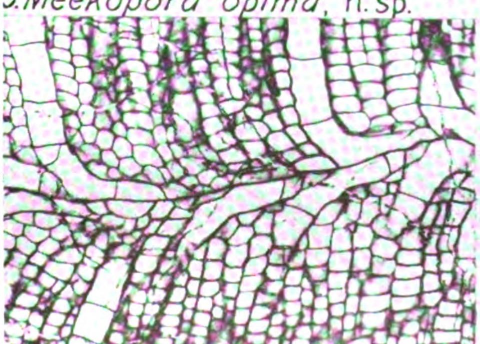

2. *Meekopora prosseri* Ulrich


3. *Meekopora parilis*, n. sp.


4. *Meekopora prosseri* Ulrich


5. *Meekopora opima*, n. sp.


6. *Meekopora opima*, n. sp.

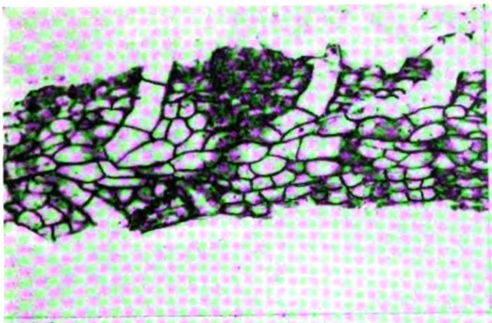

7. *Meekopora opima*, n. sp.


8. *Meekopora parilis*, n. sp.

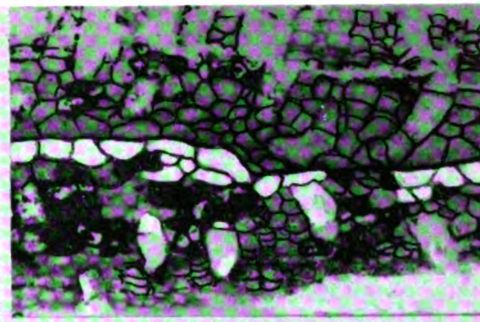
Explanation of Plate 46

(All figures longitudinal sections x20.)

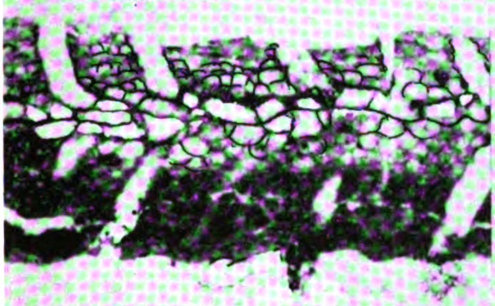
Figure	Page
1-3—*Meekopora mollis* Moore and Dudley, n. sp., from the Brownville limestone, Virgilian, near Admire Junction, Lyon County, Kan. *1*, Specimen (Univ. Kansas no. 278031). *2*, Specimen (Univ. Kansas no. 278032). *3*, Specimen (Univ. Kansas no. 217533).	300
4, 8—*Meekopora prosseri* Ulrich, from the Hughes Creek shale member, Foraker formation, Lower Permian, in Nebraska. *4*, Specimen (Univ. Kansas no. 554733), from southeast of Bennett, Neb. *8*, Specimen (Nebraska Geol. Survey coll.), from southeast of Unadilla, Neb.	299
5, 7—*Meekopora parilis* Moore and Dudley, n. sp. *5*, Type specimen (Yale Univ. Peabody Mus. no. 93-36), from Wolfcampian beds northeast of Wolfcamp, Glass Mountains, 12 miles N. 35° E. from Marathon, Tex. *7*, Specimen (Univ. Kansas no. 741736), from Leonardian limestone at Split Tank, 1 mile northeast of old Word ranch, 16 miles northeast of Marathon, Tex.	303
6—*Meekopora vesca* Moore and Dudley, n. sp., type specimen (Univ. Kansas no. 559235), from the Gaptank formation, Pennsylvanian, at Gaptank, Pecos County, Texas.	301



1. *Meekopora mollis*, n.sp.

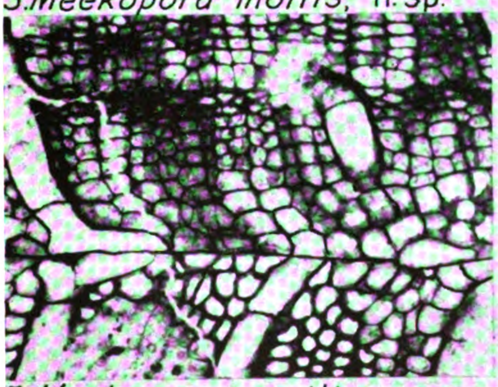


2. *Meekopora mollis*, n.sp.

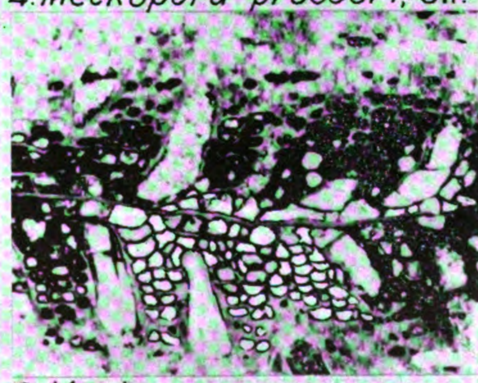


3. *Meekopora mollis*, n.sp.

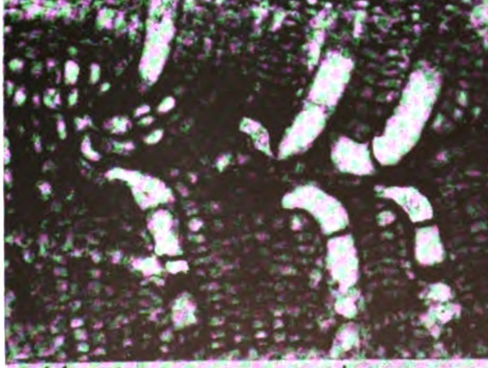
4. *Meekopora prosseri*, Ulr.



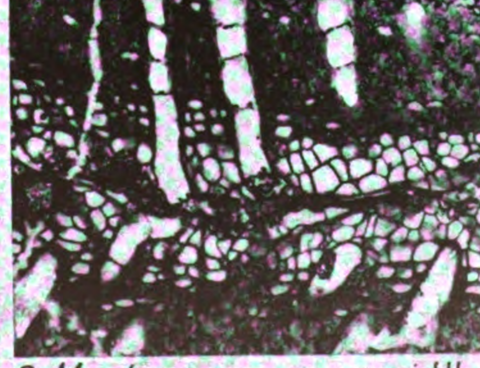
5. *Meekopora parilis*, n.sp.



6. *Meekopora vesca*, n.sp.



7. *Meekopora parilis*, n.sp.



8. *Meekopora prosseri* Ulr.

EXPLANATION OF PLATE 47

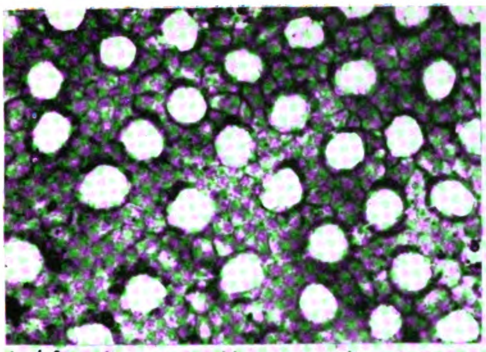
(All figures x20, except figure 3.)

FIGURE — PAGE

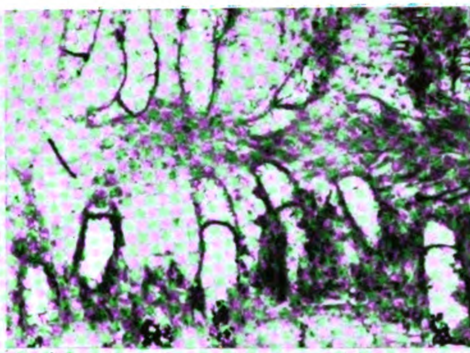
1-3—*Meekoporella nexilis* Moore and Dudley, n. sp., type specimen (Yale Univ. Peabody Mus. no. 90-31), from Wolfcampian beds at Wolfcamp, Glass Mountains, 12 miles N. 35° E. from Marathon, Tex. *1,* Tangential section, showing nearly circular outline of zooecial tubes. *2,* Longitudinal section. *3,* Tangential section (x10). 306

4, 5—*Meekoporella dehiscens* Moore and Dudley, n. sp., from the Stanton limestone, Missourian, 1 mile south of Fredonia, Kan. *4,* Specimen (Univ. Kansas no. 174315), longitudinal section. *5,* Specimen (Univ. Kansas no. 17437), tangential section showing a macula, adjacent zooecia having definite lunarial wall inflections. 305

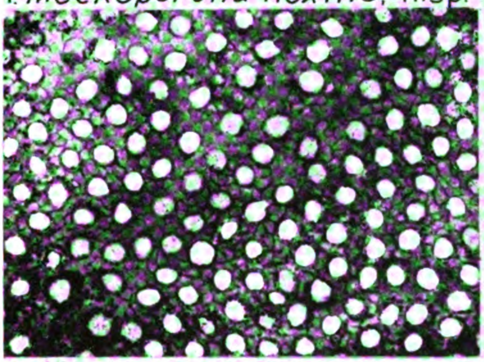
6-8—*Meekoporella repleta* Moore and Dudley, n. sp. *6,* Specimen (Yale Univ. Peabody Mus. no. 46-36), from the Word formation, Guadalupian, at King brothers' section 12, Glass Mountains, north of Marathon, Tex., tangential to oblique section. *7,* Tangential section of type specimen (Yale Univ. Peabody Mus. no. 123-4), from Leonardian beds north of Leonard Mountain, Glass Mountains, 9.5 miles north of Marathon. *8,* Longitudinal section of type specimen. 307



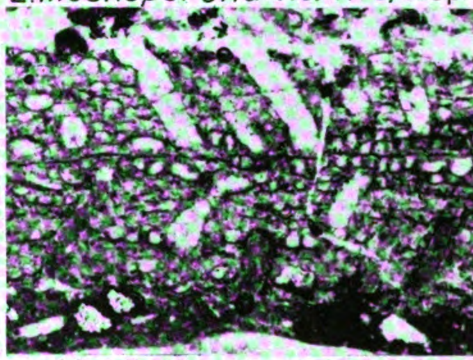
1. *Meekoporella nexilis*, n.sp.



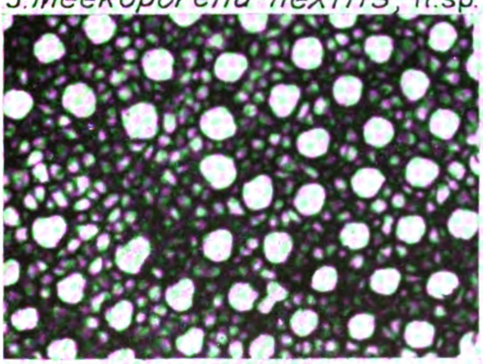
2. *Meekoporella nexilis*, n.sp.



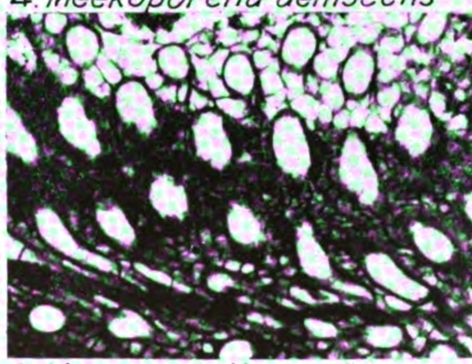
3. *Meekoporella nexilis*, n.sp.



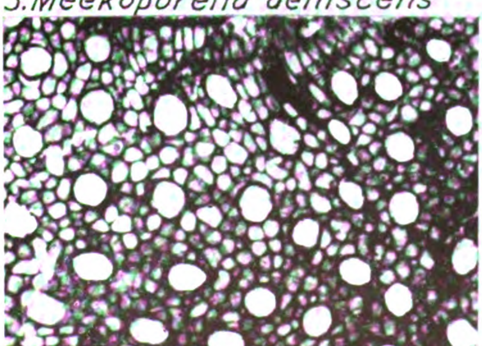
4. *Meekoporella dehiscens*



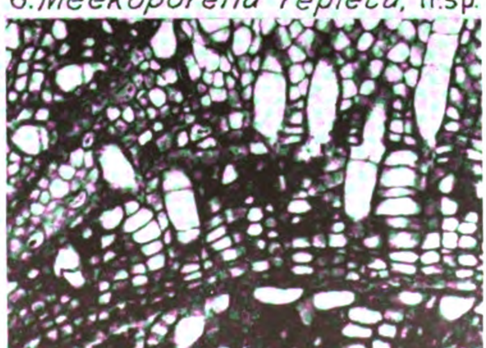
5. *Meekoporella dehiscens*



6. *Meekoporella repleta*, n.sp.



7. *Meekoporella repleta*, n.sp.

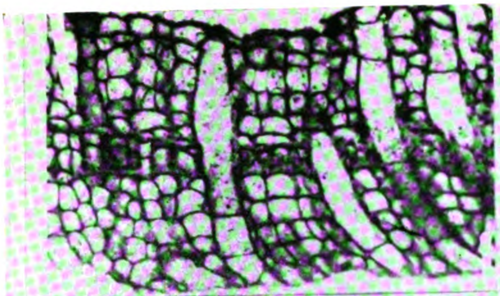


8. *Meekoporella repleta* n.sp.

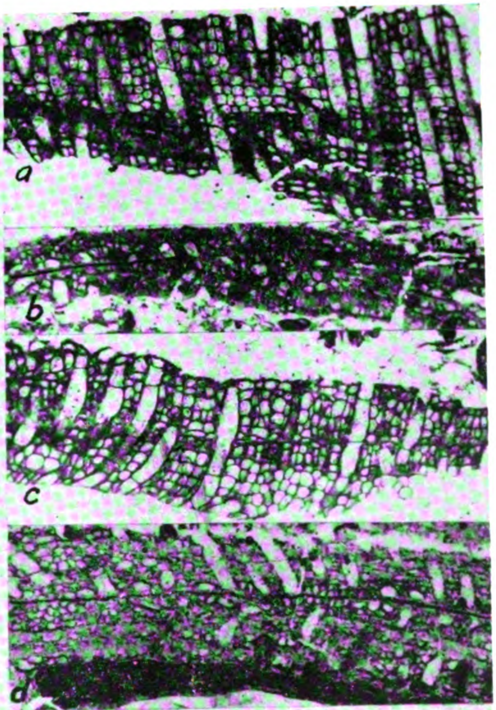
Explanation of Plate 48

(All figures longitudinal sections x10, except figures 1 and 7, which are x20.)

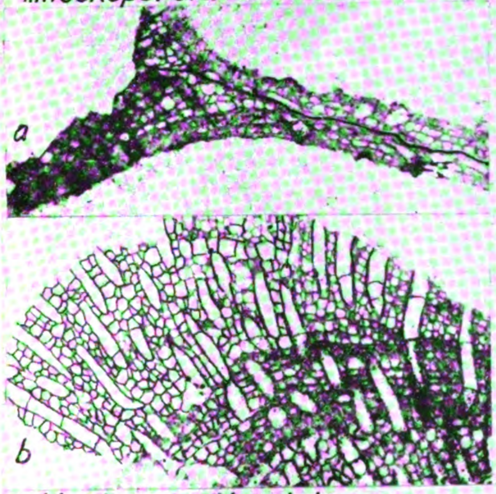
Figure		Page
1-3	—*Meekoporella dehiscens* Moore and Dudley, n. sp., from the Stanton limestone, Missourian, 1 mile south of Fredonia, Kan. Sections of one or both cell layers of the bifoliate walls forming zoaria of this species.	305
4	—*Meekoporella nexilis* Moore and Dudley, n. sp., type specimen (Yale Univ. Peabody Mus. no. 90-31), from Wolfcampian beds at Wolfcamp, Glass Mountains, 12 miles N. 35° E. from Marathon, Tex.	306
5-7	—*Meekoporella repleta* Moore and Dudley, n. sp. 5, Specimen (Yale Univ. Peabody Mus. no. 46-36), from the Word formation, Guadalupian, from King brothers section 12, Glass Mountains; median lamella near center of area. 6, Type specimen (Yale Univ. Peabody Mus. no. 123-4), from Leonardian beds, north of Leonard Mountain, Glass Mountains, 9.5 miles north of Marathon, Tex. 7, Part of section shown in fig. 5 (x20).	307



1. *Meekoporella dehiscens*, n.sp.

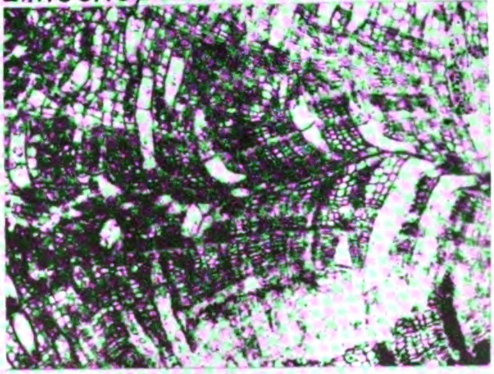


2. *Meekoporella dehiscens*,

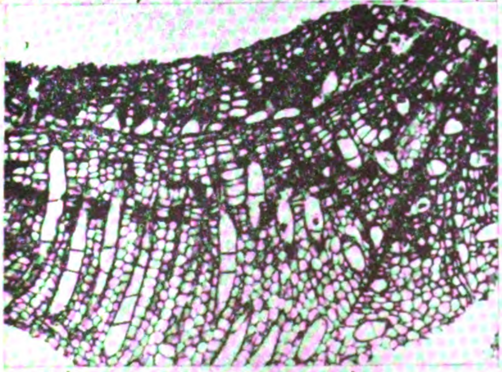


3. *Meekoporella dehiscens*

4. *Meekoporella nexilis*, n.sp.



5. *Meekoporella repleta*. n.sp.



6. *Meekoporella repleta*, n.sp.

7. *Meekoporella repleta*, n.sp

INDEX OF SPECIES DESCRIBED OR ILLUSTRATED