

A STUDY OF THE JAMES TYPES OF ORDOVICIAN AND SILURIAN BRYOZOA.

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Mr. U. P. James was one of the pioneer students of the splendid fauna of the Cincinnati group, and at various times between 1871 and 1883 printed the results of his studies in private and other publications. In these papers Mr. James described a considerable number of bryozoa as well as of other classes of fossils, but almost invariably failed to illustrate his species. Some of his names were recognized by subsequent writers who redescribed and illustrated his species, but the majority are still as left by their author.

Some years ago the James collection became a part of the paleontologic collection of Walker Museum of the University of Chicago, and its types are now accessible for study. The present paper is devoted to a consideration of the bryozoa described by Mr. James, and is based not only upon the James types but also upon numerous authentic specimens received from Mr. James and now in the collection of the U. S. National Museum. However, most of these bryozoa (Trepotomata) he referred to the Tabulate corals, others (Cryptostomata) to the bryozoa, while a few were placed with *Stromatopora* and the sponges. It is hoped that the conclusions reached by the present writer in regard to the validity and synonymy of the various species are fair to both Mr. James and subsequent workers along the same line.

The writer is under obligations to Professors Chamberlin and Weller for the opportunity of studying this portion of the James collection, and especial thanks are due Professor Weller for his help and advice at various times.

INTRODUCTION.

The early systematic work in all branches of natural history is obviously more or less faulty when compared with the standard obtaining to-day, just as many imperfections will no doubt be found by the future student in the results of present researches. This is especially true in regard to paleontologic work, where the student's observations

are limited to more or less imperfect remains, and when, in addition, a class such as the Bryozoa requires the microscopic as well as the macroscopic characters for the delimitation of species, it is not astonishing that pioneer work in such a field should be quite imperfect.

All of the Paleozoic systems of the North American continent, with the exception of the Cambrian, afford a large number of Bryozoa which have essentially the same general macroscopic features, but which show their specific differences mainly upon microscopic examination. This applies particularly to species of the order Trepostomata, or, as they have been commonly designated, the *Monticuliporoids*. Species of Trepostomata as well as of the other orders were described from the external characters alone until 1876, when Doctor Nicholson published his paper Notes on the Paleozoic Corals of the State of Ohio.^a Here for the first time the internal characters were studied and illustrated by means of thin sections. This and succeeding articles by the same writer pointed out the way for the accurate study of the monticuliporoids. Previous to the date mentioned, names such as *Chaetetes lycoperdon* or *C. petropolitanus* were applied to almost any massive paleozoic bryozoan, while *Stenopora fibrosa* was a convenient designation for ramose forms irrespective of their geological horizon. To-day the characterization of any new species, particularly of the Trepostomata, is incomplete without the description and illustration of the internal structure as well as the external features. Fortunately some of the species hitherto described without a study of their internal parts have such well-marked external characters that, with good illustrations of the latter, it has been possible to identify the species. The generic characters being in nearly all cases internal, it remained for subsequent authors to properly place such species.

Several authors have described a considerable number of bryozoa almost entirely without illustration. In a few cases the specific characters are so salient that little trouble is experienced in identifying the species, but in the majority of cases it is impossible to do so without an examination of the original types. To determine the status of as many as possible of these more or less obscure species, and thus to clear up the literature of the subject, has been the endeavor of the writer for some years. In the identification and final recognition of such species, especially when the synonymy, if any, is in question, one's personal equation is so liable to enter that considerable care is necessary in order to obtain unbiased results. The writer has tried to eliminate this element in work of this character by adhering strictly to the rules of nomenclature. The Code of Nomenclature adopted by the American Ornithologists Union (New York, 1892) contains probably the best and most recent expression of the laws upon this subject, and the rules employed in this paper and cited later are quoted from this valuable work.

^aAnn. Mag. Nat. Hist. (4), XVIII, 1876, pp. 85-94, pl. v.

In the application of these rules to the James types, many difficulties are encountered. These occur especially in those cases where the specimens marked as types fail to conform in important respects with the original descriptions. In many cases it seems almost certain that the specimens now marked as the types were not the ones originally used by the elder James in describing the species. Furthermore, it is probable that the selection of the types occurred subsequently, possibly when the younger James joined his father in the study of these organisms. As it is now impossible to determine this point, and as labels in the elder James's handwriting in every case accompany the type, we must accept the specimens thus marked as the original types and apply the rules to these.

The study of these type specimens has forcibly impressed upon the writer the caution that ought to be observed by cataloguers in recording literature of this kind. In 1900^a Nickles and the writer recognized a number of the poorly defined James species, placing well defined and figured species of other authors as synonyms. These identifications were based mainly upon "authentic" specimens one of them had received from Mr. U. P. James, and also partly upon their interpretation of his descriptions. Unfortunately this interpretation and the authentic specimens do not in a number of cases agree with the types, thus making a revision of the synonymy necessary.

BIBLIOGRAPHY.

The paleontological publications of Mr. U. P. James commenced in 1871 with the issue of a Catalogue of Lower Silurian Fossils. In this pamphlet a few species now referred to the bryozoa were named but not described. In a second and enlarged edition of the catalogue, which appeared in 1875, these and other species were briefly described. In July, 1878, appeared the first number of the *Paleontologist*, a private publication devoted to geology and paleontology. Seven numbers, consisting altogether of 53 pages and 2 plates, were issued at irregular intervals from 1878 to 1883. The descriptions in this paper are often clear and concise, and have the additional advantage of including accurate measurements, as well as a statement of the horizon, locality, and range of the species. In the treatment of the monticuliporoids, in Nos. 6 and 7, more or less detailed accounts of their internal structure are given. Five additional species of this class are described by Mr. James in articles appearing in the *Journal of the Cincinnati Society of Natural History*. Many of the descriptions in the foregoing articles are, as mentioned before, clear and concise and show that their author was not only an acute observer, but also appreciated the value of both external and internal characters in the discrimination of species belonging to this group.

The series of papers by U. P. James and Joseph F. James, listed

^aBull. U. S. Geol. Surv., No. 173, 1900.

below and entitled *On the Monticuliporoid Corals of the Cincinnati Group, with a Critical Revision of the Species*, contains a treatment of the monticuliporoids that is in marked contrast to the previous work of the elder James. The form and surface characters of the zoarium are now considered the diagnostic points, and the species and synonymy are arranged accordingly. Joseph F. James continues the same style of work in his *Manual of the Paleontology of the Cincinnati Group*, but his death left this series of articles unfinished.

The following list and remarks upon the papers of both U. P. and J. F. James relate only to those which deal in part or wholly with bryozoa or organisms which have proved to be bryozoa.

U. P. JAMES.

1. CATALOGUE OF LOWER SILURIAN FOSSILS, CINцинATI GROUP, CINцинATI, 1871.
Under the heading of Zoophyta lists the Bryozoa of the Cincinnati group.
2. ADDITIONS TO CATALOGUE OF LOWER SILURIAN FOSSILS, CINцинATI GROUP, CINцинATI, 1873.
Lists several additional species of Bryozoa and corrects some of the earlier names.
3. CATALOGUE OF LOWER SILURIAN FOSSILS OF THE CINцинATI GROUP, WITH DESCRIPTIONS OF SOME NEW SPECIES OF CORALS AND POLYZOA, CINцинATI, 1875.
This is an enlarged edition of the catalogue of 1871 and contains in addition an introduction wherein the following new species of Bryozoa are described: *Chatetes* ? *calycula*, *C. clavacoideus*, *C. cincinnatiensis*, *C. ? onealli*, *Ceramopora nicholsoni*, *Ptilodictya acuminata*, and *Alecto nevillei*.
4. THE PALEONTOLOGIST, No. 1, pp. 1-8, CINцинATI, JULY 2, 1878.
Contains descriptions of the following species of Bryozoa: *Chatetes crustulatus*, *C. sp. ? (meeki suggested)*, *C. sp. ? (varians proposed)*, *Fistulipora ? multipora*, *Helopora dendrina*, *H. tenuis*, *H. meeki*, *H. parvula*, *H. approximata*, *Ptilodictya hilli*, *P. plumaria*, *P. flexuosa*, *P. granulosa*, *P. parallela*, *Ceramopora ? beani*, *C. ? irregularis*, *C. alternata*, *C. concentrica*, *Hippothoa delicatula*, *Ptilodictya fimbriata* and *P. sp. ? (welsli proposed)*.
5. THE PALEONTOLOGIST, No. 2, pp. 9-16, CINцинATI, SEPT. 14, 1878.
The following species of Bryozoa are described: *Chatetes lycoperdon*, *C. petropolitans*, *C. turbinatum*, *Callopora milfordensis*, *Ceramopora whitei*, and *C. radians*.
6. THE PALEONTOLOGIST, No. 3, pp. 17-24, CINцинATI, JAN. 15, 1879.
Describes the following species which are now regarded as Bryozoa: *Stromatopora ? lichenoides*, *Fistulipora sibiriana*, *Chatetes minutus*, *C. crustulatus*, *C. lycopodites*, *Ptilodictya nodosa*, *P. platyphylla*, *Escharina distorta*, and *Sugenella striata*.
7. THE PALEONTOLOGIST, No. 4, pp. 25-32, CINцинATI, JULY 10, 1878.
No Bryozoa are described in this number, which includes a "Supplement to Catalogue of Lower Silurian Fossils of the Cincinnati Group." Under the headings of Polypi and Polyzoa, this supplement lists the species of Bryozoa and in some cases indicates the synonymy.
8. THE PALEONTOLOGIST, No. 5, pp. 33-44, CINцинATI, JUNE 10, 1881.
In this number the following Bryozoa are described: *Monticulipora (Chatetes) whitfieldi*, *M. (C.) meeki*, *M. (C.) varians*, *Dekayia maculata*, *Ptilodictya antiqua*, *P. cleavelandi*, *P. kentuckyensis*, *P. clintonensis*, *P. ? cincinnatiensis*, *P. grahmi*, *P. dubia*, and *P. teres*.

9. THE PALEONTOLOGIST, No. 6, pp. 45-56, CINCINNATI, SEPT. 12, 1882.

This number is devoted entirely to species of *Monticulipora* and contains descriptions of both the external and internal features of the following: *Monticulipora (Heterotrypa) clintonensis*, *M. (H.) circularis*, *M. (H.) onealli?* var. *communis*, *M. (H.?) eccentrica*, *M. (H.) winchelli*, *M. (H.?) cleavelandi*, *M. (Monotrypa) wortheni*, *M. (M.) welchi*, *M. (M.?) subfusiformis*, and *M. (M.) dychei*.

10. THE PALEONTOLOGIST, No. 7, pp. 57-59, pls. I, II, CINCINNATI, APRIL 16, 1883.

Describes *Monticulipora kentuckensis* and *Helopora harrisi*.

The plates contain rough sketches of the Bryozoa described in this and the preceding number of the Paleontologist. These figures are of little or no value in the identification of the species.

All of the above references are to pamphlets published privately by Mr. James. Some writers, notably Mr. S. A. Miller in his North American Geology and Paleontology, have ignored these pamphlets altogether, mainly because of their obscure mode of publication, but also because many of the species are "not defined so as to be recognized." Other writers have adopted some of Mr. James's specific names and rejected others, but inasmuch as all of these papers fill the requirements of publication, there is no reason for ignoring the work as a whole, no matter how difficult it may be to recognize the species described. The A. O. U. Code of Nomenclature states that "Publication consists in the public sale or distribution of printed matter, books, pamphlets, or plates" (Canon XLVII), but recommends that authors avoid publishing in obscure pamphlets of limited circulation. The Paleontologist, although certainly of the class to be avoided, must be recognized under the rules since copies were distributed to some extent by the author, and were also placed on sale at his book store in Cincinnati, where they may still be obtained.

The following references are to articles appearing in the proceedings of a well established scientific society, and hence there is no question in regard to their recognition as publications:

11. DESCRIPTIONS OF THREE SPECIES OF FOSSILS. JOURNAL CINCINNATI SOCIETY NATURAL HISTORY, VII, 1884, pp. 21-24.

Describes and gives fairly good illustrations of two bryozoa, *Fistulipora oweni* and *Ceramopora? beani*.

12. DESCRIPTIONS OF FOUR NEW SPECIES OF FOSSILS FROM THE CINCINNATI GROUP. JOURNAL CINCINNATI SOCIETY NATURAL HISTORY, VII, 1884, pp. 137-139, PL. VII.

Describes and illustrates two new bryozoa, *Monticulipora ohioensis* and *M. falesi*. The article also includes descriptions and figures of more or less weathered examples of *Ceramoporella*, which are referred to *Stromatopora* under the name of *S. tubularis* and *S. Ludlowensis*.

U. P. JAMES AND J. F. JAMES.

13. ON THE MONTICULIPOROID CORALS OF THE CINCINNATI GROUP, WITH A CRITICAL REVISION OF THE SPECIES. JOURNAL CINCINNATI SOCIETY OF NATURAL HISTORY, X AND XI.

PART 1, VOLUME X, 1887, pp. 118-141.

PART 2, VOLUME X, 1888, pp. 158-184, PL. I.

PART 3, VOLUME XI, 1888, pp. 15-47, PL. I.

The three installments by U. P. and J. F. James noted above were bound together and distributed by their authors under the title of

Monograph of the Monticuliporoid Corals of the Cincinnati Group. In this monograph external characters alone are employed in distinguishing species, and as a result the specific synonymy given is a revelation. The various monticuliporoid genera and subgenera proposed, particularly those by Nicholson and Ulrich, are made synonyms of either Hall's *Ceramopora* or D'Orbigny's *Monticulipora*. Only *Dekayia* Edwards and Haime, *Constellaria* Dana, and *Fistulipora* McCoy are recognized, and these only as subgenera of *Monticulipora*. The correct placing of some of the synonymous genera seems to have troubled the authors. For example, *Crepipora* and *Chiloporella* are first placed as synonyms of *Ceramopora* and *Monticulipora*, respectively, but in the last installment the authors decide that the subgenus *Fistulipora* is the proper name with which to make them synonymous. However, even this is not final, as later in the same paper *Crepipora* is again made a synonym of *Ceramopora*.

The synonymy of species is on a par with the generic work, as may be illustrated by one of many examples. *Callopora cincinnatiensis* and *Chiloporella flabellata* of Ulrich are considered synonyms of *Monticulipora nicholsoni* James, the two synonyms being founded, according to James and James, "upon slightly worn specimens." It happens, however, that *Callopora cincinnatiensis* is founded upon well-preserved specimens of *Lioclema occidens* (Hall and Whittfield) from the Upper Devonian of Iowa, and, as admitted by Ulrich,^a was erroneously recorded as coming from Cincinnati.

No new species are described in these articles, but many of the James species are figured on the two plates. These figures, especially the illustrations of the surface characters of the various species, are misleading and in many cases are quite unlike the specimens they are said to represent. For example, contiguous angular, polygonal zoecia, such as are exhibited by the specimens called *Monticulipora turbinata*, are represented as more or less irregularly rounded and separated by a space of varying diameter, with here and there a rounded mesopore interpolated.

This series of articles appearing several years after Nicholson's excellent volume *The Genus Monticulipora*, can not be excused on the ground of pioneer work. Instead of marking an advance upon work in the *Paleontologist*, the monograph is very much inferior to the earlier publication, and instead of being the promised aid to the student, the articles are positively confusing and detrimental to progress.

JOSEPH F. JAMES.

14. MANUAL OF THE PALEONTOLOGY OF THE CINCINNATI GROUP. JOURNAL CINCINNATI SOCIETY OF NATURAL HISTORY, XV-XVIII.

VOLUME XV, 1893, pp. 144-159.

VOLUME XVI, 1894, pp. 178-208.

VOLUME XVIII, 1895, pp. 67-88.

VOLUME XVIII, 1896, pp. 115-140.

^aGeol. Surv. Illinois, VIII, 1890, p. 427.

This series of articles differs from the preceding in its less critical tone and iconoclastic spirit. The synonymy is considerably modified, more species now being recognized as valid. The same specific grouping according to zoarial growth is followed, but the author has apparently modified his views as to the value of internal characters, since these are now noted in his descriptions. The work was left unfinished by the death of the author.

LAWS OF NOMENCLATURE.

In order to avoid repetition in the descriptive portion of this work, the writer has selected and quoted below such laws of nomenclature as will be found to have special application to the James species. These are given as published in the Code of Nomenclature adopted by the American Ornithologists' Union (New York, 1892), and it is believed that the canons quoted cover all the cases afforded by the James bryozoan species.

OF THE RETENTION OF NAMES.

Canon XXXVII.—A *nomen nudum*, generic or specific, may be adopted by a subsequent author, but the name takes both its date and authority from the time when, and from the author by whom, the name becomes clothed with significance by being properly defined and published.

OF THE REJECTION OF NAMES.

Canon XXXIV.—A *nomen nudum* is to be rejected as having no status in nomenclature.

Canon XXXVI.—A name resting solely on an inadequate diagnosis is to be rejected, on the ground that it is indeterminable and therefore not properly defined.

Canon XXXV.—A name which has never been clearly defined in some published work is to be changed for the earliest name by which the object shall have been so defined, if such name exist; otherwise a new name is to be provided, or the old name may be properly defined and retained, its priority and authority to date from the time and author so defining it.

OF THE DEFINITION OF NAMES.

Canon XLIII.—The basis of a specific or subspecific name is either (1) an identifiable published description, or (2) a recognizable published figure or plate, or (3) the original type specimen or specimens, absolutely identified as the type or types of the species or subspecies in question; but in no case is a type specimen to be accepted as the basis of a specific or subspecific name, when it radically disagrees with or is contradictory to the characters given in the diagram or description based upon it.

Canon XLV.—Absolute identification is requisite in order to displace a modern current name by an older obscure one.

OF THE PUBLICATION OF NAMES.

Canon XLVII.—Publication consists in the public sale or distribution of printed matter—books, pamphlets, or plates.

CLASSIFICATION OF ORDOVICIAN STRATA IN THE VICINITY OF
CINCINNATI, OHIO.

Various classifications of the Cincinnati rocks have been proposed from time to time, but reference to most of these is unnecessary, especially since the subject was ably discussed and reviewed by Nickles in 1902.^a At that time this author indicated all of the divisions of the Cincinnati series, but applied names only to the various beds of the Lorraine. In a subsequent paper^b he named the divisions of the Richmond group. More recently Foerste^c has proposed several new names as well as a few changes.

The classification presented below is one now in preparation for publication by Mr. E. O. Ulrich of the U. S. Geological Survey and the writer, and will be employed for mapping purposes in the Cincinnati area. As the publication of this article may be delayed, departures from the classifications of Nickles and Foerste, and the new terms are briefly discussed below. The thickness of the various divisions is indicated by giving their range in height above low-water mark in the Ohio River, starting at a point where the lowest beds are exposed, namely, at West Covington, or at Bromley, Kentucky, and supposing that the rocks are horizontal. The heights mentioned are thus only relative and this method is introduced here mainly because it was employed by Mr. James and most of the other Cincinnati paleontologists in locating the horizon of their fossils.

	Formation (mapable units).	Members.	Approximate height in feet above low-water mark in Ohio River.	
Cincinnati series.	Richmond group	Saluda	665-700	
		Whitewater	625-665	
		Liberty	590-625	
		Waynesville	540-590	
		Arnheim	460-540	
Cincinnati series.	Covington group	Fairview	Mt. Auburn	425-460
			Corryville	390-425
			Bellevue	375-390
		Eden	Fairmount	325-375
			Mt. Hope	280-325
			McMicken	220-280
			Southgate	100-220
Trenton	Bromley	Economy	50-100	
		Fulton	45-50	
		Point Pleasant	30-45	
			0-30	

^aThe Geology of Cincinnati. Jour. Cincinnati Soc. Nat. Hist., XX, 1902, pp. 49-101.

^bAmerican Geologist, XXXII, 1903, pp. 202-218.

^cScience, XXII, 1905, No. 553, pp. 149-152.

Bromley.—This name is applied to the series of drab to dark blue shales underlying the Trenton limestone outcropping along the Ohio River bank opposite Cincinnati. These shales are about 30 feet in thickness and are well exposed along the river just below Bromley, Kentucky. The characteristic fossils are trilobite remains and a form of *Dalmanella*, both of which occur in comparative abundance, although other fossils are rare. This division is probably the equivalent of the Hermitage formation of Tennessee.

Point Pleasant.—The strata to which this name was applied by Prof. Edward Orton are represented in the vicinity of Cincinnati by the Trenton limestone overlying the Bromley shales. Here, on account of erosion preceding the deposition of the Utica, these limestones are not more than 25 feet thick, but at the type locality a considerable thickness is added to the top. *Eridotrypa briareus* is the most characteristic fossil, and the strata represent probably the whole of the Bigby and Catheys of Tennessee.

Covington group.—This term is proposed to embrace all the strata in the Cincinnati area from the top of the Trenton to the base of the Richmond. It thus includes the Utica and Lorraine of previous authors.

Fulton.—The typical Utica is represented along the Ohio River by only a few feet (seldom more than 5) of dark gray or drab colored shales which contrast very distinctly with the overlying Eden shales. These strata are well exhibited along the Ohio River bank at Fulton, the old name for the eastern part of Cincinnati. *Triarthrus becki*, *Leptobolus insignis*, graptolites and other typical Utica fossils are abundant.

Eden.—The Eden shales of Professor Orton may be divided into three members well marked both faunally and lithologically. Hitherto these have been indicated by the divisions lower, middle, and upper Utica, with the exception that the lower Utica has included both the members here called Economy and Fulton.

Economy.—This term, the old name of the village now known as West Covington, Kentucky, is applied to the lower division of the Eden. About 50 feet of blue shales and limestones comprise this member, which is distinguished faunally by a large number of bryozoa, the characteristic species being *Coeloclema commune*, *Crepipora venusta*, and several forms of *Aspidopora*.

Southgate.—The middle Eden beds are well exposed just south of Newport and Covington, Kentucky, particularly in the vicinity of Southgate, so that the latter name may be employed to distinguish them. This division consists of about 120 feet of blue to yellow shales, with fewer limestones than in the rest of the Eden. The lower beds of this member contain a considerable number of gastropods and pelecypods, while throughout the entire member, *Ctenobolbina ciliata*,

Aspidopora eccentrica, and *Batostoma jamesi* are particularly abundant and characteristic.

McMicken.—The upper third of the Eden consists of about 60 feet of highly calcareous and extremely fossiliferous shales and limestones holding the bryozoan *Dekajella ulrichi* in great abundance. Good exposures occur along McMicken avenue, Cincinnati, whence the name for the division.

Fairview.—Nickles's divisions of Mount Hope and Fairmount, although useful for detailed work, are so closely related faunally and distinguished with such difficulty that for mapping purposes the term Fairview, from Fairview Heights at Cincinnati, is here proposed to embrace both. The Fairview formation is about 100 feet thick, and is the equivalent in part of the "Hill quarry beds" of Professor Orton.

McMillan.—The Bellevue, Corryville, and Mt. Auburn members are closely related and not of sufficient importance to be mapped separately. The three are here recognized as members of the new formation, the McMillan, from the street of that name at Cincinnati, along which the 85 feet of strata comprising this formation are fairly well exposed.

Arnheim.—Nickles's term Warren being preoccupied, the new name Arnheim was proposed^a for this division, which here is considered a part of the Richmond group rather than of the Lorraine, as hitherto placed. Excellent exposures of these strata are found in the vicinity of Oregonia and Lebanon, Ohio.

DISCUSSION OF SPECIES IN ALPHABETICAL ORDER.

In many cases the James type lots contain such a variety of specimens, or are so involved in other respects, that it has seemed best to discuss in alphabetical order not only Mr. James's own species but also those of which his forms have proved to be synonyms. In order to facilitate reference to any particular form, this discussion of species is followed by an index. The synonymy of some of the species is so extended that for the sake of space, only that part of it essential to this paper is given. The complete synonymy is presented in Bulletin U. S. Geological Survey, No. 173.

ALECTO NEXILIS James.

Alecto nexilis JAMES, Intr. Catal. Foss. Cincinnati Group, 1875, p. 3.

Original description.—"Polyzoary attached to branches of coral, consisting of thread-like tubes anastomosing closely, resembling fine network, with 7 or 8 meshes in the space of a line; the little circular mouths are raised and at irregular distances, varying from one-eighth to one-sixteenth of a line apart.

"The typical specimen of this species is spread over a small,

^a Foerste, Science, XXII, 1905, No. 553, p. 151.

uneven, cylindrical branched coral, from one-fourth to three-eighths of an inch in diameter.

“Found at Cincinnati, about 400 feet above low water of the Ohio River.”

The above description would lead one to believe that the form under consideration was a very small species of *Stomatopora* incrusting foreign objects. The type specimen, however, is not incrusting, but is a solid ramose bryozoan belonging to the species later named by Ulrich and described by Nicholson as *Monticulipora (Heterotrypa) implicata*, now referred to the genus *Batostoma*. James's description was based upon the surface of this highly acanthopored species, his network or meshes being formed by the zoecial walls and the large perforated acanthopores representing the “little circular mouths.” The name *Alecto nerilis*, therefore, has no standing since it rests on an inadequate diagnosis and the species will take the name given by Nicholson, this being the first by which the object was clearly defined. Nicholson accredits the species to Ulrich, but this is incorrect because, although Ulrich did first recognize the species as distinct, his name of *Chaetetes implicatus* published in a catalogue is merely a *nomen nudum*.

Batostoma implicatum is quite an abundant fossil in the Eden shale at Cincinnati and vicinity, but in no instance, to the best of the writer's knowledge, has it been found in beds above the top of this formation (about 280 feet above low water in the Ohio River). James's reference of his *Alecto nerilis* to the 400-foot level (Corryville bed) is therefore probably incorrect.

AMPLEXOPORA DISCOIDEA (Nicholson).

Chaetetes discoideus JAMES, Catal. Foss. Cincinnati group, 1871, p. 4. (Named but not defined.)

Chaetetes discoideus NICHOLSON, Quar. Jour. Geol. Soc. London, XXX, 1874, p. 511, pl. xxx, figs. 4-4d.

Chaetetes discoideus NICHOLSON, Geol. Surv. Ohio, Pal., II, 1875, p. 206, pl. xxi, figs. 15-15c.

Monticulipora (Monotrypa) discoidea NICHOLSON, Genus *Monticulipora*, 1881, p. 193, pl. iv, figs. 3-3f.

Monticulipora discoidea JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 163.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 178.

Amplexopora discoidea ULRICH, Jour. Cincinnati Soc. Nat. Hist., V, 1882, p. 255.

Nicholson accredits this species to James, but inasmuch as the latter named it without definition, *Chaetetes discoideus* James is a *nomen nudum*. The James types of *Chaetetes discoideus* include, in addition to the well-known form described by Nicholson under the same name, specimens of *Amplexopora petasiformis* (Nicholson) and *Aspidopora newberryi* (Nicholson) from the Eden shale, *Prasopora hospitalis* (Nicholson) from the Richmond group, and several undetermined species ranging in time from the Eden to the Richmond. These various

species agree in one character only, namely, the discoid method of growth.

Amplexopora discoidea is readily recognized by its discoid habit of growth, absence of mesopores and by rather numerous acanthopores and diaphragms.

Occurrence.—A characteristic fossil of the Fairmount member of the Covington group at Cincinnati, Ohio, and vicinity.

AMPLEXOPORA FILIOSA (D'Orbigny).

Plate III, figs. 1-3.

Monticulipora filiosa D'ORBIGNY, Prodr. de Pal., I, 1850, p. 25.

Leptotrypa filiosa ULRICH, Geol. Surv. Illinois, VIII, 1890, p. 456, pl. XXXVI, figs. 7, 7a.

Monticulipora filiosa JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 162.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XV, 1893, p. 158.

Amplexopora filiosa NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 164.

Monticulipora subcylindrica (U. P. JAMES, MS.) J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1896, p. 123, fig. 13a-c.

The type lot of James's *Monticulipora subcylindrica* consists of two specimens, one of which is an example of *Dekayella ulrichi* and the other—the one from which his illustrations were prepared—proves to be the same as *Amplexopora filiosa* (D'Orbigny). Under the circumstances, only the figured specimen should or can be considered as the type of James's species. As this is an unquestionable example of *A. filiosa*, a species described long before by D'Orbigny and well known to Cincinnati collectors, James's *M. subcylindrica* naturally falls into synonymy under *A. filiosa*. The unfigured specimen resembles the figured type only in that it is a thick subcylindrical stem. In all other respects it differs decidedly and shows the characters of *Dekayella ulrichi*. (Plate II, figs. 3, 4.) The figured specimen differs from the ordinary masses of *Amplexopora filiosa* merely in this, that in growing over and completely covering an *Orthoceras* it finally assumed a subcylindrical shape. This is not an unusual occurrence, though the majority of specimens are irregularly massive or hemispheric in shape. J. F. James has illustrated the internal characters of the specimen regarded as the type of his species, but thin sections of the same prepared by the writer show that his figures are not only misleading but also incorrect. On Plate III of this paper the views presented by these thin sections have been carefully drawn.

Amplexopora filiosa is a characteristic and not uncommon fossil ranging from the Fairmount to and through the Corryville members throughout the Ohio Basin, and may readily be recognized by its massive zoaria, monticulated surface, thin-walled polygonal zoecia and absence of mesopores. The size of the zoarium in specimens seen by the writer has varied from lumps less than 25 mm. in diameter to

dome-shaped masses 400 mm. wide and 200 to 300 mm. in height. The surface is generally monticulated, the monticules usually being low and rounded but sometimes strongly elevated and sharply pointed. Nine of the ordinary zoecia may be counted in a distance of 2 mm. Acanthopores are present in the successive mature zones, but are seldom readily noticeable at the surface.

The internal characters of this species are unusually well marked and constant. A vertical section shows that the zoarium is made up of successive zones distinguished by variations in tabulation and other respects. Often the zones are separated by clay-filled interspaces, but in most cases the zoecial tubes are practically continuous throughout a zoarium. In such specimens the individual zones can only be distinguished by the alternate development of immature and mature regions. In each of the successive immature regions the zoecia have thin walls and few or no acanthopores. Diaphragms are present but are separated from each other by distances varying from 1 to 2 tube diameters. This region passes upward, sometimes abruptly but more commonly rather gradually, into the mature region in which the walls are considerably thickened, small acanthopores developed in large numbers, and the diaphragms increased in number so that two or even three occur in a distance equal to their own diameter. An occasional curved or funnel-shaped diaphragm, like those frequently seen in the typical species of the genus, also may be observed in the mature region. Tangential sections passing through the mature zone bring out especially the character separating the genus *Amplexopora* from the otherwise quite similar group recently named *Cyphotrypa*. This is, namely, the presence of a central black line separating the walls of adjoining zoecia. In the latter genus the zoecial walls are so amalgamated that their boundaries can not be distinguished, the central portion being clear or light colored. The zoecia in the immature region have such thin walls that sections show no structural features.

Occurrence.—Fairmount, Bellevue, and Corryville members of the Covington group at many localities in the Ohio Basin. Cincinnati, Ohio, is the type locality for both D'Orbigny's and James's specimens.

AMPLEXOPORA PETASIFORMIS—WELCHI (James).

Monticulipora (Monotrypa) welchi JAMES, Paleontologist, No. 6, 1882, p. 50; No. 7, 1883, pl. 1, figs. 4-4c.

Monticulipora petasiformis var. *welchi* JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 169.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 187.

Amplexopora petasiformis-welchi NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 165.

This variety differs from *A. petasiformis* only in the shape of the zoarium, which tends to assume a subramose or ramose growth instead of the usual hat-shaped masses. Variety *welchi* is of interest mainly

in that it bridges the gap between the typical ramose species of *Amplexopora* and the massive forms, such as *A. filiosa* or *A. petasiformis*.

Occurrence.—Eden shale, Cincinnati, Ohio, and vicinity.

ARTHROPORA CINCINNATIENSIS (James).

Plate IV, fig. 7.

Ptilodictya? cincinnatiensis JAMES, Paleontologist, No. 5, 1881, p. 39.

This is one of the Cincinnati species of *Arthropora*, a genus of bifoliate bryozoa characterized by its regularly and frequently jointed zoaria. In its zoecial structure the species is very similar to the abundant *A. shafferi* (Meek), but the respective zoarial peculiarities of the two forms are so constant and evident as to justify their recognition as distinct species. James gave a fairly good description of his species, a part of which is quoted below, and his diagnosis, together with the figure of the type presented on Plate IV, will probably serve for its ready identification.

Original description.—Polyzoary * * *, consisting of sub-cylindrical, or cylindrical stems, giving off lateral branches from half a line to one line apart at an angle, generally of about 45 degrees; branches varying in length from half a line to over one line; diameter of stems about half a line. The pores vary from long oval to subcircular in shape, and are arranged in alternating rows, three or four in the space of half a line measuring their longer diameter (longitudinally), and nearly twice that number transversely; separated, generally, about their own diameter. * * * "

Compared with *Arthropora cleavelandi* (James) with which *A. cincinnatiensis* agrees most nearly in growth, the latter may be distinguished by its smaller, nearly cylindrical and proportionally stouter branches, while in zoecial structure it differs in having decidedly broader interzoecial spaces, causing the zoecial apertures to be much smaller. *A. shafferi* agrees better in the external appearance of its zoecia, but differs decidedly in the greater size of its segments and in their broader, relatively shorter, more frequent, and compressed lateral branches.

Occurrence.—Not uncommon in the lowermost strata of the Mount Hope member at Cincinnati, Ohio, and vicinity.

ARTHROPORA CLEAVELANDI (James).

Plate III, figs. 13-16; plate IV, fig. 6.

Ptilodictya cleavelandi JAMES, Paleontologist, No. 5, 1881, p. 38.

Arthropora shafferi-cleavelandi NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 171.

Ptilodictya grahami JAMES, Paleontologist, No. 5, 1881, p. 39.

Ptilodictya dubia JAMES, Paleontologist, No. 5, 1881, p. 40.

Ptilodictya cleavelandi James, as shown by the type, is founded upon segments of a rather well-marked species of *Arthropora* occur-

ring abundantly throughout the various subdivisions of the Eden shale. The species is characterized by slender, generally nonbifurcating segments (in consequence of which the complete zoarium must have consisted of comparatively only a few rigid branches), and by the numerous and small lateral branchlets springing out at nearly right angles from the main stem. The segments are usually found separated, specimens retaining more than a sequence of two or three being extremely rare. In length they vary but little from the average of 7 mm. The basal segment is bifurcated and drawn out acuminate below.

The types of *P. grahami* and *P. dubia* agree exactly in their zoecial characters with those of *P. cleavelandi* and differ from the last only in each having a long striated pointed base and fewer or no lateral branchlets. As here interpreted these three supposed species are founded in two cases upon nothing further than basal segments and in the third case upon the upper segments of one and the same species of *Arthropora*, for which the name *cleavelandi* is adopted and the other two rejected.

Occurrence.—Eden shale, Cincinnati, Ohio, and vicinity.

ARTHROPORA KENTUCKYENSIS (James).

Plate IV, fig. 5.

Ptilodictya kentuckyensis JAMES, Paleontologist, No. 5, 1881, p. 38.

Compare *Arthropora bifurcata* ULRICH, Geol. and Nat. Hist. Surv. Minn., Final Rep., III, Pt. 1, 1893, p. 178, pl. XIV, figs. 22-25.

The types of *Ptilodictya kentuckyensis* James consist of two fragmentary examples of a species of *Arthropora*, which may prove to be closely related to the Minnesota Black River form described by Ulrich^a as *Arthropora bifurcata*. Better and more complete examples are necessary before this relationship can be determined with certainty. In the meantime both James's and Ulrich's names may be recognized as valid. James's type specimens differ from other species of *Arthropora* in having exceptionally narrow interzoecial spaces. This character, if constant, may very well be regarded as of specific importance.

The jointed, bifoliate zoarium will distinguish *A. kentuckyensis* from all associated bryozoa. With the exception of *A. bifurcata*, the other species of *Arthropora* are too different to require comparison.

Occurrence.—Bromley shale of the Trenton, Ohio River bank opposite Cincinnati, Ohio, in strata 10 or 15 feet above low watermark.

ARTHROSTYLUS TENUIS (James).

Helopora tenuis JAMES, Paleontologist, No. 1, 1878, p. 3.

Arthonema tenuis ULRICH, Jour. Cincinnati Soc. Nat. Hist., V, 1882, p. 160, pl. VI, figs. 8-8c.

Arthrostylus tenuis ULRICH, Geol. and Nat. Hist. Surv. Minnesota, Final Rept., III, Pt. 1, 1893, pl. III, fig. 16c.

^a Geol. and Nat. Hist. Surv. Minn., Final Rep., III, Pt. 1, 1893, p. 178.

Although the original description of this fine species is incorrect in several details, the study of the types shows that it was correctly identified and well illustrated by Ulrich in 1882.^a

The zoarium is jointed, but specimens showing the segments still in connection are not common. The segments are very slender, straight, needle-shaped rods, about 5 mm. in length, slightly expanding toward the obtusely rounded upper extremity. The latter articulates with the pointed lower ends of generally two succeeding segments, the complete zoarium appearing to consist of extremely delicate and regularly bifurcating branches. Cross sections of a segment are subquad-rangular in shape, three of the sides being concave and equal in width, while the fourth side is slightly convex and half again as wide. Each of the three equal sides bears a row of zoecia, while 6 to 8 longitudinal striæ mark the fourth side. The zoecial apertures are oval, and when perfect have a delicate and prominent equally elevated rim; 9 zoecia in 2 mm.

The small slender segments of *A. tenuis* with the three equal celluliferous sides and the broader, striated, noncelluliferous fourth side are so different from the zoaria of all other bryozoa in the Cincinnati series that comparison is not necessary.

Occurrence.—Not uncommon throughout the Eden shale at Cincinnati and vicinity. James's type is from the lower division (Economy member) where specimens are particularly abundant.

ASPIDOPORA CALYCULA (James.)

Plate I, figs. 8-10.

Lichenalia ? calycula JAMES, Catal. Foss. Cincinnati Group, 1871, p. 5 (not defined).

Chetetes ? calyculus JAMES, Introd. Catal. Foss. Cincinnati Group, 1875, p. 1.

Monticulipora (Diptotrypa) calycula NICHOLSON, Genus Monticulipora, 1881, p. 165, pl. IV, figs. 4-4b.

Monticulipora calycula JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 167.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 184.

Aspidopora calycula ULRICH, Geol. and Nat. Hist. Surv., Minnesota, Final Rept., III, Pt. 1, 1893, p. 255.

Most of the characters of this species have been so well described and illustrated by Nicholson that its identification is a matter of little difficulty. New figures of the internal structure are introduced here partly to show the identity of James's types with the form described by Nicholson, but mainly to give a better illustration of a vertical section than has been published heretofore. In the vertical section figured by Nicholson the zoarium is cut in such a way that a false idea of the internal features is presented. Such sections, in order to bring out the essential characters, should cut the zoarium at right angles to the growing edge. *A. calycula*, when sectioned in this way, shows

^aGeol. and Nat. Hist. Surv. Minn., Final Report, III, Pt. 1, 1893, pl. III, fig. 16c.

that an immature zone is present as in nearly all Paleozoic bryozoa, but this region is so short that it will not be noticed unless the section is made in the manner indicated above. Numerous acanthopores and closely tabulated mesopores are developed in the mature region, while each zoecium generally shows a single large cystiphragm occupying the bend from the immature to the mature region. Rarely a second and even a third may be developed above the first.

Aspidopora calyculata is the only described species of the genus occurring in the particular strata in which it is found, while from associated bryozoa the discoid zoarium with numerous mesopores and acanthopores and the zoecial tubes with large cystiphragms will serve as a ready means of separation.

Occurrence.—Not uncommon in the Bromley shale of the Trenton, exposed along the Ohio River bank opposite Cincinnati, Ohio.

ASPIDOPORA ECCENTRICA (James).

Plate VI, figs. 8–12; plate V, figs. 7, 8.

Monticulipora (Heterotrypa?) eccentrica JAMES, Paleontologist, No. 6, 1882, p. 48; No. 7, pl. I, figs. 6, 6a.

Monticulipora eccentrica JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 167, pl. 11, figs. 2a–c.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 185.

Aspidopora eccentrica ULRICH, Geol. and Nat. Hist. Surv., Minnesota, Final Rept., III, Pt. 1, 1893, p. 255.

Zoarium a small, free, subcircular expansion averaging 4 mm. in diameter and 1 mm. or less in thickness. Occasionally several of these disks may be found in contact and forming a zoarium as in *A. areolata* Ulrich. Celluliferous face smooth, slightly convex, and showing that the zoarium is composed of a single macula surrounded by zoecia of the normal size. Under surface flat or concave and lined with an epithelial membrane whose wrinkles or lines of growth are arranged about a point nearer the margin than the center of the base. Zoecial apertures rounded or ovate, the average diameter of the ordinary zoecium 0.3 mm. with 6 in 2 mm. while the largest zoecia of the maculae attain a diameter half again as great. Mesopores rather numerous, 6 usually surrounding a zoecium and occupying the interspaces left by the zoecia where their walls fail to touch. Acanthopores few and small and seldom detected either in sections or on the specimens.

The internal characters of this form differ but little from other species of the genus. The large, elongate but few cystiphragms and the absence of diaphragms characterize the zoecial tubes while the mesopores are, as usual in this genus, closely tabulated.

This neat little species can readily be recognized by its small subcircular zoarium and the eccentric wrinkles of the epithelated side. The species seems to be restricted to the middle division of the Eden shale in the Cincinnati area. Washings from certain shale beds will often

yield hundreds of free examples while the limestone layers sometimes show an abundance of specimens on their surfaces. The best development of the species at Cincinnati occurs in the shales at a horizon 170 feet above low water mark in the Ohio River.

Occurrence.—Southgate member of the Eden shale, Cincinnati, Ohio, and vicinity.

BATOSTOMA VARIANS (James).

Chaetetes varians JAMES, Paleontologist, No. 1, 1878, p. 2.

Monticulipora (Chaetetes) varians JAMES, Paleontologist, No. 5, 1881, p. 36.

Monticulipora varians JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 177, pl. II, figs. 4a, b.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 199.

Batostoma varians NICKLES and BASSLER, Bull. U. S. Geological Survey, No. 173, 1900, p. 179.

Batostoma variabile (part) ULRICH, Geol. Surv. Illinois, VIII, 1890, p. 460, pl. xxxv, figs. 4b–4e (not 4, 4a, 5, or pl. xxxvi, fig. 1).

The earliest description of this species was sufficient for its recognition especially since it was compared with *Chaetetes* (now *Batostoma*) *jamesi* Nicholson, of which good figures and a description had appeared some years before. James's description of 1881 also gives a fair idea of the form and comparisons with the related *B. jamesi*. Ulrich's definition and figures of *Batostoma variabile*^a prove upon further investigation to be founded upon at least two distinct species of *Batostoma*, one of which as indicated above is synonymous with *B. varians*, while the second is here recognized and redefined as *B. variabile*. The geological occurrence of the two species is quite different, *B. varians* ranging from the Arnheim formation to and through the Whitewater formation of the Richmond group, and *B. variabile* being a characteristic fossil of the uppermost beds of the same group.

Comparing *B. varians* with *B. jamesi*, the former is found to have thin-walled, angular, instead of oval, thick-walled zoëcia, few and irregularly placed instead of numerous mesopores, fewer diaphragms, and a lobate or subfrondescent zoarium instead of a regularly ramose one as in the latter species. For good figures of both the internal and external characters of *B. varians*, the student is referred to those mentioned above under the citation of *B. variabile*.

Occurrence.—Abundant in the Arnheim, Waynesville, Liberty, and Whitewater formations of the Richmond group in Ohio, Indiana, and Kentucky.

BATOSTOMA VARIABILE Ulrich (restricted).

Plate VII, figs. 9, 10.

Batostoma variabile (part) ULRICH, Geol. Surv. Illinois, VIII, 1890, p. 460, pl. xxxv, fig. 5; pl. xxxvi, fig. 1 (not pl. xxxv, figs. 4b–4e=*B. varians*).

As mentioned in the remarks under the preceding species, Ulrich's *Batostoma variabile* includes at least two distinct forms, one of which

^aGeol. Surv. Illinois, VIII, 1890, p. 460.

is the same as *Batostoma varians* (James), while the second is a good species of the same genus. The writer proposes to restrict the species *Batostoma variable* to the second form. Illustrations of the external features of this form have already been published by Ulrich, as cited above, and figures of the internal structure are given on Plate VII of this article.

B. variable, as thus restricted, forms robust, cylindrical or subcompressed usually infrequently dividing stems, 10 mm. or more in diameter. The surface of the zoarium is smooth but maculae of conspicuously larger zoecia are present. The zoecia are thin-walled and angular at the surface with mesopores practically absent. Below the surface the zoecial walls are so thickened by deposits of tissue along their sides that a tangential section through this region gives a rounded aspect to the apertures. Six to seven of the ordinary zoecia occur in 2 mm. Acanthopores sometimes large and occupying all the zoecial angles, but at other times not a conspicuous feature. Distribution of diaphragms and other internal features as shown on Plate VII.

Because of the absence of mesopores, this species shows with unusual distinctness in tangential sections, the black line separating the walls of contiguous zoecia, a characteristic feature of this as well as a number of other genera of the monticuliporoids. The large, smooth, ramose zoarium, angular contiguous zoecia, few mesopores, and conspicuous clusters are characters sufficient to distinguish this form from other species of the genus.

The specimens figured by Ulrich from the Richmond group at Savannah, Illinois (Plate XXXV, figs. 4, 4a, in the work cited above) can not be determined with certainty on account of their ill-preserved internal structure, but it is probable that they belong to neither of the two species under discussion.

Occurrence.—Uppermost beds of Richmond group at a number of localities in Indiana and Ohio. The types which are in the collections of the U. S. National Museum, were found in the vicinity of Osgood, Indiana.

BYTHOPORA ARCTIPORA (Nicholson).

Plate II, figs. 1, 2.

Ptilodictya ? arctipora NICHOLSON, Ann. Mag. Nat. Hist. (4), XV, 1875, p. 180, pl. XIV, figs. 4-4b.

Ptilodictya ? arctipora NICHOLSON, Geol. Surv. Ohio, Pal., II, 1875, p. 262, pl. xxv, figs. 9-9b.

Bythopora arctipora MILLER and DYER, Contr. to Pal., No. 2, 1878, p. 6.

Chaetetes minutus JAMES, Paleontologist, No. 3, 1879, p. 20.

The types of *Chaetetes minutus* James consist of a number of specimens of a small species of *Bythopora*. Carefully compared with other species of this genus, they all prove to be more or less youthful branches of the same species of which Nicholson had previously

described^a very old examples under the name *Ptilodictya? arctipora*. This determination was quite unexpected since in their revision of the Monticuliporoids James and James, who might be expected to know the facts in the case and therefore were followed by Nickles and the writer,^b place *C. minutus* as a synonym of *Monticulipora* (now *Bythopora*) *delicatula* (Nicholson).^c

Occurrence.—*Bythopora arctipora* is a characteristic and very abundant fossil of all the divisions of the Eden shale in the Ohio basin. The types of *C. minutus* were found near Loveland, Clermont County, Ohio.

BYTHOPORA DENDRINA (James).

Helopora dendrina JAMES, Paleontologist, No. 1, 1878, p. 3 (July 2, 1878); No. 2, p. 14.

Bythopora dendrina NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 185.

Bythopora fruticosa MILLER and DYER, Contr. to Pal., No. 2, 1878, p. 6. pl. iv, figs. 6, 6a (July 22, 1878).

The type of *Helopora dendrina* does not belong to the James collection and the following remarks are introduced here only to indicate the rather unusual history of the species. As indicated in the above synonymy, James's species antedates *B. fruticosa* by only twenty days, but both names seem to be founded upon the same specimen. The specimen described by James was an unusually fine zoarium found by Mr. Charles Schuchert, who, after James's description had been written, disposed of it to Mr. C. B. Dyer. The type of *B. fruticosa* came from Mr. Dyer's collection, and apparently is the same specimen as that found by Mr. Schuchert, the result being that the two names have not only been founded upon the same species, but probably also upon the same specimen.

B. dendrina may be distinguished from other species of *Bythopora* by its frequently branching, slender stems; James's description brings out the superficial characters even though unaccompanied by illustration.

Occurrence.—Fairview formation, Cincinnati, Ohio, and vicinity.

BYTHOPORA GRACILIS (Nicholson.)

Chaetetes gracilis JAMES, Catal. Low. Sil. Foss. Cincinnati Group, 1871, p. 3 (named only).

Chaetetes gracilis NICHOLSON, Quar. Jour. Geol. Soc. London, XXX, 1874, p. 504, pl. xxix, figs. 7, 7a; Geol. Surv. Ohio, Pal., II, 1875, p. 198, pl. xxi, figs. 8, 8b.

Monticulipora (Heterotrypa) gracilis NICHOLSON, Genus Monticulipora, 1881, p. 125, pl. ii, figs. 1-1b, and fig. 20.

^a Geol. Surv. Ohio, Pal., II, 1875, p. 262.

^b Bull. U. S. Geological Survey, No. 173, 1900, p. 184.

^c *Chaetetes delicatulus* Nicholson, Quart. Jour. Geol. Soc. London, XXX, 1874, p. 505, pl. xxix, figs. 8-8b.

Monticulipora gracilis JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 173.

Monticulipora gracilis J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 191.

Batostomella gracilis ULRICH, Geol. Surv. Illinois, VIII, 1890, p. 432, pl. xxxv, fig. 2.

Bythopora gracilis NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 185.

This species among others was merely named by James but described and accredited to him by Nicholson. As in this and other similar cases, the James name is a *nomen nudum*, so that the real author of the species is Nicholson. The species has been well described and figured by Nicholson and Ulrich, and the student is referred to the works above cited for their detailed descriptions.

Occurrence.—Abundant in the Fairview and McMillan formations throughout the Ohio Basin. The species is especially abundant in the Coryville member, many slabs from this division being covered with their white, smooth, narrow branches.

BYTHOPORA MEEKI (James).

Chaetetes meeki JAMES, Paleontologist, No. 1, 1878, p. 1.

Monticulipora (Chaetetes) meeki JAMES, Paleontologist, No. 5, 1881, p. 35.

Monticulipora gracilis var. *meeki* NICHOLSON, Genus Monticulipora, 1881, p. 127.

Monticulipora meeki JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 174.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 192.

Bythopora meeki NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 186.

The type lot of *Chaetetes meeki* James contains, besides the well-known form regarded by Nicholson as a variety of *Monticulipora gracilis*, specimens of *Rhombotrypa quadrata* (Rominger), *Homotrypa communis* Bassler, an undetermined species, and a ramose example of *Homotrypa flabellaris* Ulrich. All of these species agree in but one feature, the general form of the zoarium, and also show how little value can be attached to this character alone. Strangely enough with such a mixture, James's descriptions are correct since he recognizes the relationship of his species with *Chaetetes* (now *Bythopora*) *gracilis* and gives good comparisons between the two forms. Evidently he based his remarks upon a few of his "types" and these happened to be of the species now recognized as *Bythopora meeki*.

The various species of *Bythopora* are so much alike in internal structure that it is not strange that Nicholson considered the species under discussion only a variety of his *Monticulipora gracilis*. However, the fact that it occupies and is characteristic of a different geological horizon, and always forms a considerably larger zoarium, seems to me reason enough for its rank as a distinct species. *Bythopora gracilis* forms long slender stems seldom over 3 mm. in diameter and characterizes the Fairview, and McMillan formations, while the

branches of *B. meeki* are seldom less than 6 or 7 mm. in diameter, and occur only in the Waynesville formation of the Richmond group.

Occurrence.—Waynesville formation, Richmond group, at most localities in the Ohio Basin. James's types were from Clinton and Warren counties, Ohio.

BYTHOPORA PARVULA (James).

Plate III, figs. 11, 12; plate V, fig. 4.

Helopora parvula JAMES, Paleontologist, No. 1, 1878, p. 3.

Bythopora parvula NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 186.

The types of *Helopora parvula* are from the upper part of the Eden shale, and prove to represent a form of *Bythopora* quite distinct from other species of this genus. The following description and comparison bring out its essential features.

Zoarium consisting of very slender cylindrical branches seldom exceeding 0.4 mm. in diameter, dividing at irregular but rather long intervals and bearing 4 or 5 rows of elongate oval zoecia rounded behind and drawn out in front, separated from each other longitudinally by spaces equal to their longer diameter. Measuring lengthwise about 5 zoecia in 2 mm. Narrow, channeled interspaces separate the rows of zoecia. Mesopores and acanthopores obsolete or apparently wanting. Diaphragms sparingly developed.

In its internal characters the species simulates *Nematopora*, but the proportionally much greater length of the zoecial tubes is regarded as indicating the trepostomatous genus *Bythopora* rather than the *Cryptostomata*.

Compared with other species of *Bythopora*, the present form may be easily distinguished by its extremely slender branches and widely separated zoecial apertures. The associated *B. arctipora* has broader branches and more closely set zoecia and well developed acanthopores in greater or less abundance.

Occurrence.—McMicken member of Eden shale, Loveland, Ohio.

CALLOPORA MULTITABULATA (Ulrich).

Plate I, figs. 5-7.

Monticulipora kentuckensis JAMES, Paleontologist, No. 7, 1883, p. 57, pl. 11, figs. 1-1b.

Monticulipora kentuckensis JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 180, pl. 11, figs. 6a-d.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 203.

Monotrypella multitabulata ULRICH, Fourteenth Ann. Rep. Geol. Nat. Hist. Surv. Minnesota, 1886, p. 100.

Callopora multitabulata ULRICH, Geol. and Nat. Hist. Surv. Minnesota, Final Rept., III, Pt. 1, 1893, p. 280, pl. XXIII, figs. 11, 12, 16, 17, 24-26, 30, 31.

Monticulipora kentuckensis James could certainly never be recognized from any of the descriptions or figures given by its author.

The descriptions bring out no distinctive characters and the figures, especially of the internal structure, are inadequate and indeed quite incorrect. Figs. 5-7 on Plate I faithfully present the characters shown in the sections originally used and figured by James and James. A comparison of the two sets of figures will show decided differences.

James's types prove to be the same as the Kentucky form of the species well described by Ulrich as *Monotrypella multitabulata*.^a However, since James's description and figures, as already stated, are wholly inadequate and incorrect in the most essential features, it clearly falls into synonymy under the rules cited on a previous page.

Occurrence.—Abundant in the Lexington limestone of the Trenton at a number of localities in Kentucky. James's types were found at Paris, Kentucky, but were erroneously recorded as coming from the Cincinnati group.

CALLOPORA ONEALLI (James).

Plate VI, figs. 1, 2.

Chaetetes? *onealli* JAMES, Introd. Catal. Low. Sil. Foss., 1875, p. 2.

Monticulipora onealli JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 174.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 194.

Callopora onealli MILLER, North American Geol. Pal., 1889, p. 296.

Not *Monticulipora* (*Heterotrypa*) *onealli* NICHOLSON, Genus *Monticulipora*, 1881, p. 118 = *Callopora onealli sigillarioides* (Nicholson).

The lower third of the Eden shale wherever exposed in the Ohio Basin generally contains a small species of *Callopora* in abundance. The same formation, especially the upper third, affords great numbers of two well-marked varieties. The small, earlier form of this species was first described by James in 1875, as above cited, under the name of *Chaetetes*? *onealli* but figures were never published. In 1882, the same author distinguished one of the varieties as *Monticulipora* (*Heterotrypa*) *onealli*? var. *communis*. The other variety is the same as the form described in 1875 by Nicholson under the name *Chaetetes sigillarioides*.^b In the "Genus *Monticulipora*," Nicholson abandoned his species, believing it to be identical with *C. onealli*. Nickles and Bassler in their Synopsis proposed the arrangement of these forms as given in this paper, namely, recognizing *C. onealli* as a distinct species with the two varieties *communis* and *sigillarioides*.

The zoarium of *C. onealli* is of narrow, frequently dividing branches 1.5 to 2.0 mm. in diameter, often anastomosing so as to form a small bushy clump. The zoecia, of which 5 to 6 occur in 2 mm., are oval and separated by more or less numerous mesopores. Variety *communis* has the same zoarial growth, but its branches are much more robust, their average diameter being 7 mm. Its zoecia also are polygonal

^a Fourteenth Ann. Rep. Geol. Nat. Hist. Surv. Minnesota, 1886, p. 100.

^b Pal. Ohio, II, 1875, p. 203, pl. xxii, figs. 9, 9a.

and in contact at the surface because of the scarcity of mesopores in this region. The zoecial characters of variety *sigillarioides* are the same as in the typical form, but the zoarium differs in consisting of rather long, graceful branches, 4 or 5 mm. in diameter, dividing less frequently and not tending to anastomose.

The internal structure of *C. onealli* is essentially the same as that figured by Nicholson in 1881^a for the variety *sigillarioides*, but tangential sections of variety *communis* differ from both in showing few mesopores and polygonal zoecia.

Occurrence.—*C. onealli* is particularly abundant in the Economy member of the Eden shale in the vicinity of Cincinnati; variety *sigillarioides* ranges through the formation in equal abundance while variety *communis* is best developed in the upper (McMicken) member of these rocks.

CALLOPORA ONEALLI COMMUNIS (James).

Plate I, fig. 13; plate IV, figs. 8, 9.

Monticulipora (Heterotrypa) onealli? var. *communis* JAMES, Paleontologist, No. 6, 1882, p. 47; No. 7, 1883, pl. 1, fig. 8.

Monticulipora communis JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 175, pl. 11, figs. 5a, b.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 195.

Callopora onealli-communis NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 190.

This variety has been discussed in the remarks under *Callopora onealli* and, as there stated, may be distinguished from the typical form of the species by its decidedly robust instead of delicate branches and by its few mesopores. The branches are usually about 7 mm. in diameter and form bushy masses by their anastomosis. The internal structure is the same as in *C. onealli* and var. *sigillarioides* with the exception that as the surface is approached many of the mesopores pinch out so that at the surface itself the zoecia are in contact practically on all sides. This causes the zoecia to assume a polygonal outline and to become a trifle larger than in typical *C. onealli*. They are also larger than in the variety *sigillarioides*, but the average number of zoecia in a given space is the same in all three forms.

The types of the variety *communis* are missing, but the examples here figured on Plate IV are identical with specimens labeled by Mr. James in the collections of the U. S. National Museum.

Occurrence.—Abundant in the Eden shale at many localities in the Ohio Basin, Cincinnati being the type locality. Especially fine specimens are found in the upper beds of this formation.

^aGenus *Monticulipora*, 1881, p. 118, pl. 111, figs. 3-3f.

CALLOPORELLA CIRCULARIS (James).

Monticulipora (Heterotrypa) circularis JAMES, Paleontologist, No. 6, 1882, p. 46.

Monticulipora circularis JAMES, Paleontologist, No. 7, 1883, p. 58, pl. 1, figs. 3, 3a.

Monticulipora lens JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 165.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 181. (Not *Nebulipora lens* McCoy.)

Calloporella harrisi ULRICH, Jour. Cincinnati Soc. Nat. Hist., VI, 1883, p. 91, pl. 1, figs. 5–5c.

Calloporella circularis NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 193.

James's original description of this form is clear enough to make one reasonably certain that his species is the same as that described and figured shortly after by Ulrich as *Calloporella harrisi* and an examination of the type specimens of each proves this beyond a doubt. The absence of figures in the case of *M. circularis* is not a valid excuse for rejecting the name, inasmuch as the description gives a clear statement of both the internal and external characters. James and James in 1888 and J. F. James again in 1894 recognize *M. circularis* as a synonym of McCoy's *Nebulipora lens*—a species from Great Britain which has a similar zoarial growth, but whose zoecial characters are not yet known. The possibility of the two forms proving to represent the same species is, in the opinion of the writer, very remote.

Ulrich has given a good description and figures of the species and the student is referred to his work. The discoid zoarium, with rounded zoecia surrounded by ring-like walls and separated by numerous closely tabulated mesopores, characterize the species.

Occurrence.—Not uncommon in the Waynesville formation of the Richmond. The type locality is Westboro, Ohio, but the species has been found at many other places in southwestern Ohio and southeastern Indiana.

CERAMOPORA CONCENTRICA James.

Ceramopora concentrica JAMES, Paleontologist, No. 1, 1878, p. 5.

Ceramopora concentrica JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 38, pl. 1, figs. 8, 8 a.

Not *Celoclema concentricum* NICKLES and BASSLER, Bull. U. S. Geol. Surv. No. 173, 1900, p. 212 (= *Celoclema (Dianesopora) commune* (ULRICH)).

The original description of this form is too vague for recognition, and the species must date from 1883, when James and James gave another description and figured a specimen. The type lot, from which the original description was apparently drawn, consists of the following:

(1) Three specimens of *Ceramoporella distincta* Ulrich from the Eden shale at Cincinnati or vicinity.

(2) Two specimens of *Ceramoporella ohioensis* (Nicholson) from the upper beds of the Eden shale at Cincinnati.

(3) One specimen of the basal expansion of *Chiloporella flabellata* (Ulrich) from the Corryville member at Cincinnati.

(4) Several specimens of the basal expansion of *Coeloclema commune* (Ulrich) and fragments of the branches of the same species, all of these being from the lower part of the Eden shale, and probably from the bank of the Ohio River at Ludlow, Kentucky.

The specimen selected for illustration by James and James,^a and which should be adopted as the real type of the species, is a robust, frequently branching specimen of *Callopora oncalli-sigillarioides* (Nicholson) overgrown by a finely preserved example of *Ceramoporella ohioensis* (Nicholson).^b This specimen was found in the upper beds of the Eden shale, near Eden Park reservoir, Cincinnati. *Ceramopora concentrica* James and James, therefore, as based on the figured type, is a synonym for *Ceramoporella ohioensis* (Nicholson). Without the specimen it would be impossible to make this determination, since the figure is wholly without distinctive characters. As stated, the original description is too indefinite, and, as the type lot shows, based upon too many distinct species for recognition.

Nickles and the writer in their Synopsis of American Fossil Bryozoa referred James's *Ceramopora concentrica* to the genus *Coeloclema*, making Ulrich's *Diamesopora communis* a synonym. How erroneous our ideas of the species were is shown by the above remarks, our conception of the species being based upon a "typical" specimen received by Mr. Nickles some years ago from Mr. James, and which happened to be the same as Ulrich's *Diamesopora* (now *Coeloclema*) *communis*. Hence *Coeloclema concentricum* of Nickles and Bassler is a synonym of *Coeloclema commune* (Ulrich).

CERAMOPORA ? IRREGULARIS James.

Ceramopora ? irregularis JAMES, Paleontologist, No. 1, 1878, p. 5.

This species was described as incrusting foreign substances and having cells similar to those of *Chaetetes jamesi* Nicholson. The similarity to the species mentioned is borne out by the type specimens, inasmuch as three of the type lot are typical ramose examples of *C.* (now *Batostoma*) *jamesi* and four are incrusting forms of the same species, while the remaining specimen represents the parasitic base of *Batostoma implicatum*.

The variation in the shape of the zoecia which suggested the specific name is due either to growth over an uneven surface or to indentations of the zoecial walls caused by the development of numerous acanthopores. Instead of being a synonym of *B. implicatum*, as stated by Nickles and Bassler, the name should have been placed as

^a Jour. Cincinnati Soc. Nat. Hist., XI, 1888, pl. 1, figs. 8, 9a.

^b *Ceramopora ohioensis* Nicholson, Pal. Ohio, II, 1875, p. 265, pl. xxv, figs. 10a, b, c (not 10 c, d).

synonymous in part with both *B. jamesi* and *B. implicatum*. However, the original and only diagnosis is so vague that for that reason alone the name ought to be dropped.

CERAMOPORA NICHOLSONI James.

Ceramopora nicholsoni JAMES, Catal. Foss. Cincinnati Group, 1875, p. 3.

Monticulipora (Fistulipora) nicholsoni JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 34, pl. 1, figs. 6-6c.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1896, p. 121, fig. 12.

Not *Chiloporella nicholsoni* NICKLES and BASSLER, Bull. U. S. Geol. Survey, No. 173, 1900, p. 207 (= *Chiloporella flabellata* ULRICH).

This species was first described by James as "incrusting foreign substances." The type species, however, is not an incrusting form but is a solid flabellate expansion, and that this specimen is the one used by James for his description is attested by the label in his handwriting accompanying it. The name *C. nicholsoni* therefore, being founded on characters which do not belong to the specimen, following the laws of nomenclature, must be abandoned.

James's type is an example of *Fistulipora flabellata* described by Ulrich in 1879. In 1879 James also described the two species, *F. multipora* and *F. siluriana*, but in the James and James revision of the *Monticuliporidae* in 1888, these two names, together with Ulrich's *F. flabellata* and also *Callopora cincinnatiensis* of the same author were made synonyms of *C. nicholsoni*. The respective types of *F. multipora* and *F. siluriana*, as noted under these headings in this paper, contain a number of different species, while Ulrich's *Callopora cincinnatiensis*, the third supposed synonym which was erroneously described by its author as coming from Cincinnati, happens to be the same as *Lioclema occidens* (Hall and Whitfield) from the Upper Devonian of Iowa.^a

Nickles and Bassler, believing that with the exception of *C. cincinnatiensis*, the synonymy given by James for *C. nicholsoni* was correct, recognized his species as *Chiloporella nicholsoni*, and placed Ulrich's well-defined *Chiloporella (Fistulipora) flabellata* as a synonym. Had they seen the types they certainly would not have fallen into this error, nor would such stress have been put upon "authentic" specimens had they known of the number of distinct forms often included among the specimens marked as the original types of one and the same species.

To sum up, the writer would now regard *Ceramopora nicholsoni* and its so-called synonyms as follows: (1) *Ceramopora nicholsoni* itself must be abandoned, since the species is founded upon characters not shown by the type. (2) *Fistulipora flabellata* Ulrich is recognized as a good species and as the type of the genus *Chiloporella*. (3) Both

^aGeol. Surv. Illinois, VIII, 1890, p. 427.

Fistulipora multipora and *F. siluriana* are inadequately described and the types of each, moreover, include a number of distinct species. Therefore neither of the last two names is held as valid. (4) *Callopora cincinnatiensis* is a synonym for *Lioclema occidens* and has no relation at all with any of the Cincinnati bryozoa.

CERAMOPORA RADIATA James.

Ceramopora radiata JAMES, Paleontologist, No. 2, 1878, p. 12.

The type and only specimen described under this name proves to be a young example of *Ceramoporella granulosa milfordensis* (James) from the Eden shale at Cincinnati. The specimen consists of but a few macule with the zoecial apertures long-drawn out and radiating from them in a more marked degree than usual. A similar condition characterizes young specimens of all species of *Ceramoporella*. Consequently the radial arrangement depended upon in distinguishing the species should not be regarded as a valid specific character.

CERAMOPORELLA GRANULOSA MILFORDENSIS (James).

Plate VI, fig. 7.

Callopora milfordensis JAMES, Paleontologist, No. 2, 1878, p. 11.

Monticulipora (Fistulipora) milfordensis JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 36, pl. 1, figs. 7-7b—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1896, p. 122.

Ceramoporella granulosa milfordensis NICKLES and BASSLER, Bull. U. S. Geol. Survey, No. 173, 1900, p. 200.

None of the descriptions or figures of this form is sufficient for its recognition, but I have adopted James's name in a subordinate sense to distinguish an abundant Eden shale variety of *Ceramoporella*. The specimens separated by James under the specific name *milfordensis* are of a *Ceramoporella* that ranges with certain slight but distinguishable modifications through all the subdivisions of the Covington and Richmond groups. The first recognizable description and figures of one of the varieties of this cosmopolitan species was published in 1890 by Ulrich^a when he proposed the specific designation *C. granulosa* for the form occurring so abundantly in the shaly limestone of the Richmond group in northern Illinois. Variety *milfordensis* differs from the typical *C. granulosa* in having slightly smaller zoecia and in the very slight development of the peculiar granules that occur so abundantly in the Illinois types of the species. The zoaria of the latter also grow into much thicker and larger masses than those of the Eden shales variety.

Other forms of this general type were found in succeeding Cincinnati rocks. In course of time these probably will receive similar subordinate designations.

^aGeol. Surv. Illinois, VIII, 1890, p. 466, pl. xli, figs. 2, 2^a.

Occurrence.—The James types were found in the Eden shales at Milford, Ohio, but the variety occurs generally in abundance in the Ohio Basin wherever the strata mentioned are exposed.

CERAMOPORELLA WHITEI (James),

Plate V, fig. 6; plate VI, figs. 8-10.

Ceramopora whitei JAMES, Paleontologist No. 2, 1878, p. 12.

Ceramopora ? whitei JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 38, pl. 1, figs. 9, 9a.

Ceramoporella whitei NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 201.

James recognized the relations of this species by comparing it in his original description with Nicholson's *C. ohioensis*.^a The description and figures given by James and James in 1888 are practically worthless. The figure of the type agrees so little with the specimen itself that were it not for the presence of three cracks traversing it, one could not be certain of the identification. The view of the surface enlarged is also incorrect, as a comparison with a photograph of the same on Plate V will show. Fortunately the species has not been described under any other name, so that James's specific designation may be retained.

The zoarium forms thin crusts over foreign bodies, but by the superposition of numerous layers may become massive. Each zoarial layer is short, rarely exceeding 1.5 mm. in thickness. Surface smooth, the maculae or clusters of rather thick-walled mesopores not being elevated. Zoecia small, more or less angular, thin-walled and direct, about 7 in 2 mm. Mesopores generally few, sometimes absent altogether. Lunarium occupying from one-fourth to one-third of the zoecial circumference, seldom overarching the zoecial cavity and always a more or less inconspicuous feature of the surface. The internal structure is essentially the same as in other species of the genus and is more clearly brought out by the figures on Plate VI than would be possible by description.

As is the case in other species of the same section of *Ceramoporella*, *C. whitei* exhibits considerable variation. This consists principally of (1) differences in the relative number and distribution of the mesopores even in different or adjoining parts of the same zoarium, (2) in the degree in which the zoecia imbricate, and consequently (3) in the degree of obliquity of the apertures, and (4) in the extent to which the lunaria are developed in the zoecia occupying the maculae. However, the features presented by James's type are exhibited on at least a portion of nearly every one of several hundred specimens seen by the writer.

^a *Ceramopora ohioensis* Nicholson, Pal. Ohio, II, 1875, p. 265, pl. xxv, figs. 10 a, b, e (not 10 c, d.).

C. ohioensis, a closely related species, may be separated by its uniformly more imbricating and radially arranged triangular-shaped zoecial apertures and conspicuous, over-arching lunaria.

Occurrence.—James's type came from the Corryville member at Cincinnati. The species is not uncommon and ranges from this bed to and through the various divisions of the Richmond group.

CHAETETES CRUSTULATUS James.

Chaetetes crustulatus JAMES, Paleontologist, No. 1, 1878, p. 1; No. 3, 1879, p. 20.

Monticulipora crustulata JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 23, pl. 1, figs. 2, 2a.

Monticulipora crustulata J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1895, p. 82.

The original description of this form is so general that it is impossible to determine which particular one of the four or five species found in the Cincinnati series incrusting Orthocerata was intended by its author. Indeed it is probable that he had no particular one in mind as the synonymy given later by James and James indicates.

The specimens upon which Mr. James founded his original diagnosis are not distinguished in the collection. The type specimen selected and figured in 1888 as *Monticulipora crustulata* is probably an example of *Spatiopora maculosa* Ulrich which had been accurately defined and figured by that author in 1883.^a This identification, however, is based only on the general view of the zoarium,^b the figure of the surface enlarged (fig. 2a) being almost certainly incorrect since the thickness of wall shown is not attained by any Cincinnati bryozoan known to me. This figured specimen is missing, but another example now marked as the type is *Spatiopora maculosa* Ulrich.

The name *Chaetetes crustulatus*, therefore, must be dropped since it was not defined exactly enough for recognition. *Monticulipora crustulata* although figured, can not be determined with certainty because of the poor illustrations and the absence of the type specimen.

CHAETETES LYCOPERDON James (not Hall).

Chaetetes lycoperdon JAMES Paleontologist, No. 2, 1878, p. 11.

Chaetetes lycopolites JAMES Paleontologist, No. 3, 1879, p. 20.

The specific names *lycoperdon* and *lycopolites* were employed by James for some massive Cincinnati bryozoan but which one can not be decided from his descriptions. His collection also now contains no specimen labelled with either of these names. It matters little, however, since so many species have been described by authors under the designation *Chaetetes lycoperdon* that the name, never having been restricted to any particular one, now has no standing.

^aJour. Cincinnati Soc. Nat. Hist., VI, 1883, p. 167, pl. VII, fig. 6.

^bJames and James, 1888, pl. 1, fig. 2.

CHAETETES PETROPOLITANUS James (not Pander).

Chaetetes petropolitanus JAMES, Paleontologist, No. 2, 1878, p. 11.

The Cincinnati form referred to as above by James is most certainly not the same as the European Ordovician species described by Pander. Which particular one of the massive or hemispheric forms James had in mind can not be determined. Possibly *Amplexopora petasiformis* (Nicholson) was the form intended, but the matter is of no consequence since the James identification of *C. petropolitanus* is unmistakably incorrect.

CHAETETES SUBROTUNDUS James.

Chaetetes subrotundus JAMES, Paleontologist, No. 2, 1878, p. 11.

Astylospongia subrotundus JAMES, Paleontologist, No. 5, 1881, p. 34.

Microspongia? subrotundus J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XIV, 1891, p. 55, fig. 1.

The name under which this form was first described would lead one to believe it to be a bryozoan. Subsequently, as shown above, the form was regarded as a species of *Astylospongia* and later as *Microspongia*. There is little doubt that the specimens belong to one of the numerous forms or variations of *Hindia sphaeroidalis* Duncan. The type specimens of *C. subrotundus* were found at Ogden Station, Clinton County, Ohio.

CHAETETES TURBINATUM James.

Chaetetes turbinatum JAMES, Paleontologist, No. 2, 1878, p. 11.

Monticulipora turbinata JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 161, pl. II, figs. 1 a-c.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XV, 1893, p. 158.

Not *Monotrypa turbinata* NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 316 (= *Monotrypa subglobosa* Ulrich).

The name *Chaetetes turbinatum* was proposed tentatively in 1878 for specimens differing from *Chaetetes petropolitanus* in being turbinate in form and in having the basal attachment small. *C. turbinatum* was stated to range from the lowest to the highest exposed beds at Cincinnati and vicinity. Now just which one of the six or more massive bryozoa occurring in this range of strata at Cincinnati was considered as *Chaetetes petropolitanus* can never be accurately determined from the literature, and none of the specimens in the James's collection is labelled so as to indicate which form that author had in mind. This first reference to *Chaetetes turbinatum* is therefore of no value, the name being little more than a *nomen nudum*.

In 1879 Ulrich described *Chaetetes subglobosus*,^a which James and James recognized as a synonym of their *C. turbinatum* in 1888,^b when

^aJour. Cincinnati Nat. Hist., II, 1879, p. 129, pl. XI, figs. 11-11b.

^bIdem., X, 1888, p. 161.

they figured and described their species for the first time, the original definition being merely a comparison with an incorrectly identified Cincinnati species. In the paper mentioned the latter authors figure two specimens which in the collection are labelled as the types of the species. These specimens agree in one character only, namely, the turbinate growth ascribed to the species by the authors. The zoecia of each, however, are so different in size, shape, and arrangement that a lens is not necessary to determine that the two specimens represent very distinct species. The original of fig. 1b^a is a specimen of *Cyphotrypa acerrulosa* (Ulrich),^b a species hitherto known only from the Trenton. It is doubtful whether this specimen came from Cincinnati, as is stated by James. Still, it is possible that it was found in the Trenton strata exposed opposite Cincinnati along the banks of the Ohio River. The second figured type (fig. 1a of the article cited) is a typical example of *Monotrypa subglobosa* (Ulrich),^c found only in the lower part of the Eden shales. Fig. 1c presumably is intended to represent the surface of one of the two types. No matter which one was chosen, the figure is incorrect, since both species have thin-walled, polygonal zoecia, with no mesopores in the case of the former and very few angular young cells in the latter. The figure shows rounded or irregular zoecial apertures with subcircular mesopores at their junction angles.

J. F. James in 1895 states, in his remarks under the description of *Monticulipora selwyni*, that *M. (Prasopora) selwynii* var. *hospitalis* Nicholson (now *Prasopora hospitalis*) is the same as *M. turbinata* (James), and that an examination of the internal structure of the two shows their identity beyond a doubt. This author evidently did not base his observations upon the figured types of *M. (Chaetetes) turbinata*, inasmuch as their internal structure, although different in each specimen, is totally distinct from Nicholson's species. Moreover, the last was described by the elder James as *Monticulipora winchelli*. To add to the confusion, Nickles and the writer very unwisely recorded, as cited above in the synonymy, *Chaetetes turbinatum* as a valid species of the genus *Monotrypa*, making Ulrich's *Monotrypa subglobosa* a synonym.

To sum up, the first definition of *Chaetetes turbinatum* is worthless, while the second is based upon two distinct species. These two forms, however, can not be correctly determined from the published figures, since the enlarged view of the surface—the only figure given that might be of any value—is an incorrect representation. Finally, a

^aJour. Cincinnati Soc. Nat. Hist., X, 1888, pl. n.

^b*Leptotrypa acerrulosa* Ulrich, Geol. and Nat. Hist. Surv. Minnesota, Final. Rept., III, Pt. 1, 1893, p. 318, pl. xxvii, figs. 24, 25.

^c*Chaetetes subglobosa* Ulrich, Jour. Cincinnati Soc. Nat. Hist., II, 1879, p. 129, pl. XII, figs. 11-11b.

species with internal and also external characters different from either of the figured types is stated to have the same internal features. It is work of this character that is so disheartening to the conscientious student. That James's species does not deserve recognition need hardly be stated.

COELOCLEMA ALTERNATUM (James).

Ceramopora alternata JAMES, Paleontologist, No. 1, 1878, p. 5.

Monticulipora (Fistulipora) alternata JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 34, pl. 1, figs. 5-5b.

Coeloclema alternatum NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 212.

Diamospora raupeli ULRICH, Geol. Surv. Illinois, VIII, 1890, p. 468, pl. XXXIX, figs. 3-3b; pl. XII, figs. 4-4c.

Original description.—"Polyzoary consisting of hollow, branching, cylindrical, or compressed stems from one to four lines in diameter, with irregular swellings; the hollows filled with foreign matter (clay). Cell apertures of the most perfect specimens, elevated, oblique, arched, subcircular, or oval; five or six in the space of a line, including the interspaces; generally arranged in alternating rows, sometimes in a diagonal manner around the branches. Spaces between the cells equal to their diameter, or a little more or less on different examples. Slightly cut longitudinal sections of some specimens show the cells arranged in diagonal, alternating rows of a lozenge-shape, with minute interstitial pores. Distributed over the surface about two lines apart are spots, sometimes slightly elevated, bearing fewer cell apertures and more or less of the small pores. The surface of worn or weathered examples—mostly so found—are nearly smooth; destitute in most cases of prominent cell mouths, but show more minute interstitial tubes and divisions than perfect specimens."

The characters of this species are well brought out in Mr. James's earliest description, quoted above, and there should be no difficulty in recognizing the form. The illustrations given by James and James in 1888 are of little value, and for a good description and trustworthy figures the student is referred to Ulrich's work in 1890.

The slender, hollow-stemmed branches, with thick-walled, oval zoecia arranged in diagonally intersecting lines and arched over by prominent hoods—the lunaria—causes the recognition of the species to be an easy matter.

Occurrence.—*C. alternatum* is found usually in great abundance wherever the Southgate and McMicken members of the Eden shale are exposed at Cincinnati, Ohio, and vicinity.

COELOCLEMA OWENI (James).

Plate VI, figs. 5, 6.

Fistulipora oweni JAMES, Jour. Cincinnati Soc. Nat. Hist., VII, 1884, p. 21, fig. 2-2g.

Monticulipora (Fistulipora) oweni JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 34.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1896, p. 119.

Coeloclema oweni NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 212.

The hollow, contorted or utricular stems of this form are so different in growth alone from the other species of the genus that its identification is quite easy. The figures of the type specimen given by James are sufficient for the recognition of the species, but one of its most marked characteristics—an unusually prominent lunarium—has not been pointed out by its author. The lunaria are so strongly developed and sharply raised that the zoarial surface is fairly roughened by them. The lunarium is shown exceptionally well in tangential sections where the zoecia are seen to be so indented with it as to be bilobed. In shape the lunarium is semicircular with the ends pinched slightly together. The other internal characters are essentially the same as in the remaining species of *Coeloclema*.

Occurrence.—A characteristic and quite abundant fossil of the Mt. Auburn beds. Lebanon, Ohio, is the type locality, but Cincinnati, Ohio, Madison, Indiana, and other localities exposing this horizon, furnish specimens.

DEKAYELLA ULRICHI (Nicholson).

Plate II, figs. 3, 4.

Monticulipora (Heterotrypa) ulrichii NICHOLSON, Genus Monticulipora, 1881, p. 131, fig. 22.

Dekayella ulrichi ULRICH, Jour. Cincinnati Soc. Nat. Hist., VI, 1883, pp. 91, 153.

Monticulipora ohioensis JAMES, Jour. Cincinnati Soc. Nat. Hist., VII, 1884, p. 137, pl. VII, figs. 1, 1a.—JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 183.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 207.

Dekayella robusta FOORD, Ann. Mag. Nat. Hist. (5), XIII, 1884, p. 341, pl. XII, figs. 2-2d.

Dekayella ulrichi-robusta NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 228.

Monticulipora ohioensis was distinguished by its author from *M. ulrichi*, because (1) its interstitial tubes (mesopores) were less closely tabulated than those of the latter species; (2) it had a more robust habit of growth, and (3) conspicuous monticules were present. The first distinction is based on erroneous observation, since the tabulation of the mesopores of the types of *M. ohioensis* is precisely the same as in typical examples of *D. ulrichi* (see Plate II). The more robust growth and conspicuous monticules are characters of such minor importance that they are scarcely worthy of even varietal recognition.

Experience shows that this is true, especially in species of *Dekayella* and related genera of the *Heterotrypidæ*. Nicholson figured branches of his species with a smooth surface, but every variation from this to sharply monticulated examples may be found. Foord^a described this sharply monticulated form as *Dekayella robusta* and Nickles and the writer, in their Synopsis, recognized his species as a variety of *D. ulrichi*, with James's name as a synonym. For the reasons mentioned, *D. robusta* is now regarded as not even of varietal importance.

Occurrence.—A characteristic and exceedingly common fossil in the Eden shale of most localities in the Ohio basin. The types of *M. ulrichi*, and also of *M. ohioensis* and *D. robusta* came from Cincinnati, Ohio.

DEKAYIA MACULATA James.

Plate II, figs. 13, 14.

Dekayia maculata JAMES, Paleontologist, No. 5, 1881, p. 36.

Monticulipora (Dekayia) maculata J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1896, p. 116, fig. 11.

This is one of the best marked species of the genus *Dekayia* and may easily be recognized from the figures published by J. F. James in 1896 (after an unpublished plate by Ulrich). The study of many specimens of this species has indicated that its principal specific character is not, as stated by both the elder and younger James, the presence of maculae composed of mesopores alone. James's two type specimens, show such maculae in a marked degree, but in many other examples from the same bed and locality, otherwise indistinguishable, the maculae are composed only of zoecia larger than the average, and with other specimens every gradation between the two may be established. J. F. James states in his description (1896), "walls of corallites thin, internal structure unknown," and yet gives at the beginning of this same description, figures showing all of the internal characters, and particularly the unusually great peripheral thickening of the walls. This latter feature is the specific character which will readily separate *D. maculata* from other species of the genus.

The ramose zoarium, thick zoecial walls, conspicuous acanthopores, few and delicate diaphragms and practical absence of mesopores together with the size of the zoecia—8 in 2 mm.—form a combination of characters which will readily separate *D. maculata* from all associated bryozoa. Views illustrating the structure and thickness of the walls, the distribution of acanthopores, mesopores, and diaphragms, and other internal features are given on Plate II.

Occurrence.—Quite an abundant and characteristic fossil of the McMicken member of the Eden at Cincinnati and vicinity. James's types were from Loveland, Ohio.

^aAnn. Mag. Nat. Hist. (5), XIII, 1884, p. 341.

DICRANOPORA MEEKI (James).

Plate V, fig. 1.

Helopora meeki JAMES, Paleontologist, No. 1, 1878, p. 3.

Original description.—"Polyzoary consisting of very small cylindrical or subcylindrical stems; sometimes branching dichotomously. About 6 cells in the space of a line measuring their longer axes, and arranged in rows between strong elevated longitudinal lines. The cells are generally opposite each other in the rows, but sometimes are alternating; cell apertures long oval, margins not raised; length of fragments observed from one-fourth to one-half an inch; diameter one-fifth of a line."

The original and only description of this species, quoted above, is good as far as it goes, but fails to state the two most important features, namely, that the zoarium is bifoliate and is also jointed. Its zoecial structure is that of the family *Rhinidictyonidae*, and this fact together with the jointed zoarium causes the reference of the species to the genus *Dicranopora*. As in all species of this genus, the zoarium of *D. meeki* consists of either simple or dichotomously branched segments with the lower end of each pointed for articulation and the upper end or ends excavated to receive the pointed extremity of the following segments.

D. meeki may be distinguished from all other species of *Dicranopora* by its comparatively long and extremely narrow segments, their average length being 5.8 mm. and width about .4 mm. Four rows of zoecia generally occupy each face of a segment, but sometimes only three are found.

Occurrence.—The species was listed by James as from Warren County, Ohio, but his label states Cincinnati as the locality for the type. Specimens occur often quite abundantly in the Mt. Hope member in the vicinity of Cincinnati.

ESCHAROPORA ACUMINATA (James).

Ptilodictya acuminata JAMES, Catal. Foss. Cincinnati Group, 1875, p. 3.*Escharopora acuminata* ULRICH, Geol. and Nat. Hist. Surv., Minnesota, Final Rep., III, Pt. 1, 1893, p. 167.Compare *Ptilodictya falciformis* NICHOLSON, Ann. Mag. Nat. Hist. (4), XV, 1875, p. 177, pl. XIV, figs. 1-1b.

The types of James *Ptilodictya acuminata* prove to be of a sword-shaped *Escharopora* from the Eden shales. To point out constant differences between this form and *Escharopora (Ptilodictya) falciformis* from the Fairview formation is very difficult if not impossible and James's name is adopted here as a convenient term for the Eden shale form of this type of *Escharopora* rather than as that of a good species. James distinguished his species from Nicholson's by its narrower and

relatively thicker form and more gradual expansion from the pointed striated base. These differences, however, are maintained only by his three type specimens. A larger number of specimens shows that the zoarium varies from narrow blades less than 2 mm. at their greatest width to sword-shaped fronds 6 mm. wide. However, specimens of the latter dimension are rare in the Eden shale, while the Fairview species is seldom of less width. *E. falceiformis* is evidently a descendant and a more robust form of *E. acuminata*.

Occurrence.—Not uncommon in the Eden shale at Cincinnati and vicinity.

ESCHAROPORA HILLI (James).

Ptilodictya hilli JAMES, Paleontologist, No. 1, 1878, p. 4.

Ptilodictya hilli ULRICH, Jour. Cincinnati Soc. Nat. Hist., V, 1882, pl. VII, figs. 7, 7a.

Ptilodictya hilli NETTLEROTH, Kentucky Fossil Shells, 1885, p. 30, pl. XXXV, figs. 1, 2, 4, 5.

Escharopora hilli ULRICH, Geol. and Nat. Hist. Surv. Minnesota, Final Rep., III, Pt. 1, 1893, p. 162.

The specific character of this fine species was pointed out by Mr. James in his description as follows: "The marked and decided difference between this species and *P[tilodictya] falceiformis* Nicholson lies in the prominent transverse ridges." The zoarium in this form, however, is usually wider and stronger than in *Escharopora falceiformis*, but as already mentioned the transverse ridges are the most obvious difference. These ridges are formed by the elevated maculae, which are so transversely elongated that they become confluent.

Occurrence.—The type specimen is said to have been found on the bank of the Ohio River at Cincinnati. Evidently it was drifted here, inasmuch as the Fairview rocks have furnished all other specimens known to the writer. The type does not belong to the James collection, so whether it occurred *in situ* at Cincinnati in the Trenton outcrops along the river bank or was washed down from some geologically higher locality could not be determined.

ESCHAROPORA PAVONIA (D'Orbigny).

Ptilodictya pavonia D'ORBIGNY, Prodr. de Pal., I, 1849, p. 22.

Monticulipora (Monotrypa) pavonia NICHOLSON, Genus Monticulipora, 1881, p. 195, fig. 41, pl. VI, figs. 3, 3a.

Stictopora clathratula JAMES, Catal. Foss. Cincinnati Group, 1871.

Chaetetes? clathratulus NICHOLSON, Quar. Jour. Geol. Soc. London, XXX, 1874, p. 509, pl. XXX, figs. 1-1b.

Chaetetes? clathratulus NICHOLSON, Geol. Surv. Ohio, Pal., II, 1875, p. 209, pl. XXII, figs. 2-2b.

Chaetetes clathratulus NICHOLSON, Ann. Mag. Nat. Hist. (4), XVIII, 1876, p. 91, pl. V, figs. 9, 9a.

James's name *Stictopora clathratula* was published without description and is therefore a *nomen nudum*. As indicated above, Nicholson

described the species using James's specific name, and as his descriptions are based on typical *Escharopora paronia*, James's name is also made synonymous with this species.

D'Orbigny's species is distinguished from the other forms of *Escharopora* by its broad zoarium. It is a common fossil and is found at most localities in Ohio, Kentucky, Indiana, and Tennessee where the beds of the Fairview formation are exposed.

EURYDICTYA MULTIPORA (Hall?) Ulrich.

Plate I, figs. 11, 12.

Phenopora multipora HALL, Foster and Whitney's Rep. Geol. Lake Superior Land District, Pt. 2, 1851, p. 206, pl. XXIV, figs 1a, b.

Phenopora? multipora ULRICH, Jour. Cincinnati Soc. Nat. Hist., V, 1882, p. 171, pl. VIII, figs. 7-7b.

Eurydictya multipora ULRICH, Geol. Surv. Illinois, VIII, 1890, p. 520.

Ptilodictya antiqua JAMES, Paleontologist, No. 5, 1881, p. 37.

The type of *Ptilodictya antiqua* James is identical with the specimens figured and described by Ulrich in 1882^a as *Phenopora? multipora* Hall. As admitted by Ulrich in 1893, an examination of the internal characters of Hall's type specimen is necessary before it can be positively stated that his identification is correct. Until this is done, the synonymy had best remain as given above. For the identification of the species, at least the Kentucky form, Ulrich's description and figures should be consulted.

Occurrence.—Hall's types were found in Trenton strata along the Escanaba River, Michigan, while those of James and Ulrich came from the Lexington limestone in the vicinity of Harrodsburg and Burgin, Kentucky, respectively.

FISTULIPORA? MULTIPORA James.

Fistulipora? multipora JAMES, Paleontologist, No. 1, 1878, p. 2.

In 1888 James and James decided that *Fistulipora multipora* James and *Chiloporella (Fistulipora) flabellata* Ulrich were synonymous with *Ceramopora nicholsoni* James published in 1875. The specimens in the James collection labelled as the types of *F. multipora*, however, consist of the following:

(1) Twenty-one specimens of *Ceramoporella distincta* Ulrich from the Eden shale at Cincinnati and vicinity.

(2) Six typical examples of *Chiloporella flabellata* Ulrich.

If the majority ruled in such cases, *F. multipora* would certainly not be a synonym of *C. nicholsoni* as decided by James. However, in view of the facts (1) that the name was placed in synonymy by its author, (2) that the types represent two distinct and well-defined species, and (3) that the original diagnosis is not only insufficient, but

^a Jour. Cincinnati Soc. Nat. Hist., V, 1882, p. 171.

also would apply equally to most of the species of *Ceramoporella* and related genera, the name had better be abandoned. Further remarks on this species are given in the discussion of *Ceramopora nicholsoni*.

FISTULIPORA SILURIANA James.

Fistulipora siluriana JAMES, Paleontologist, No. 3, 1879, p. 19.

In the revision of the Monticuliporidae in 1888, James and James concluded that this species was a synonym of *C. nicholsoni* and represented a stage in which the intercellular spaces were thick and the interstitial cells few in number. The type lot contains typical specimens of the following:

(1) Four specimens of *Ceramoporella distincta* Ulrich from the Eden shale at Cincinnati or vicinity.

(2) One specimen of *Coeloclema commune* Ulrich from the Economy member.

(3) Two specimens of *Chiloporella flabellata* Ulrich from the Corryville member.

The original diagnosis is of little value, and moreover is not borne out by the majority of the type specimens, the first four specimens having thin-walled zoecia and rather numerous mesopores instead of the opposite. The same reason for abandoning the name may be invoked here as in the case of *F. multipora* and *C. nicholsoni*, both of which see for further remarks.

HELOPORA APPROXIMATA James.

Helopora approximata JAMES, Paleontologist, No. 1, 1875, p. 3.

Original description.—"Associated with this species [*Helopora parvula*] are cylindrical examples with one or two more rows of cells, and *bulbous* upper terminations; the bulbs carry very small pores, which are not on other parts of the fossil; in other features they do not seem to differ from *H. parvula*. Should these prove, on further investigation, to be distinct, I propose the name *Helopora approximata*."

The writer has failed to find specimens having the characters mentioned above either on the slabs containing the types of *Helopora parvula* or in the rest of the collection. However, specimens of small species of *Bythopora* are often found showing a bulbous extremity as described by James, and undoubtedly he had some of these before him. This bulbous extremity is probably due to abortive growth following some injury and since it is occupied solely by small cells may be regarded as analogous to the expanded base of the zoarium.

Helopora approximata is probably a synonym of the common *Utica* form, *Bythopora arctipora* (Nicholson), but in the absence of the types or other specimens bearing this name it is impossible to decide the

point satisfactorily. Besides, James may or might have included several or indeed all of the small species of *Bythopora* (*B. arctipora*, *parvula*, *dendrina*, *striata* and *delicatula*) under his name. For these and other obvious reasons the name should have no standing.

HELOPORA HARRISI (James) Ulrich.

Plate VII, fig. 8.

Helopora harrisi JAMES, Paleontologist, No. 7, 1883, p. 58, pl. II, figs. 2-2*b*.

Helopora harrisi ULRICH, Geol. and Nat. Hist. Surv. Minnesota, Final Rep., III, Pt. 1, 1893, p. 195, pl. III, figs. 11*b*, 11*c*, 12.

The description and figures of this characteristic and abundant Richmond species given by Mr. James are incorrect in so many details that it is doubtful if the form could be recognized from his work. The published knowledge of the species really dates from Ulrich's work in 1893, when this author gave a good description and figures which accurately represent the form. It is unnecessary to mention the incorrect details of James's description and figures, since a comparison with Ulrich's work, which is known to be correct by comparison with his types, will bring out the errors of the former.

Occurrence.—This species is a characteristic fossil of the Waynesville formation of the Richmond group, the type specimens of both James and Ulrich coming from Waynesville, Ohio. Often when the clay above the limestone layers bearing the species is washed, free joints of the dismembered zoaria are found literally by the million.

HEMIPHFRAGMA WHITFIELDI (James).

Plate II, figs. 15, 16; plate IV, figs. 1-4; plate V, fig. 5.

Chonetes barrandi? (NICHOLSON) JAMES, Catal. Foss. Cincinnati Group, 1875, p. 4.

Monticulipora (Chonetes) whitfieldi JAMES, Paleontologist, No. 5, 1881, p. 34.

Monticulipora whitfieldi JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 178.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 200.

Hemiphragma whitfieldi NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 286.

All of the previous descriptions of this fine species fail to reveal its chief characteristic, namely, the presence of semidiaphragms in the peripheral region. These structures occur in the original types and may be readily observed in all thin sections, both vertical and tangential. These incomplete partitions may also be seen on well preserved, clean specimens with the aid of a hand lens. Vertical fractures when moistened and examined with a glass likewise show these partitions very clearly.

The species is found generally in abundance wherever the lower and middle divisions of the Eden shale are exposed in the vicinity of Cincinnati. The zoarium of the form found in the lower division, from which James's types of the species were derived, is of rounded, fre-

quently dividing stems commonly varying between 4 and 8 mm. in diameter. The middle Eden form, however, is more robust, the branches being subcylindrical or compressed and usually over 10 mm. in width. In all other respects the two forms are alike.

Surface smooth, with maculae composed of zoecia larger and mesopores more numerous than in the intervening spaces. Zoecia large, rather thin-walled, polygonal, 5 of the normal size in 2 mm. Mesopores angular, few among the ordinary zoecia, more numerous in the maculae. Acanthopores seemingly absent and, if developed at all, small and inconspicuous.

In internal structure the most marked feature is the presence of semi-diaphragms in the peripheral region of the zoecial tubes. Besides these, vertical sections as well as vertical fractures show the zoecial walls in the axial region to be strongly crinkled. The zoecial tubes in this region are almost entirely without diaphragms. The mesopores which develop in the peripheral region only, are crossed by the usual straight complete tabulae. Tangential sections show thin-walled polygonal zoecia, few mesopores and apparent absence of acanthopores, but bring out especially the dark line separating adjoining zoecia.

H. whitfieldi is closely related to and is probably a descendant of the Trenton species *Hemiphragma tenuimurale* Ulrich,^a but the more robust growth and several internal features, particularly the crinkled walls, of the species under consideration will suffice in distinguishing the two. Of associated bryozoa none approaches *H. whitfieldi* closely enough to require comparison.

Occurrence.—Abundant and characteristic of the lower (Economy) and middle (Southgate) divisions of the Eden shale at Cincinnati, Ohio, and vicinity.

HOMOTRYPA WORTHENI (James).

Monticulipora (Monotrypa) wortheni JAMES, Paleontologist, No. 6, 1882, p. 50; No. 7, 1883, pl. 1, fig. 2.

Monticulipora wortheni JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 184, pl. II, figs. 3a, b.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 207.

Homotrypa wortheni BASSLER, Proc. U. S. Nat. Mus., XXVI, 1903, p. 583, pl. XXIV, figs. 10-14.

Both the internal and external features of this species were described and illustrated by the writer in 1903,^b this conception of the species being based upon specimens in the collection of the U. S. National Museum with Mr. James's labels attached. A comparison of these specimens with the types shows that all are of the same species.

H. wortheni is a characteristic fossil of the Whitewater member of

^a Ulrich, Geol. Nat. Hist. Surv. Minn., Final Rep., III, Pt. 1, 1893, p. 301, pl. XXIV, figs. 20-23.

^b Proc. U. S. Nat. Mus., XXVI, 1903, p. 583.

the Richmond group and is found generally in abundance wherever these strata are exposed. The species may be distinguished from associated bryozoa by its sharply tuberculated branches, while vertical fractures examined under a hand lens will show the cystiphragms in the peripheral region of the tubes and other features characterizing *Homotrypa*.

Occurrence.—Richmond group, Whitewater member. The types are from Lynchburg, Ohio, but the species is abundant at many localities in Ohio and Indiana and notably so at Richmond, Indiana, and vicinity.

LEPTOTRYPA CLAVACOIDEA (James).

Chatetes clavacoidens JAMES, Catal. Lower Sil. Foss., 1871, p. 1 (named only);

Catal. Foss. Cincinnati group, 1875, p. 1.

Monticulipora (*Monotrypa*) *clavacoidea* NICHOLSON, Genus *Monticulipora*, 1881, p. 182, fig. 37.

Leptotrypa clavacoidea ULRICH, Jour. Cincinnati Soc. Nat. Hist., VI, 1883, p. 159.

Monticulipora clavacoidea JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 25.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1895, p. 84.

The club-shaped zoarium and the absence of mesopores cause the recognition of this species to be comparatively easy. James gave a brief description in 1875, but the knowledge of the species is really based on Nicholson's full description and figures published in 1881.

Occurrence.—An abundant and characteristic fossil of the Corryville member, McMillan formation, Cincinnati and vicinity.

LIOCLEMELLA SUBFUSIFORMIS (James).

Plate VII, figs. 4-7.

Monticulipora (?*Monotrypa*) *subfusiformis* JAMES, Paleontologist, No. 6, 1882, p. 52; No. 7, 1883, pl. 1, fig. 1.

Monticulipora fusiformis (not WHITFIELD sp.) JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 26.—J. F. JAMES, Cincinnati Soc. Nat. Hist., XVIII, 1895, p. 83.

Lioclemella subfusiformis NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 308.

James and James in 1888^a regarded this species as synonymous with Whitfield's *Monticulipora fusiformis*,^b but a comparison of specimens of the latter with the types of *M. subfusiformis* shows that Whitfield's species has a much larger zoarium, conspicuous and numerous acanthopores, more rounded zoecia, and many more mesopores.

Zoarium small, generally less than 13 mm. in length, club shaped, pointed at the lower end probably for articulation with a basal expansion, expanding slightly toward the upper portion. Surface smooth, maculae inconspicuous. Zoecia small, 10-12 in 2 mm., angular, thin-walled, sometimes in contact but generally separated by thin-walled,

^a Jour. Cincinnati Soc. Nat. Hist., XVIII, 1895, p. 83.

^b Ann. Rep. Geol. Surv. Wisconsin for 1877, 1878, p. 70.

angular mesopores. The latter often attain the size of the zoæcia and, especially in thin sections, may be mistaken for them. However, a glance at the tabulation shown in vertical sections will distinguish the two, the mesopores being closely tabulated and the zoæcia having no diaphragms at all. In tangential sections the outer side of the walls of the zoæcia are always more or less convex, while the sides of the mesopores are correspondingly concave. Acanthopores small and usually inconspicuous both at the surface and in sections.

The small, unbranched, club-shaped zoarium with thin-walled polygonal zoæcia separated by more or less numerous mesopores, causes the separation of this species from associated bryozoa to be quite easy. Comparison with the related form *L. fusiformis* from the Richmond group of Wisconsin is given above.

Occurrence.—Quite abundant in the Waynesville formation of the Richmond at a number of localities in Ohio and Indiana. The James types were found at Westboro, Ohio.

MONOTRYPA UNDULATA var. HEMISPHERICA (J. F. James).

Monticulipora (Monotrypa) undulata (part) NICHOLSON, Genus *Monticulipora*, 1881, p. 170, fig. 33*a-c*.

Monticulipora undulata var. *hemispherica* J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XV, 1893, p. 157, figs. 10*a-c*.

Monotrypa undulata-hemispherica NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 317.

This variety is founded upon Nicholson's description and figures^a of what he regarded as a "rounded or irregularly spheroidal" form of his *Monotrypa undulata*. There are no specimens of this variety in the James collection, nor is it known that either the species or variety occur in the vicinity of Cincinnati. If James's subordinate name, which is a misnomer, the form being subglobular and not hemispheric, is to be recognized, it must rest upon the Canadian types in Nicholson's collection. Until these or other authentic examples are again studied, the status of the name can not be definitely determined. It may be remarked, however, that this supposed subglobular variety of *M. undulata* must be very near, if indeed not identical, with Ulrich's *M. subglobosa*.

Occurrence.—Nicholson's specimens are said to come from the Hudson River group in Ontario, Canada.

MONTICULIPORA CINCINNATIENSIS (James).

Chatetes cincinnatiensis JAMES, Catal. Sil. Foss., Cincinnati group, 1875, p. 2.

Monticulipora cincinnatiensis JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 170.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 188.

Monticulipora (Peronopora) cincinnatiensis NICHOLSON, Genus *Monticulipora*, 1881, p. 226, pl. II, figs. 6-6*c*.

^aGenus *Monticulipora*, 1881, p. 170.

Although Mr. James gave a fair definition of this species in the Catalogue,^a our knowledge of the form really dates from Nicholson's work in 1881.

The species is a rather abundant and characteristic fossil of the Corryville member, and may be distinguished from other forms of the genus by its loosely incrusting habit of growth, strong and closely set monticules, and numerous mesopores. Its internal characters are those of a typical *Monticulipora*, cystiphragms occurring in both the immature and mature regions, while the walls have the peculiar granulose structure characterizing that genus.

Occurrence.—Corryville member, McMillan formation, Cincinnati, Ohio, and vicinity.

MONTICULIPORA CLEAVELANDI James.

Monticulipora (Heterotrypa?) cleavelandi JAMES, Paleontologist, No. 6, 1882, p. 49, pl. 1, fig. 7.

Monticulipora cleavelandi JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 15, pl. 1, fig. 4.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1895, p. 68.

Monticulipora cleavelandi ULRICH and BASSLER, Smithsonian Misc. Coll. (Quart. issue), XLVII, 1904, p. 16, pl. VI, figs. 4-6.

This is one of the most easily recognized bryozoa of the Cincinnati rocks, inasmuch as it is the only ramose species of *Monticulipora* so far known from these strata. A vertical fracture when examined under the hand lens will show the presence of cystiphragms in both the axial and peripheral regions, thus indicating its generic position under *Monticulipora*. The specific characters are particularly the ramose habit of growth and the absence of mesopores.

Ulrich and the writer^b have recently redefined this species and given figures of the internal structure. None of the James descriptions are adequate for the recognition of the species, inasmuch as the method of growth and internal characters attributed to it by them do not agree with the specimen marked as the type. This reason would doubtless have justified the rejection of the name, but as the species had not been described in the meantime it was deemed advisable to establish it under the same name proposed for it by James.

Occurrence.—Very abundant at several localities in Clinton County, Ohio, where the Whitewater formation of the Richmond group is exposed. James's type is from a locality near Lynchburg, Highland County, Ohio.

^a Catal. Sil. Foss., Cincinnati group, 1875, p. 2.

^b Smithsonian Misc. Coll., XLVII, 1904, p. 16.

MONTICULIPORA CLINTONENSIS James.

Monticulipora (Heterotrypa) clintonensis JAMES, Paleontologist, No. 6, 1882, p. 45, pl. 1, fig. 9.

Monticulipora clintonensis JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 20, pl. 1, figs. 1, 1a.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1895, p. 73.

The types of this form are missing, and unless they are found at some later date it will be impossible to determine its exact status. However, the description of *M. clintonensis* leads the writer to believe that Mr. James had before him specimens of the species described by Ulrich in 1879 as *Atactopora subramosa*,^a now referred to the genus *Heterotrypa*. This belief is strengthened by the fact that a specimen in the collection of the U. S. National Museum labelled by Mr. James as *M. clintonensis* is a typical example of *Heterotrypa subramosa*.

Occurrence.—James's types were recorded from the upper part of the Cincinnati rocks (Richmond) in Clinton County, Ohio. *Heterotrypa subramosa* is a common and characteristic fossil in the Richmond group of Ohio, Indiana, and Kentucky.

MONTICULIPORA HOSPITALIS NEGLECTA James and James.

Monticulipora hospitalis var. *neglecta* JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 27, pl. 1, fig. 3.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1896, p. 124.

Neither the type nor any other specimen of this variety could be found in the collection, and therefore unless the type turns up later the status of the above name can not be determined. The authors in separating the variety from *M.* (now *Prasopora*) *hospitalis* say that "variety *neglecta* differs mainly in possessing conspicuous monticules." If this is the only point of difference exhibited by the type specimen, var. *neglecta* is a synonym for the species itself since in the genus *Prasopora*, as in many other monticuliporoid genera, the monticules show a considerable variation in the same species. It is thought probable that the type specimen will show that it is not at all related to *Prasopora hospitalis*, but until the figured specimen is found the name might as well be dropped. Judging from James and James's figure, it seems not unlikely that the original may belong to *Monticulipora consimilis* described by Ulrich in 1882.

MONTICULIPORA PAPILLATA James and James.

Monticulipora papillata JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 23.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1895, p. 81 (not *Nebulipora papillata* McCoy).

The specimens from the Cincinnati rocks, supposed by James and James to be identical with the English species *Nebulipora papillata*

^aJour. Cincinnati Soc. Nat. Hist., II, 1879, p. 124, pl. XII, figs. 6-6c.

McCoy can not now be located in the collection. The matter is of no consequence, however, since a fragment of McCoy's type specimen, now in the collection of the U. S. National Museum, does not agree with any of the Cincinnati bryozoa, and there is thus little doubt that James and James were in error.

PALESCHARA BEANI (James).

Ceramopora ? beani JAMES, Paleontologist, No. 1, 1878, p. 5.

Ceramopora ? beani JAMES, Jour. Cincinnati Soc. Nat. Hist., VII, 1884, p. 23, fig. 3-3b.—JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 37.

Paleschara beani ULRICH, American Geologist, I, 1888, p. 186.

This fine species was so defined and figured by James in 1884 that its recognition is a matter of no difficulty. The very important feature of the species was, however, not mentioned, namely, that unlike all other similar Ordovician bryozoa, maculæ are absent. Though the zoecia radiate from one or more initial points, the surface of the zoarium presents no indication of the clusters of larger zoecia or of mesopores that invariably mark the surface of otherwise similar Paleozoic bryozoa. In this peculiarity, as well as in all other features, the species in question is in accord with *Paleschara*. As remarked by James, *P. beani* seems constantly to incrust the shells of *Orthoceras duseri*, the most abundant cephalopod in the beds containing it. Indeed, this association of the bryozoan and cephalopod is so common that Hall and Whitfield^a seem to have figured *P. beani* as the surface ornamentation of *Orthoceras duseri*.

Occurrence.—Not uncommon in the Waynesville formation of the Richmond group in Ohio and Indiana. In the original description James erroneously cites the species from Cincinnati.

PHÆNOPORA EXPANSA Hall and Whitfield.

Phænopora (Ptilodictya) expansa HALL and WHITFIELD, Geol. Surv. Ohio, Pal., II, 1875, p. 114, pl. v, fig. 1.

Phænopora expansa FOERSTE, Geol. Surv. Ohio, VII, 1895, p. 598, pl. XXIX, fig. 1.

Ptilodictya platyphylla JAMES, Paleontologist, No. 3, 1879, p. 21.

Phænopora platyphylla WELLER, Geol. Surv. New Jersey, Rept. on Pal., III, 1903, pl. XIX, figs. 5-7.

The type of James's *Ptilodictya platyphylla* has recently been figured by Professor Weller,^b whose figures led the writer to suspect that the species was a synonym for *Phænopora expansa* Hall and Whitfield. An examination of the types themselves changed the suspicion to a certainty.

^aGeol. Surv. Ohio, Pal., II, 1875, p. 97, pl. III, fig. 4.

^bGeol. Surv. of New Jersey, Report on Pal., III, 1903.

James gave a good definition of his species with the exception that he omitted stating the generic character—the presence of the two mesopores between the ends of the zoecia.

Phænopora expansa is distinguished from associated bryozoa by its broad bifoliate fronds springing from a pointed base, with oval zoecia arranged in parallel rows and with the ends of the zoecial apertures separated by two mesopores. The species is distinguished from other species of *Phænopora* by the broad, unbranched monticulated zoarium, and by the size of the zoecia (6.5 in 2 mm. measuring lengthwise, and 8.5 in the same space transversely).

Occurrence.—James's types were found in the Clinton of Clinton County, Ohio, while those of Hall and Whitfield came from the corresponding strata at Dayton, Ohio.

PHÆNOPORA FIMBRIATA (James).

Plate VII, figs. 11, 12.

Ptilodictya fimbriata JAMES, Paleontologist, No. 1, 1878, p. 8.

Phænopora fimbriata FOERSTE, Bull. Sci. Lab. Denison Univ., II, 1887, p. 161; III, 1888, pl. xv, fig. 7.

Phænopora fimbriata FOERSTE, Geol. Surv. Ohio, VII, 1895, p. 599, pl. xxviii, fig. 7.

Stictopora vanderei HALL, Twelfth Ann. Rept. Indiana Geol. Nat. Hist., 1883, p. 268, pl. xiii, figs. 1, 2.

Zoarium of narrow, parallel margined, smooth, compressed, bifoliate branches averaging 3.5 mm. in width, and forming by frequent bifurcation a flexuous frond, which in the type specimen is about 50 mm. in height and 60 mm. wide. Margins of branches rather wide and occupied by several rows of pores similar to the mesopores placed between the ends of the zoecial apertures. These marginal pores give to the edges of the branches the very finely striated appearance mentioned by James as the marked feature of the species. However, the number of pores along the margin can not be considered a good specific character, as it depends upon the age of the zoarium, young examples exhibiting few, and the oldest specimens the maximum number. The zoecial apertures are elliptical and arranged in longitudinal rows; 5 zoecia in 2 mm. measuring lengthwise, and nine rows in the same space transversely. Two pits or mesopores usually separate the ends of the zoecia, but occasionally three may be detected.

This fine, characteristic Clinton species is distinguished from the other branching forms of *Phænopora* by its narrow, flexuous, dichotomously dividing branches and the general aspect of the resulting zoarium.

Occurrence.—The type is from the Clinton formation in Clinton County, Ohio. Other localities are Dayton and Belfast, Ohio.

PRASOPORA FALESI (James).

Plate I, figs. 1-4.

Monticulipora falesi JAMES, Jour. Cincinnati Soc. Nat. Hist., VII, 1884, p. 138, pl. VII, figs. 2-2d.—JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., X, 1888, p. 168.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVI, 1894, p. 185.

The character relied upon by the author for distinguishing this species was the presence of a conical, sharp-pointed groove extending across the under surface. Any student of the bryozoa knows, or ought to know, that the shape of the excavation left by the object upon which zoarial growth commenced, is certainly not a specific character. The same species may select indiscriminately any foreign object such as a mollusk, brachiopod, or another bryozoan to commence its zoarial growth. The specimens distinguished by James as *M. falesi* selected some conical shell such as *Hyolithes* or the tapering end of a cephalopod, the impressions left of the shell after its removal not permitting of accurate determination. An examination of the types—the three specimens figured in 1884—shows that two distinct species are represented. Inasmuch as one of these is new, James's specific name is here adopted for this form. The original of fig. 2 of the article cited above (1884) is a small but typical specimen of *Prasopora simulatrix* Ulrich,^a while figs. 2a-2d represent young examples of a species differing from *P. simulatrix*, notably in having acanthopores and smaller zoecia.

Comparing *P. falesi* and *P. simulatrix* the following differences are noted. In growth the latter rises into dome-shaped or petasiform masses usually 40 or 50 mm. in diameter, and with a concave base lined by a concentrically wrinkled epitheca, while mature specimens of the former are rounded or irregularly hemispherical in shape, seldom over 20 mm. in diameter, and do not show such a well-marked epitheca. *P. simulatrix* has about 7 of the ordinary zoecia in 2 mm., while *P. falesi* shows 8 to 8½ in the same space. Vertical sections bring out especially the small acanthopores of *P. falesi*, but in *P. simulatrix* these structures are absent. The tabulation and number and distribution of the mesopores is much alike in the two species, but the difference in growth, size of zoecia, and the development of acanthopores in one, makes their separation comparatively easy.

Occurrence.—Very abundant in the Lexington limestone of the Trenton, in the vicinity of Danville, Kentucky. James records the horizon as about that of the tops of the hills at Cincinnati, but this is undoubtedly an error, as his type specimens correspond exactly with other examples of the species found in the Trenton at Danville.

^a Fourteenth Ann. Rep. Geol. and Nat. Hist. Surv. Minnesota, 1886, p. 85.

PRASOPORA HOSPITALIS (Nicholson).

Plate VII, figs. 1-3.

Monticulipora (*Prasopora*) *schwinnii* var. *hospitalis* NICHOLSON, Genus *Monticulipora*, 1881, p. 209, fig. 45.

Monticulipora (*Heterotrypa*) *winchelli* JAMES, Paleontologist, No. 6, 1882, p. 48; No. 7, 1883, pl. 1, fig. 5.

Monticulipora winchelli J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1895, p. 87.

An example of the type specimen figured by James shows that *Monticulipora* (*Heterotrypa*) *winchelli* is the same as the common Richmond form, *Prasopora hospitalis* (Nicholson). In the original description James compares his species with Nicholson's, but states that the internal structure is very different. The tabulation of the zoecia as shown in the slide studied by James (see Plate VII, fig. 1) does appear different from that found in *P. hospitalis*, but this appearance is largely due to an error in the preparation of the thin section. The zoecial tubes of *P. hospitalis*, when properly sectioned are always lined by cystiphragms. In James's section of *P. winchelli*, however, although it exhibits all the other characters of *P. hospitalis*, the tabulation appears as though not including true cystiphragms but to consist entirely of merely more or less curved diaphragms. The originally sectioned specimen, as proved by a section prepared by the writer, contains an abundance of true cystiphragms, and thus is shown to be a normal example of *P. hospitalis* in every respect. That James's section appears to show a different type of tabulation is believed to result from the fact that it divided the zoarium in a direction parallel with, instead of at right angles to, its growing edge. On reflection it is apparent that species such as this in which the zoecia radiate from the center toward the growing edge will exhibit their normal internal characters best in vertical sections taken along such a radius; or, in other words, at right angles to the growing edge. Thus the cystiphragms of a species will generally appear as nearly straight or more or less curved diaphragms in a section cutting them in a direction opposite to their radial arrangement. Furthermore, it is a fact that James's section was taken from the thin outer edge of the zoarium and therefore exhibits only an immature condition of the zoecial tubes. In nearly all *Monticuliporidae* the cystiphragms in the basal part of the zoarium are much larger and extend much farther toward the opposite side of the tube than they do in later stages of growth. Hence, in an improperly prepared vertical section of the immature region, the appearance presented by the cystiphragms is likely to be, as in James's section, that of merely curved diaphragms.

The massive growth, numerous and closely tabulated mesopores, strong acanthopores, and rounded zoecia with both cystiphragms and

diaphragms abundantly developed, distinguish *Prasopora hospitalis* from associated bryozoa, while the numerous and strong acanthopores serve to separate it from other species of the genus.

Occurrence.—Abundant throughout the Richmond group at most localities in the Ohio Basin. The type of *M. winchelli* was found near Lynchburg, Highland County, Ohio.

PROBOSCINA FRONDOSA (Nicholson).

Aulopora frondosa JAMES, Additions to Catal. Foss. Cincinnati Group, 1873, p. 15 (named only).

Alecto frondosa NICHOLSON, Geol. Surv. Ohio, Pal., II, 1875, p. 266, pl. xxv, figs. 3-36.

Proboscina frondosa ULRICH, Geol. and Nat. Hist. Surv. Minnesota, Final Rep., III, Pt. 1, 1893, p. 119, pl. 1, fig. 28.

The name *Aulopora frondosa* is a *nomen nudum*, since James never defined the species. Nicholson gives a satisfactory description and good figures of the species and credits the name to James. An excellent figure is given by Ulrich in the work cited above.

Occurrence.—The typical form is not uncommon in the Corryville member of the McMillan formation at Cincinnati and vicinity.

PTILODICTYA NODOSA James.

Ptilodictya nodosa JAMES, Paleontologist, No. 3, 1879, p. 20.

Ptilodictya nodosa ULRICH, Jour. Cincinnati Soc. Nat. Hist., IV, 1882, pl. vii, figs. 2, 2a.

Ptilodictya variabilis ULRICH, Geol. Surv. Illinois, VIII, 1890, p. 304, figs. 2a and 6b.

Ptilodictya clintonensis JAMES, Paleontologist, No. 5, 1881, p. 38.

Ptilodictya teres JAMES, Paleontologist, No. 5, 1881, p. 40.

As suggested by Ulrich's name, *P. variabilis*, this is quite a variable species, the shape of the zoarium ranging from smooth, narrow, sword-shaped examples scarcely 2 mm. in width to broader nodose fronds reaching a width of 10 mm. or more. James's type specimen of *P. nodosa*, an old and strongly marked specimen, was figured by Ulrich in 1882. This author in 1890 proposed the new name *Ptilodictya variabilis* for the species on the ground that *P. nodosa* was preoccupied by Hall's *Escharopora recta* var. *nodosa*, a New York Trenton form. At that time *Escharopora* and *Ptilodictya* were supposed to represent the same generic type, but since Ulrich's careful work in 1893 we know these two genera to be distinct. Hall's species and variety being the typical forms of *Escharopora*, *Ptilodictya nodosa* is not preoccupied and may therefore stand as a valid name.

This species is distinguished from the associated forms of *Ptilodictya* by its straight, parallel-edged frond. Young specimens have a smooth surface, but after the zoarium attains a width of 3 mm. or more the macule develops as strong nodes arranged in more or less

parallel longitudinal series. The internal structure is essentially the same as that figured by Ulrich for *P. magnifica* Miller and Dyer.^a

The types of *Ptilodictya clintonensis* are straight, parallel-edged, smooth, unbranched fronds less than 3 mm. in width, and agree in all respects with numerous other examples regarded as young zoaria of *P. nodosa*.

Ptilodictya teres was distinguished by its author mainly because the zoarium in the specimen described bears "six or seven rows of oval pores, on the upper part, arranged in an alternating manner between exceedingly delicate raised lines." The general shape and a thin section of the type indicate that *P. teres* also is a synonym of *P. nodosa*, being merely an unusual or perhaps abortive example of that species. The oval pores mentioned by James are of zoecia, the zoecial apertures being of this shape and arranged between raised lines on the striated basal parts of all ptilodictyoid bryozoa.

Occurrence.—Whitewater formation of the Richmond group. The types of *P. nodosa*, and also of its two synonyms, came from Clinton County, Ohio, where the species seems more abundant than elsewhere.

PTILODICTYA PLUMARIA James.

Ptilodictya plumaria JAMES, Paleontologist, No. 1, 1878, p. 4.

Ptilodictya plumaria ULRICH, Jour. Cincinnati Soc. Nat. Hist., V, 1882, pl. VII, figs. 1, 1a.

This species resembles the preceding *P. nodosa* in its general zoecial and surface characters, but differs in this that, instead of being sword-shaped, the zoarium expands rapidly from the pointed striated base into a leaf-like frond sometimes exceeding 25 mm. in diameter. A typical specimen of the species was figured by Ulrich.^b

The three Richmond species of *Ptilodictya*, *P. nodosa*, *P. plumaria*, and *P. magnifica* Miller and Dyer, form a series, the first comprising long, rather narrow, parallel-edged fronds, the third forming broad and rather irregular expansions, while the second is intermediate in its zoarial shape. A similar relationship is exhibited by the three Fairview species of *Escharopora*, *E. falciformis*, *E. maculata*, and *E. pavonia*. In both of these groups of bryozoa the shape of the zoarium is within reasonable limits, fairly constant, and affords a ready means of distinguishing the species.

Occurrence.—James's type is from Warren County, Ohio, but the species occurs at a number of localities in southwestern Ohio and southeastern Indiana, where the Whitewater formation of the Richmond, to which beds these three forms of *Ptilodictya* are restricted, are exposed.

^aGeol. Surv. Illinois, VIII, 1890, p. 391, figs. 11a-c.

^bJour. Cincinnati Soc. Nat. Hist., V, 1882, pl. VII, figs. 1, 1a.

PTILODICTYA WELSHI James.

Ptilodictya sp. (?) JAMES, Paleontologist, No. 1, 1878, p. 8 (name *Ptilodictya welshi* suggested).

Under the caption of *Ptilodictya* sp.? James described a Clinton bifoliate bryozoan and suggested if it prove to be a distinct species that the name *Ptilodictya welshi* be applied to it. The type is either lost or never formed a part of the James collection, but, judging from the description, *P. welshi* is almost certainly the same species as that named and figured by Van Cleve as *Eschara multifida* in 1853 on the plates of fossils which he distributed about that time. Van Cleve's figure excellently represents his species, which was later described by Hall^a and is now referred to the genus *Phænopora*. If James's species should prove to be the same, it ought to be considered a synonym for Van Cleve's name since both appear in equally obscure publications and the earlier figure of the one is of more service in recognizing the form than the description of the other.

Occurrence.—Clinton formation, Clinton County, Ohio.

RHINIDICTYA PARALLELA (James).

Plate II, figs. 5-7; plate V, figs. 2, 3.

Ptilodictya parallela JAMES, Paleontologist, No. 1, 1878, p. 5.

Rhinidictya parallela ULRICH, Jour. Cincinnati Soc. Nat. Hist., V, 1882, p. 170.

Ptilodictya granulosa JAMES, Paleontologist, No. 1, 1878, p. 4.

Original description of *Ptilodictya parallela*: "Polyzoary, a flattened, linear, unbranched, two-edged frond, about one line wide, longest example observed about one inch. Surface gently convex, celluliferous on both faces; edges very thin and sharp. Eight or ten alternating rows of elliptical cells arranged between longitudinal lines; one row on each edge having an oblique direction. Cell apertures not raised, five or six in the space of a line measuring longitudinally."

Numerous intermediate specimens in the U. S. National Museum prove beyond any question that the types of *Ptilodictya parallela* and *P. granulosa* are founded upon different stages of growth of one and the same species, the type of the latter representing merely the more mature or aged stage in which numerous granules develop. The definition of *P. granulosa* precedes that of *P. parallela* in the Paleontologist, but the parallel-edged branches are so marked a character in this species that the specific name calling attention to this fact is retained. All species of *Rhinidictya* have a *granulosa* stage, so that this name is without any special significance.

The straight, parallel-edged, seldom branching, bifoliate zoarium, with the zoecia arranged in longitudinal rows, is so different from associated bryozoa that no difficulty is experienced in recognizing the

^aTwelfth Ann. Rep. Indiana Geol. Nat. Hist., 1883, p. 268, pl. xiv, fig. 4.

species. The associated ptilodictyoids, with the exception of *Stictoporella flexuosa*, may be distinguished at sight by their jointed zoaria, the articulation being at the base alone as in *Escharopora* or at numerous points as in *Arthropora*. The mesopores of *S. flexuosa* will readily separate it from *R. parallela*.

Occurrence.—Lower beds of the Eden shale at Cincinnati, Ohio, and vicinity.

RHINOPORA VERRUCOSA Hall.

Rhinopora verrucosa HALL, Nat. Hist. New York, Pal., II, 1852, p. 48, pl. XIX, fig. 1a-c.

Escharina? distorta JAMES, Paleontologist, No. 3, 1875, p. 21.

The types of *Escharina? distorta* show that this name is founded upon specimens of the characteristic Clinton bryozoan *Rhinopora verrucosa*. The specimens are embedded in solid limestone and show only their epithecal side. In breaking the rock, the two leaves of the bifoliate fronds of *Rhinopora* part along the smooth median plane because the poriferous side of each leaf is rougher, and therefore adheres to the rock. By means of thin sections, however, the identity of these fronds with *Rhinopora verrucosa* was proved beyond a doubt.

Occurrence.—The types of James's species were from the Clinton, near Wilmington, Clinton County, Ohio. *R. verrucosa* is found generally in abundance at most localities in the New York and Ohio areas of Clinton shale.

SAGENELLA STRIATA James.

Sagenella striata JAMES, Paleontologist, No. 3, 1879, p. 22.

The type specimens described under this name by Mr. James are two small thin expansions parasitic upon bryozoa from the Eden shale. The surface of these expansions is ornamented with long, fine striae radiating from a similarly striated crater-like central area. A careful examination of this surface with a lens, or, better still, of the structure of the specimens by means of thin sections under the microscope, shows that the striae are the greatly elongated and generally confluent zoecial apertures of bryozoa with the wall structure characteristic of the genus *Escharopora*. One can now infer from their general shape and structure that the crater-like depressions of these striated parasitic growths are the basal sockets with which the pointed end of the zoaria of *Escharopora* articulated. That this inference is correct is proved by the occasional discovery of a zoarium with its point in place in the basal socket or in such close proximity that their relation to each other can not be doubted. It is also a fact that wherever these attached expansions occur, the erect fronds of one or other of the species of *Escharopora* may always be found.

By themselves these basal sockets show no specific differences, and the species to which any particular specimen belongs must be deter-

mined by the horizon in which it occurs. Naturally when several species of *Escharopora* occur at the same horizon, the determination of their respective basal sockets becomes very difficult if not impossible unless the pointed zoarium and parasitic base are still in position. There can be little doubt that *Sagenella striata* is the articulating basal expansion of *Escharopora acuminata* (James), since the latter is the only species of *Escharopora* known in the same beds of the Eden shale.

Depending upon James's statement^a that his specimens were collected "at the horizon of the hilltops at Cincinnati," Nickles and the writer, in the cross references in their Synopsis of American Fossil Bryozoa, referred *Sagenella striata* to the Fairview species *Escharopora falceiformis*. However, this reference and remarks concerning the organism were inadvertently omitted under the synonymy of the latter. The articulating bases of *E. falceiformis* were described by Ulrich under the names *Crateripora lineata* and var. *expansa*^b before their true relations, as published by him in 1882,^c were ascertained.

STICTOPORELLA FLEXUOSA James.

Ptilodictya flexuosa JAMES, Paleontologist, No. 1, 1878, p. 4.

Stictoporella flexuosa ULRICH, Jour. Cincinnati Soc. Nat. Hist., V, 1882, p. 169.

Stictoporella interstincta ULRICH, Jour. Cincinnati Soc. Nat. Hist., V, 1882, p. 169, pl. VIII, figs. 9, 9a.

Stictoporella interstincta ULRICH, Geol. Surv. Illinois, VIII, 1890, p. 394, fig. 14a, b.

For the identification of this species the student is referred to the description and figures of the external characters given by Ulrich in 1882, and the figures of the internal features published by the same author in 1890. Ulrich described the form as *Stictoporella interstincta*, believing that *Ptilodictya flexuosa* James was a distinct species of *Stictoporella*. More recent study, however, has shown that both names are founded upon unimportant mutations of the same species.

S. flexuosa is easily recognized by its narrow, generally parallel-edged, bifoliate branches bearing rather large elliptical, flaring zoecial apertures, with their ends separated always by two but sometimes by three or four elongate interstitial cells.

Occurrence.—Not uncommon in the Economy member of the Eden shales in the vicinity of Cincinnati, Ohio.

STIGMATELLA DYCHEI (James).

Plate III, figs. 8-10.

Monticulipora (Monotrypa) dychei JAMES, Paleontologist, No. 6, 1882, p. 52.

Monticulipora dychei JAMES, Jour. Cincinnati Soc. Nat. Hist., VI, 1883, p. 235, pl. X, figs. 2-2e.—JAMES and JAMES, Jour. Cincinnati Soc. Nat. Hist., XI, 1888, p. 25.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XVIII, 1895, p. 83.

^aPaleontologist, No. 3, 1875, p. 21.

^bJour. Cincinnati Soc. Nat. Hist., II, 1879, p. 30.

^cIdem, V, 1882, p. 151.

Leptotrypa ? *dyehei* NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, p. 298.
Stigmatella dyehei ULRICH and BASSLER, Smithsonian Misc. Coll. (Quart. Issue),
 XLVII, 1904, pl. x, fig. 11.

Both the internal and external features of this species have been figured by its author satisfactorily enough for its recognition, and additional illustrations of the internal structure are given here only to bring out points not mentioned by James nor shown in his figures.

The zoarium is an expansion loosely incrusting crinoid columns and sometimes attains considerable size, the type specimen being about 180 mm. in length and varying from a minimum diameter of 5 mm. at the ends to a maximum of 60 mm.

In vertical sections the noticeable features are the almost complete absence of diaphragms and the development of the acanthopores in zones, the latter feature in combination with the former being the principal characteristic of the genus *Stigmatella*. Tangential sections passing through one of these zones of acanthopores exhibit these structures of a fair size at the zoecial angles, but a section through any other part of the zoarium shows thinner-walled zoecia with the acanthopores either very small or not present at all.

The loosely incrusting method of growth, thin-walled angular zoecia with mesopores practically wanting, the development of acanthopores in zones and the almost entire absence of diaphragms are characters causing this species to be easily recognized. *S. clavis* (Ulrich), a common and highly characteristic fossil of the Eden shales, also grows on crinoid columns, but it can not be confused with *S. dyehei*, its zoaria being much smaller and the surface nearly always spinulose.

Occurrence.—A highly characteristic although somewhat uncommon fossil of the Mount Auburn member of the McMillan formation at Lebanon and other localities in southwestern Ohio.

STOMATOPORA DELICATULA (James).

Plate III, figs. 4-7.

Hippothoa delicatula JAMES, Paleontologist, No. 1, 1878, p. 6.

Stomatopora delicatula NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 419.

Stomatopora proutana MILLER, Jour. Cincinnati Soc. Nat. Hist., V., 1882, p. 39, pl. 1, figs. 4-4b.

Stomatopora proutana ULRICH, Geol. and Nat. Hist. Surv., Minnesota, Final Rep., III, Pt. 1, 1893, p. 117, pl. 1, figs. 8-12.

Rhopalonaria pertensis ULRICH, Fourteenth Ann. Rep. Geol. and Nat. Hist. Surv., Minnesota, 1886, p. 59.

Stomatopora tenuissima ULRICH, Jour. Cincinnati Soc. Nat. Hist., XII, 1890, p. 175, fig. 2.

Stomatopora delicatula-tenuissima NICKLES and BASSLER, Bull. U. S. Geol. Surv., No. 173, 1900, p. 419.

Original description.—"Polyzoary creeping, adnate, branching dichotomously, and sometimes anastomosing. Branches linear, about

one-tenth of a line in diameter. Cells uniserial, each growing by a pointed base from the cell below, and expanding gradually to the mouth; two or three cells in the space of a line. Apertures terminal, elevated, and nearly or quite the diameter of the cells and placed on their front face."

Mr. James's description brings out all the essential features of this variable species. Its constant characters are the elongate, club-shaped zoecia increasing very gradually and regularly in width from the narrow proximal portion to the wider rounded anterior end, where a diameter of about .12 mm. is reached. Considerable variation occurs in the length of zoecia of the same zoarium, so that specific differences made upon this character can not be maintained. At certain horizons, and especially in the Corryville bed, very luxuriant growths of this form are found upon other organisms, and it is in such specimens that the greatest variation is exhibited. Mr. Miller applied the name *S. proutana* to the very elongate form from the Corryville bed at Cincinnati, while specimens with the same characters, but coming from the lower part of the Eden shale were described as *S. tenuissima* by Mr. Ulrich. The form with short zoecia was named *Rhopalomaria pertenuis* by Mr. Ulrich, but later placed by him as a synonym of *S. proutana* Miller. Nickles and the writer recognized Mr. James's name, but considered *S. tenuissima* of sufficient value to rank as a variety. Further study may indicate that this latter form might still be ranked as a variety instead of being considered a synonym as above.

Occurrence.—Mr. James's type lot contains specimens from various horizons of the Covington and Richmond groups in southwestern Ohio. The species ranges through the various divisions of the Mohawkian and Cincinnati divisions of the Ordovician, and has also a wide geographical distribution.

STROMATOPORA ? LICHENOIDES James.

Stromatopora ? lichenoides JAMES, Paleontologist, No. 3, 1879, p. 18.

Stromatopora ? lichenoides J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XV, 1892, p. 90.

Although not described as bryozoa, the types of this species prove to belong to this class. All of the specimens are basal expansions of the articulated bryozoan *Arthropora*. Five of the examples are from the Richmond group and are undoubtedly the bases of a form of *Arthropora shafferi* found very abundantly in these rocks; the remaining four specimens are from the Eden shales at Cincinnati and probably belong to *Arthropora cleavelandi* James. Several species of *Arthropora* occur in the Eden, but as *A. cleavelandi* is the most abundant, it is most probable that the Eden specimens are of this species.

STROMATOPORA TUBULARIS James.

Stromatopora tubularis JAMES, Jour. Cincinnati Soc. Nat. Hist., VII, 1884, p. 139, pl. VII, figs. 3-3b.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XV, 1892, p. 89.

"Cylindrical or tubular, hollow, 2 to 2½ inches in diameter and 1 inch or more long; laminae about one-twentieth of an inch thick, irregular, wavy, with serrate edges; interspaces thin; oscula at irregular intervals; central cavity of the tube filled with broken shells, corals, or masses of clay, or sometimes entirely empty."^a

The type of this so-called *Stromatopora* proves to be a portion of the living chamber of a cephalopod (*Orthoceras* or *Endoceras*), which has become encrusted by successive layers of species of bryozoa belonging to the genus *Ceramoporella*. Some of these layers are of *Ceramoporella distincta* Ulrich, others are of *C. granulosa-milfordensis* (James), while vertical sections indicate that *C. ohioensis* is also present. The "serrate edges" of the "laminae" are seen only in vertical sections or fractures. This toothed appearance is caused by the projecting lunaria of each zoarial layer. The basal lamina of the succeeding layer touches only a few of these projecting points, the others remaining free. The "oscula" at irregular intervals are simply the clay-filled borings of worms or other burrowing organisms.

The type came from the Eden shale at Cincinnati, but similar specimens of incrusting *Ceramoporella* can be found throughout the Cincinnati rocks.

STROMATOPORA LUDLOWENSIS James.

Stromatopora ludlowensis JAMES, Jour. Cincinnati Soc. Nat. Hist., VII, 1884, p. 140, pl. VII, figs. 7, 7a.—J. F. JAMES, Jour. Cincinnati Soc. Nat. Hist., XV, 1892, p. 91.

"Cenosteum varying in outline and size 4½ by 3 inches and 2½ inches thick; sometimes parasitic, and then varying from one-tenth to three-tenths of an inch thick; laminae irregular, undulating, from 4 to 6 in one-tenth of an inch, including interspaces; transverse sections show numerous circular or oval oscula (!) irregularly distributed; surface irregular and rough, showing numerous minute pores and a greater or less number of oscula."^b

The "cenosteum" of this species instead of forming a tubular structure as in the preceding, grew into solid masses. Moreover, two sets of "oscula" are recognized by its author, one of them doubtful.

The type specimen is an irregular, solid mass composed of successively incrusting layers of *Ceramoporella*, *C. distincta* Ulrich and *C.*

^a Abridged description by J. F. James, Jour. Cincinnati Soc. Nat. Hist., XV, 1892, p. 89.

^b Abridged description by J. F. James, Jour. Cincinnati Soc. Nat. Hist., XV, 1892, p. 91.

granulosa-milfordensis (James) being the species observed. The larger and doubtful set of "oscula" is made up, as in *S. tubularis*, of clay-filled burrows, while the smaller set is composed of the mouths of the zoecia themselves.

The species of *Ceramoporella* seem to have bothered Mr. James considerably. This is especially true of *C. distincta*, the type lots of no less than seven of his species containing unquestionable examples of this common form.

INDEX OF JAMES'S NAMES.^a

- Alecto nexilis* James.
Culloporella milfordensis James. (See *Ceramoporella granulosa-milfordensis*.)
Ceramopora alternata James. (See *Cololectema alternatum*.)
Ceramopora ? *beani* James. (See *Paleschara beani*.)
Ceramopora concentrica James.
Ceramopora ? *irregularis* James.
Ceramopora nicholsoni James.
Ceramopora radiata James.
Ceramopora whitei James. (See *Ceramoporella whitei*.)
Chaetetes barrandei ? James (not Nicholson). (See *Hemiphragma whitfieldi*.)
Chaetetes ? *calycula* James. (See *Aspidopora calycula*.)
Chaetetes cincinmatiensis James. (See *Monticulipora cincinmatiensis*.)
Chaetetes ? *clathratulus* James. (See *Escharopora paronia*.)
Chaetetes claracoïdes James. (See *Leptotrypa claracoïdea*.)
Chaetetes claracoïdens James. (See *Leptotrypa claracoïdea*.)
Chaetetes crustulatus James.
Chaetetes discoïdea James. (See *Ampletopora discoïdea*.)
Chaetetes gracilis James. (See *Bythopora gracilis*.)
Chaetetes lycoperdou (Say) James.
Chaetetes lycopodites (Vanuxem) James.
Chaetetes meeki James. (See *Bythopora meeki*.)
Chaetetes minutus James. (See *Bythopora aretipora*.)
Chaetetes ? *onealli* James. (See *Culloporella onealli*.)
Chaetetes petropolitani (Pander) James.
Chaetetes subrotundus James.
Chaetetes turbinatum James.
Chaetetes varians James. (See *Batostoma varians*.)
Dekayia maculata James.
Escharina ? *distorta* James. (See *Rhinopora verrucosa* Hall.)
Fistulipora ? *multiopora* James.
Fistulipora oweni James. (See *Cololectema oweni*.)
Fistulipora siluriana James.
Helopora approximata James.
Helopora dendrina James. (See *Bythopora dendrina*.)
Helopora harrisi James.
Helopora meeki James. (See *Dicranopora meeki*.)
Helopora parrula James. (See *Bythopora parrula*.)
Helopora tenuis James. (See *Arthrostylus tenuis*.)
Hippothoa delicatula James. (See *Stomatopora delicatula*.)
Lichenalia calycula James. (See *Aspidopora calycula*.)

^aThe species discussed in this paper are arranged alphabetically and this index is given in order to facilitate the finding of the James species as now placed.

- Monotrypa undulata-hemispherica* J. F. James.
Monticulipora calycula James. (See *Aspidopora calycula*.)
Monticulipora cincinnatiensis James.
Monticulipora claraeidea James. (See *Leptotrypa claraeidea*.)
Monticulipora cleavelandi James.
Monticulipora clintonensis James.
Monticulipora communis James. (See *Callopora onealli-communis*.)
Monticulipora crustulata James.
Monticulipora discoidea James. (See *Amplexopora discoidea*.)
Monticulipora dychei James. (See *Stigmatella dychei*.)
Monticulipora eccentrica James. (See *Aspidopora eccentrica*.)
Monticulipora fulesi James. (See *Prasopora fulesi*.)
Monticulipora fusiformis James (not Whitfield). (See *Lioclemella subfusiformis*.)
Monticulipora gracilis James. (See *Bythopora gracilis*.)
Monticulipora hospitalis var. *neglecta* James.
Monticulipora kentuckensis James. (See *Callopora multitalulata*.)
Monticulipora lens James (not McCoy). (See *Calloporella circularis*.)
Monticulipora meeki James. (See *Bythopora meeki*.)
Monticulipora ohioensis James. (See *Dekayella ulrichi*.)
Monticulipora onealli James. (See *Callopora onealli*.)
Monticulipora papillata (McCoy) James and James.
Monticulipora petasiformis var. *welchi* James. (See *Amplexopora petasiformis welchi*.)
Monticulipora subcylindrica J. F. James. (See *Amplexopora filiosa*.)
Monticulipora turbinate James.
Monticulipora undulata var. *hemispherica* J. F. James. (See *Monotrypa undulata hemispherica*.)
Monticulipora varians James. (See *Batostoma varians*.)
Monticulipora whitfieldi James. (See *Hemiphragma whitfieldi*.)
Monticulipora wortheni James. (See *Homotrypa wortheni*.)
Monticulipora (Chaetetes) meeki James. (See *Bythopora meeki*.)
Monticulipora (Chaetetes) varians James. (See *Batostoma varians*.)
Monticulipora (Chaetetes) whitfieldi James. (See *Hemiphragma whitfieldi*.)
Monticulipora (Dekayia) maculata James. (See *Dekayia maculata*.)
Monticulipora (Fistulipora) alternata James. (See *Coeloclema alternatum*.)
Monticulipora (Fistulipora) milfordensis James. (See *Ceramoporella granulosa milfordensis*.)
Monticulipora (Fistulipora) nicholsoni James.
Monticulipora oweni James. (See *Coeloclema oweni*.)
Monticulipora (Heterotrypa) circularis James. (See *Calloporella circularis*.)
Monticulipora (Heterotrypa?) cleavelandi James. (See *Monticulipora cleavelandi*.)
Monticulipora (Heterotrypa) clintonensis James.
Monticulipora (Heterotrypa?) eccentrica James. (See *Aspidopora eccentrica*.)
Monticulipora (Heterotrypa) onealli? var. *communis* James. (See *Callopora onealli communis*.)
Monticulipora (Heterotrypa) winchelli James. (See *Prasopora hospitalis*.)
Monticulipora (Monotrypa) dychei James. (See *Stigmatella dychei*.)
Monticulipora (Monotrypa?) subfusiformis James. (See *Lioclemella subfusiformis*.)
Monticulipora (Monotrypa) welchi James. (See *Amplexopora petasiformis welchi*.)
Monticulipora (Monotrypa) wortheni James. (See *Homotrypa wortheni*.)
Ptilodictya acuminata James. (See *Escharopora acuminata*.)
Ptilodictya antiqua James. (See *Eurydictya multipora*.)
Ptilodictya? cincinnatiensis James. (See *Arthropora cincinnatiensis*.)
Ptilodictya cleavelandi James. (See *Arthropora cleavelandi*.)
Ptilodictya clintonensis James. (See *Ptilodictya nodosa*.)

- Ptilodictya dubia* James. (See *Arthropora cleavelandi*.)
Ptilodictya fimbriata James. (See *Phænopora fimbriata*.)
Ptilodictya flexuosa James. (See *Stictoporella flexuosa*.)
Ptilodictya grahami James. (See *Arthropora cleavelandi*.)
Ptilodictya granulosa James. (See *Rhinidictya parallela*.)
Ptilodictya hilli James. (See *Escharopora hilli*.)
Ptilodictya kentuckyensis James. (See *Arthropora kentuckyensis*.)
Ptilodictya nodosa James.
Ptilodictya parallela James. (See *Rhinidictya parallela*.)
Ptilodictya platyphylla James. (See *Phænopora expansa*.)
Ptilodictya plummaria James.
Ptilodictya teres James. (See *Ptilodictya nodosa*.)
Ptilodictya welsli James.
Sagenella striata James.
Stictopora clathratula James. (See *Escharopora pavonia*.)
Stromatopora ? *lichenoides* James.
Stromatopora ludlowensis James.
Stromatopora tubularis James.

EXPLANATION OF PLATES.

PLATE I.

Prasopora fulesi (James).

Figs. 1 and 2. Tangential section, $\times 20$, and portion of same, $\times 35$, showing the usual characters of this species as restricted and here redefined. The small acanthopores which seem to be confined to the vicinity of the maculae are especially characteristic.

3 and 4. Vertical section, $\times 20$, and portion of same, $\times 35$, showing the tabulation of the zoecial tubes and mesopores and the acanthopores as they appear when cut lengthwise.

Lexington limestone, Danville, Kentucky.

Callopora multitabulata (Ulrich).

5 and 6. Views of tangential and vertical sections, $\times 20$, drawn from the same sections used by James in attempting to illustrate the internal structure of his *Monticulipora kentuckyensis*.

7. A few zoecia of fig. 5, $\times 35$, illustrating the minute structure of the walls.
 Lexington limestone, Paris, Kentucky.

Aspidopora calycula (James).

8 and 9. Tangential section, $\times 20$, and a portion of same, $\times 35$, of an average example of this well-marked species.

10. Vertical section $\times 20$, showing as usual only a single large cystiphragm at the base of the zoecial tubes.

Bromley shale, Ohio River bank, West Covington, Kentucky.

Erydictya multipora (? Hall) Ulrich.

11 and 12. Tangential and vertical sections, $\times 20$, prepared from James's type of *Ptilodictya antiqua* and showing the usual characters of the species to which it is now referred.

Lexington limestone, near Harrodsburg, Kentucky.

Callopora onealli communis (James).

(See also Plate IV, figs. 8 and 9.)

FIG. 13. Tangential section, $\times 20$, of an average example, exhibiting the few mesopores and angular zoecia marking this variety, and the wall structure of a *Callopora*.

McMicken member of the Eden shale, Cincinnati, Ohio.

PLATE II.

Bythopora arctipora (Nicholson).

1 and 2. Tangential and vertical sections, respectively, $\times 20$, of one of the originals of *Chaetetes minutus* James. The external characters as well as the internal features shown in these figures are precisely the same as in the form previously described by Nicholson as *Ptilodictya arctipora*.

McMicken member of Eden shale, near Loveland, Ohio.

Dekayella ulrichi (Nicholson).

3. A few cells of a tangential section, $\times 35$.

4. Portion of the peripheral region of a vertical section, $\times 20$. These figures were drawn from sections prepared from the type of *Monticulipora ohioensis* James. The internal characters are in all respects like those of *D. ulrichi*.
Eden shale, Cincinnati, Ohio.

Rhynidiictya parallela (James).

(See also Plate V, figs. 2, 3.)

5. Tangential section, $\times 20$, of stipe taken just beneath a bifurcation and showing the aged condition of this species distinguished by James as *Ptilodictya granulosa*.

6. Tangential section, $\times 20$, of a younger branch agreeing with the original of *Ptilodictya parallela* James.

7. Vertical section, $\times 20$, prepared from the same specimen as fig. 6.
Economy member of Eden shale, Cincinnati, Ohio.

Aspidopora eccentrica (James).

(See also Plate V, figs. 7, 8.)

8 and 9. Tangential and vertical sections, $\times 20$, drawn from James's type sections.

10 and 11. Tangential section of another specimen, $\times 20$, and a small portion of same, $\times 35$.

12. Vertical section, $\times 20$, showing nearly the entire width of one of the small disks of this species.

Southgate member of Eden shale, Cincinnati, Ohio.

Dekajia maculata (James).

13. Vertical section, $\times 20$, of an average example, containing rather more of the extremely delicate diaphragms than usual.

14. Tangential section of same, $\times 20$, showing one of the maculae which often occur, and the thick walls characterizing the species.

These sections were prepared from James's type of the species.

McMicken member of the Eden shale, Loveland, Ohio.

Hemiphragma whitfieldi (James).

(See also Plate IV, figs. 1-4; plate V, fig. 5.)

- FIG. 15. Tangential section, $\times 20$, showing many of the zoecia with sections of the semidiaphragms.
16. Vertical section, $\times 20$, showing undulating walls in axial region, complete diaphragms in outer part of same and semidiaphragms in the thick-walled peripheral region. These incomplete diaphragms are distinctive of *Hemiphragma*.

Economy member of the Eden shale, Cincinnati, Ohio.

PLATE III.

Amplexopora filiosa (D'Orbigny).

1. Tangential section, $\times 20$, the upper half of figure showing the characters of the mature region, the lower half those of the immature zone.
2. Tangential section through the mature region, $\times 35$, exhibiting the numerous acanthopores and the dark line separating adjoining zoecia.
3. Vertical section, $\times 12$, showing two successive alternate pairs of immature and mature zones and above these a longer immature zone. The figure brings out the difference in wall structure and tabulation characterizing the respective regions or zones.

Sections prepared from the figured type of *Monticulipora subcylindrica* James.

Fairview formation, Cincinnati, Ohio.

Stomatopora delicatula (James).

- 4 and 5. Portion of a zoarium $\times 12$ and three zoecia, $\times 20$, of the form to which Miller applied the name *S. proutana*.
6. Portion of zoarium, $\times 12$, showing variations in the length of zoecia. In many specimens the general proportions of the zoecia in the lower half of the figure is constant.
7. Several zoecia, $\times 12$, of the form named *S. tenuissima* by Ulrich.

Economy member of Eden shale, Cincinnati, Ohio.

The specimens illustrated here were selected from the lot marked as the types of his species by Mr. James.

Stigmatella dychei (James).

8. Tangential sections, $\times 20$, the upper and lower halves exhibiting the characters of the mature and immature regions, respectively. It should be remarked that the larger size of the zoecia in the upper half of the figure is due to the fact that it includes a large part of one of the maculae.
9. Tangential section, $\times 50$, showing minute structure of walls and acanthopores.
10. Vertical section, $\times 12$, passing through successive pairs of immature and mature zones.

Sections prepared from James's figured type of the species.

Mt. Auburn member of the McMillan formation, Lebanon, Ohio.

Bythopora parvula (James).

(See also Plate V, fig. 4.)

Figs. 11 and 12. Tangential and vertical sections, $\times 20$, prepared from one of the types of this delicate bryozoan.

McMicken member of the Eden shales, Loveland, Ohio.

Arthropora cleavelandi (James).

(See also Plate IV, fig. 6.)

13. Outline drawing of type of *Ptilodictya cleavelandi* James, $\times 2$. This illustrates the usual form of the upper segments of the zoaria of this species.
 14 and 15. Outline drawings of the type specimens of *P. grahamsi* James. These are bifurcated initial segments.
 16. Outline drawing of type of *P. dubia* James, $\times 2$. This also is an initial segment of the same species as the original of *P. cleavelandi*, but differs in its simple, unbifurcated, upper articulating extremity.

All of the specimens are from the Eden shales at Cincinnati, Ohio.

PLATE IV.

Hemiphragma whitfieldi (James).

(See also Plate II, figs. 15, 16; plate V, fig. 5.)

- 1 and 2. Views of two of the James type specimens, $\times 1.5$.

Economy member of Eden shales, Cincinnati, Ohio.

- 3 and 4. Two fragments of a more robust form of this species, $\times 1.5$.

Southgate member of Eden shales, Covington, Kentucky.

Arthropora kentuckyensis (James).

5. View of the type and only known specimen of this incompletely known species, $\times 6$. The lower part of the specimen is broken away but doubtless was originally obtusely pointed.

Bromley shales of the Trenton, Ohio River bank, opposite Cincinnati, Ohio.

Arthropora cleavelandi (James).

(See also Plate III, figs. 13-16.)

6. A complete segment of this species, $\times 6$, showing the comparatively slender habit of growth and the short lateral branches which diverge very nearly at right angles and are particularly characteristic.

McMicken member of the Eden shales, Cincinnati, Ohio.

Arthropora cincinnatiensis (James).

7. View of the specimen marked as the type of this species, $\times 6$. It is merely one of the separated segments but is in a good state of preservation and quite typical.

Mt. Hope member of the Fairview formation, Cincinnati, Ohio.

Callopora onealli communis (James).

(See also Plate I, fig. 13.)

Figs. 8 and 9. Two fragments of this robust variety, $\times 1.5$.

McMicken member of the Eden shale, Cincinnati, Ohio.

PLATE V.

Dicranopora meeki (James).

1. View of a portion of the surface of the slab containing the types of this species, $\times 6$. The figure contains two simple and one bifurcated segments and exhibits the elongate, narrow, subcylindrical form distinguishing the joints of this delicate bryozoan.

Mt. Hope member of the Fairview formation, Cincinnati, Ohio.

Rhinodictya parallela (James).

(See also Plate II, figs. 5-7.)

2. View of the type specimen of *Ptilodictya granulosa* James, $\times 6$, showing the thickened granulose walls found in old examples.
3. View of the type of *Ptilodictya parallela* James, $\times 1.5$. It is the central stipe in the figure and partly covered by the free cheek of an *Acidaspis*.

Economy member of Eden shales, Cincinnati, Ohio.

Bythopora parvula (James).

(See also Plate III, figs. 11, 12.)

4. Surface of slab bearing type specimens, $\times 1.5$, showing several branches within the space outlined with ink.

McMicken member of Eden shales, Loveland, Ohio.

Hemiphragma whitfieldi (James).

(See also Plate II, figs. 15, 16; plate IV, figs. 1-4.)

5. Perfectly cleaned surface of specimen showing semidiaphragms within zoecia, $\times 8$.

Southgate member of Eden shales, West Covington, Kentucky.

Ceramoporella whitei (James).

(See also Plate VI, figs. 8-10.)

6. Surface of James's type, $\times 8$, showing the nearly direct apertures and inconspicuous lunaria, which features distinguish the species from the otherwise similar *C. ohioensis* (Nicholson).

Corryville member of the McMillan formation, Cincinnati, Ohio.

Aspidopora eccentrica (James).

(See also Plate II, figs. 8-12.)

7. The underside of a specimen of this peculiar species, $\times 8$, showing the eccentric striation of this surface.
8. Upper, celluliferous surface of another example, $\times 8$.

Southgate member of Eden shales, Cincinnati, Ohio.

PLATE VI.

Callopora onealli (James).

Figs. 1 and 2. Views of two of the type specimens, $\times 1.5$.

Economy member of Eden shales, Cincinnati, Ohio.

Callopora onealli sigillarioides (Nicholson).

3 and 4. Views of two typical examples, $\times 1.5$, introduced for comparison with *C. onealli*.

McMicken member of Utica shales, Cincinnati, Ohio.

Cocloctema oweni (James).

5. Vertical section, $\times 20$.

6. Tangential section, $\times 20$, showing the large prominent lunaria and the resulting bilobed appearance of the zoecia.

Mt. Auburn member, Lebanon, Ohio.

Ceramoporella granulosa milfordensis (James).

7. Tangential section of a portion of a macula, $\times 35$. In this region alone a few granules are developed.

Eden shales, Milford, Ohio.

Ceramoporella whitei (James).

(See also Plate V, fig. 6.)

8 and 9. Tangential sections, $\times 20$ and 35 , respectively, showing the usual aspect of this species.

10. One layer of zoecia of a vertical section, $\times 20$.

Corryville member, Cincinnati, Ohio.

PLATE VII.

Prasopora hospitalis (Nicholson).

1. Vertical section of the basal part of the zoarium, $\times 20$, drawn from James's type section of *Monticulipora winchelli*. The section, partly on account of an error in the preparation, shows only curved tabulae as described by Mr. James, instead of the usual cystiphragms.

2. Vertical section, $\times 20$, exhibiting the shape and distribution of the cystiphragms in the mature region.

3. Tangential section of the mature region, $\times 35$. The large acanthopores especially characteristic of *P. hospitalis* are well brought out in the section.

Figs. 2 and 3 were drawn from thin sections prepared from the same specimen used by Mr. James in describing and illustrating his species. Richmond group, near Lynchburg, Highland County, Ohio.

Lioclemella subfusiformis (James).

4. Vertical section, $\times 20$, of a zoarium showing the untabulated zoecia and the closely tabulated mesopores, the latter being restricted to the peripheral region.

Figs. 5 and 6. Tangential sections, $\times 20$ and $\times 35$. The angular thin-walled zoecia and mesopores often closely resemble each other, but the more rounded form and slightly thicker walls of the former will serve as a means of distinguishing them.

7. Natural size views of three of the type specimens figured by James.
Waynesville formation of the Richmond group, Westboro, Ohio.

Helopora harrisi (James).

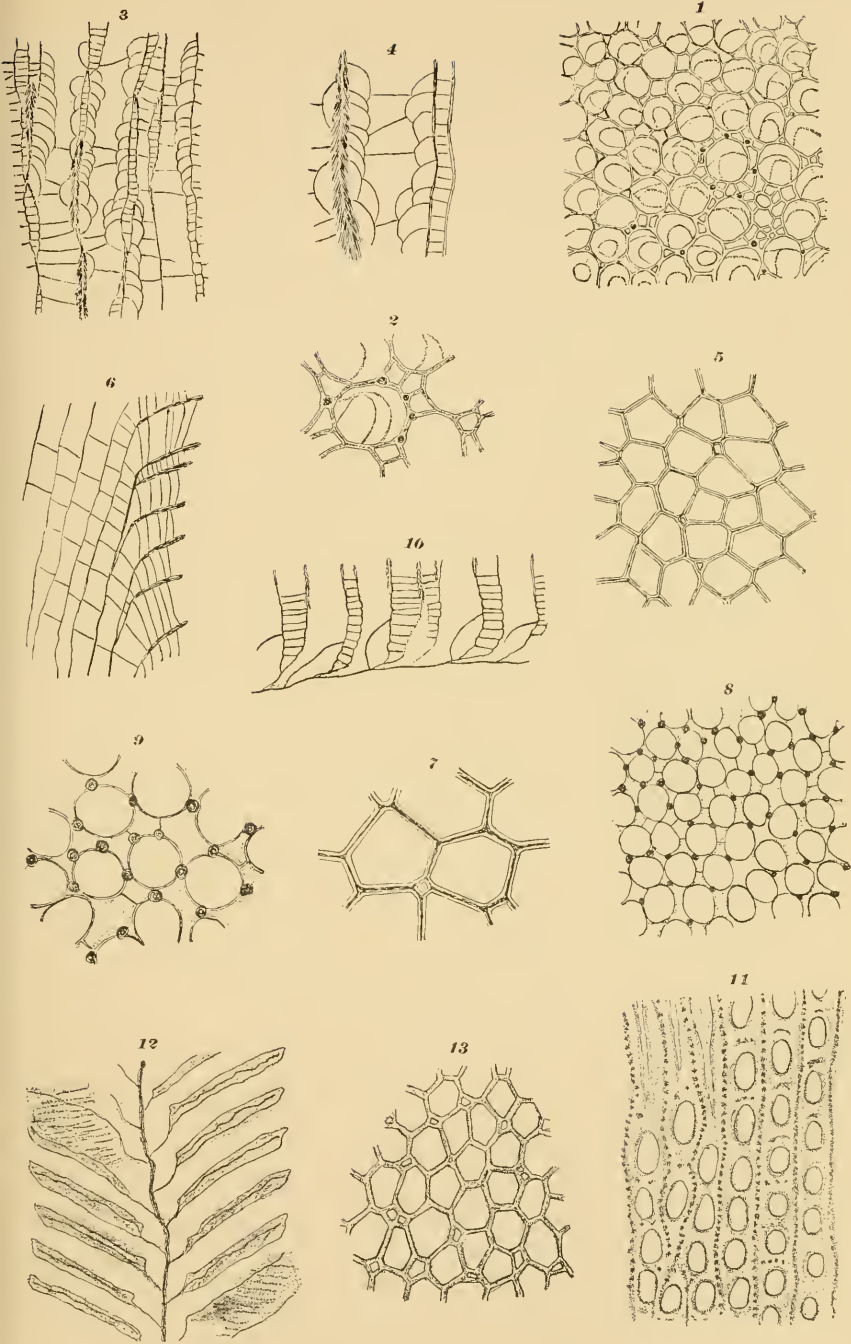
8. Two segments, $\times 12$, from type locality (after Ulrich).
Waynesville formation of the Richmond group, Waynesville, Ohio.

Batostoma variabile Ulrich (restricted).

9. Vertical section, $\times 20$, passing through the mature and a portion of the immature region.
10. Tangential section, $\times 20$, exhibiting the angular, thick-walled contiguous zoecia, the comparatively small acanthopores and the absence of mesopores.
Top of Richmond group, Osgood, Indiana.

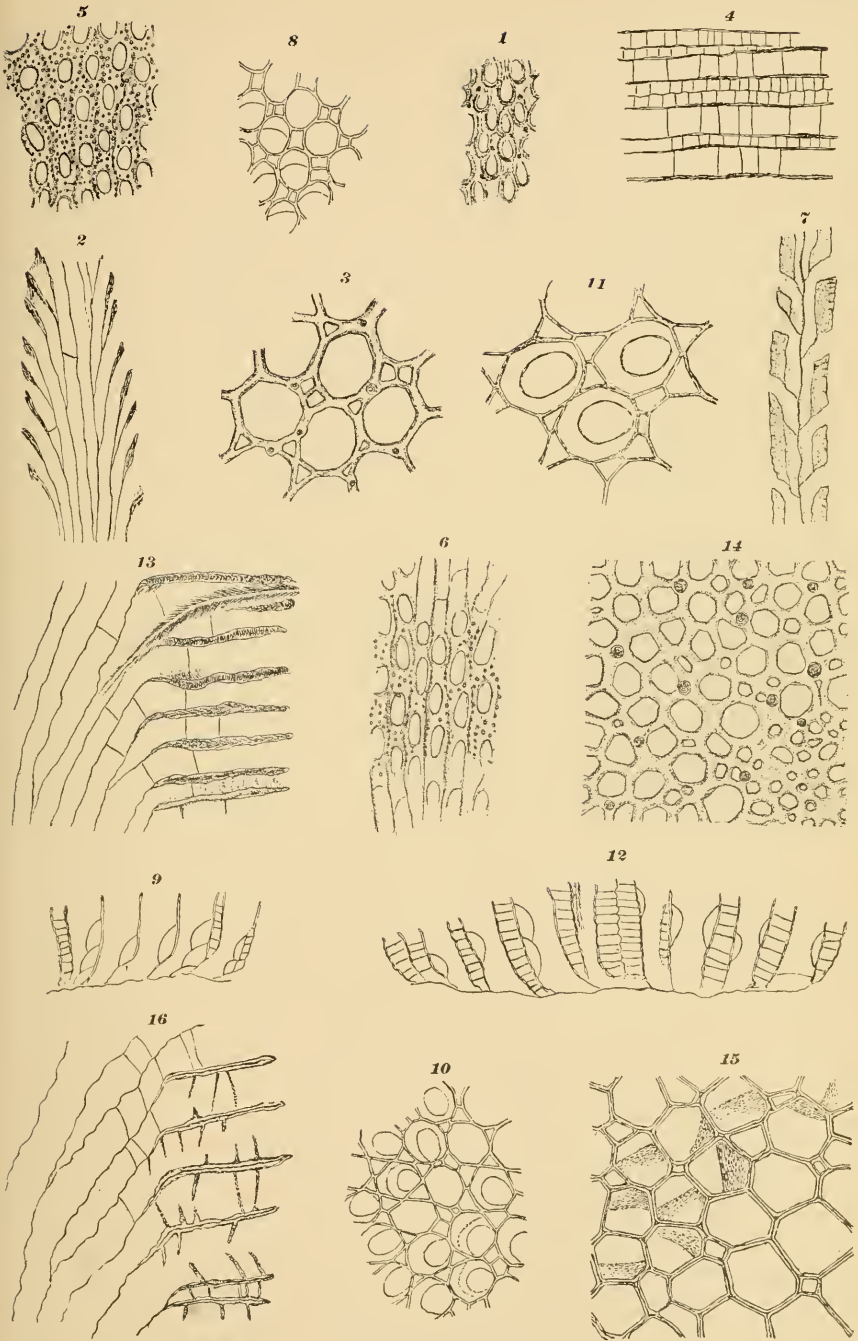
Phaeopora fimbriata (James).

11. Outline drawing of the type specimen, the basal extremity restored; natural size.
12. Tangential section of type, $\times 20$.
Clinton formation, Clinton County, Ohio.



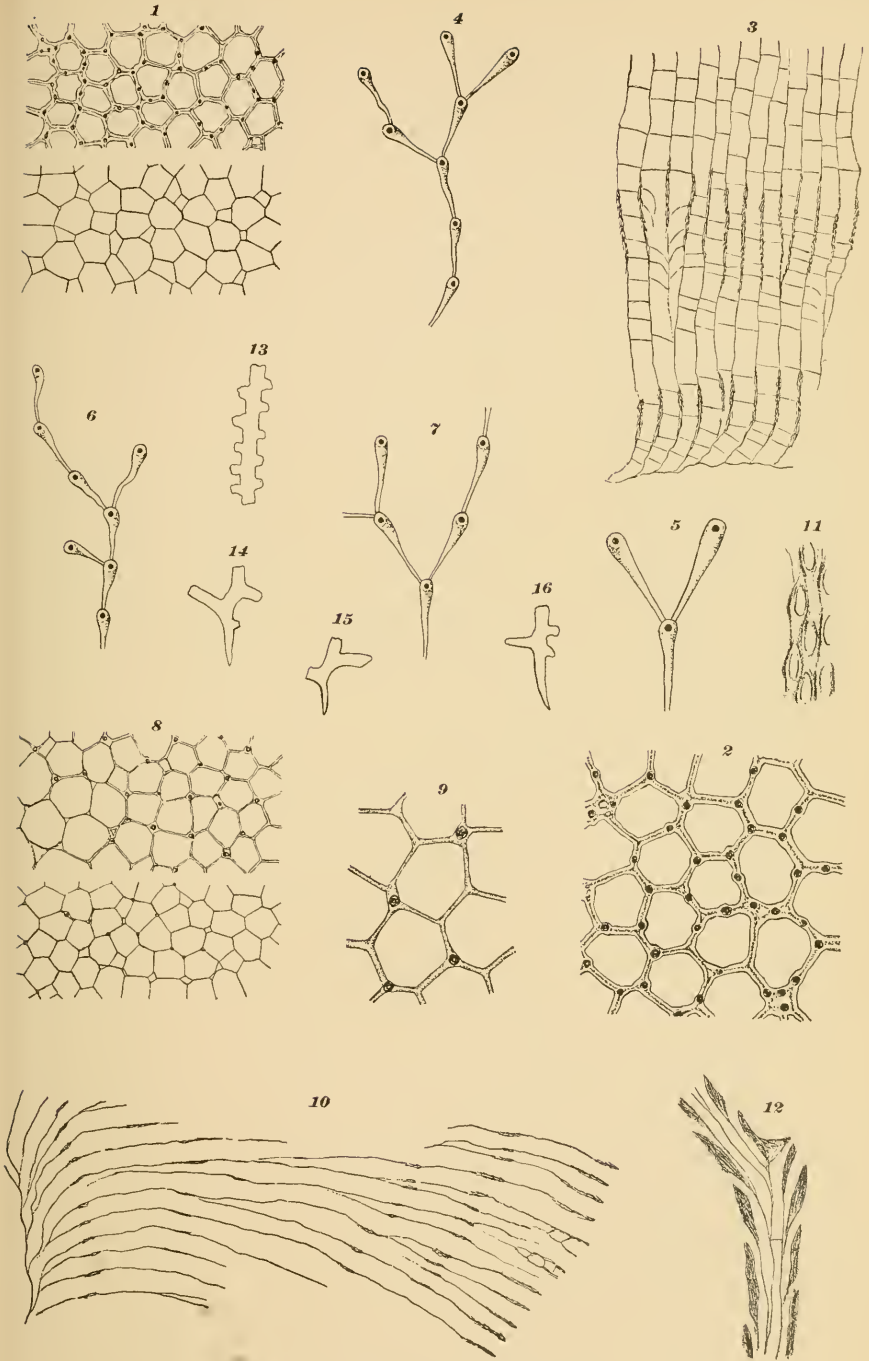
JAMES TYPES OF ORDOVICIAN BRYOZOA.

FOR EXPLANATION OF PLATE SEE PAGES 60, 61.



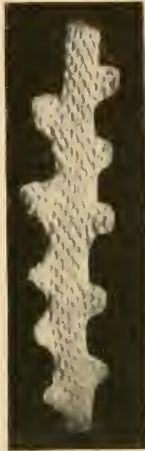
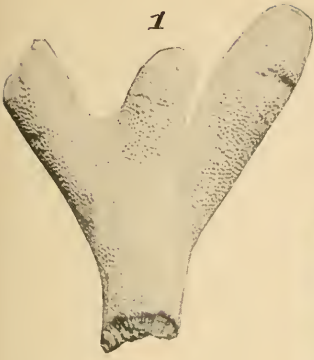
JAMES TYPES OF ORDOVICIAN BRYOZOA.

FOR EXPLANATION OF PLATE SEE PAGES 61, 62.



JAMES TYPES OF ORDOVICIAN BRYOZOA.

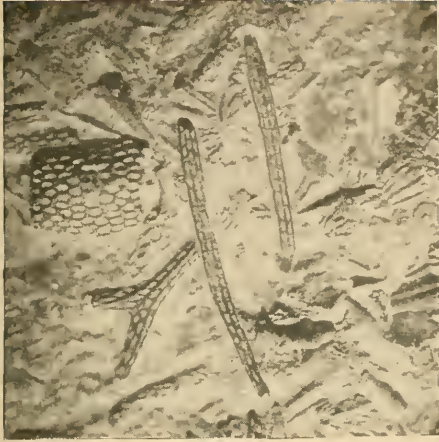
FOR EXPLANATION OF PLATE SEE PAGES 62, 63.



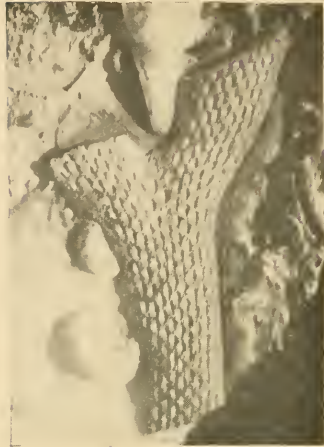
JAMES TYPES OF ORDOVICIAN BRYOZOA.

FOR EXPLANATION OF PLATE SEE PAGES 63, 64.

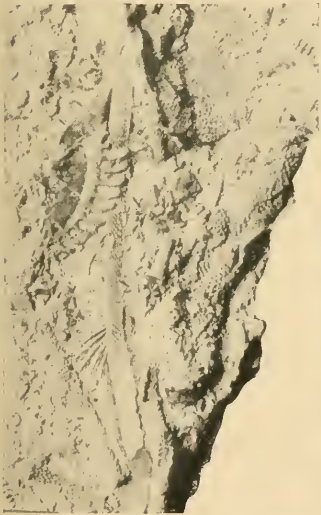
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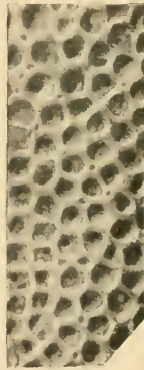
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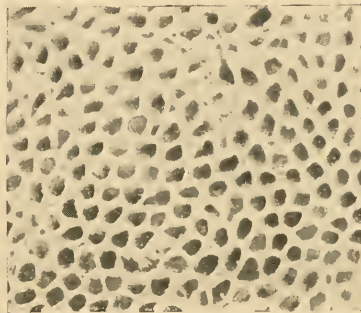
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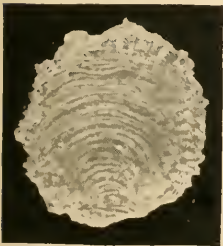
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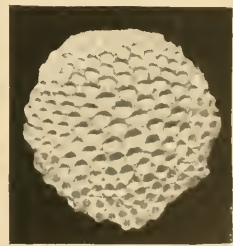
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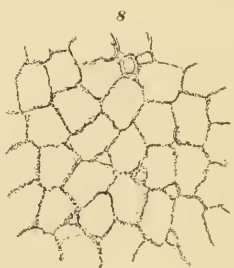
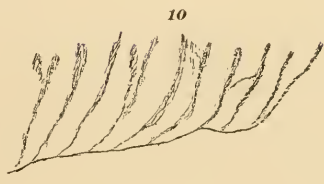
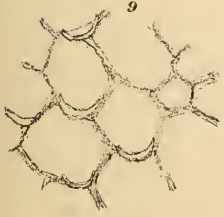
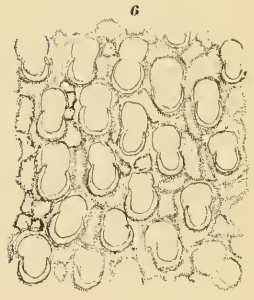
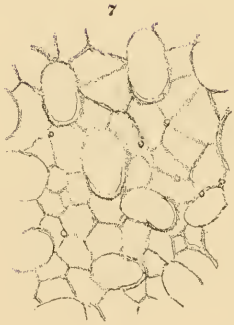
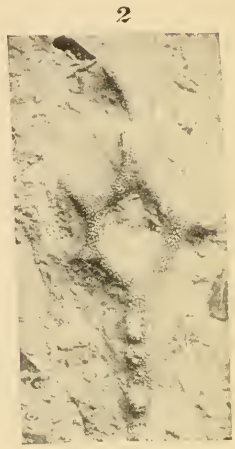


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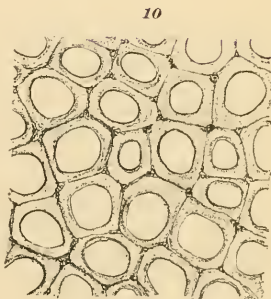
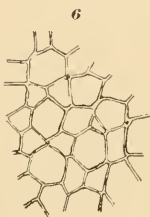
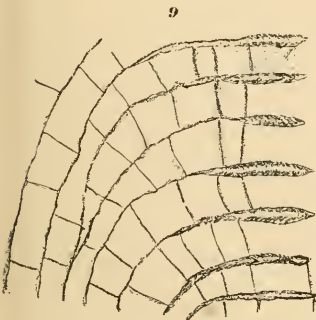
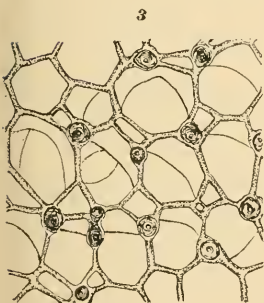
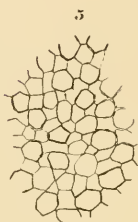
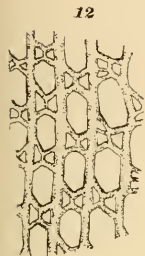
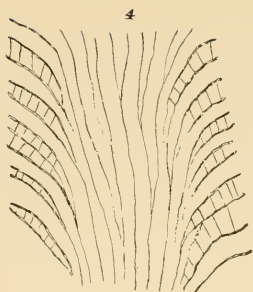
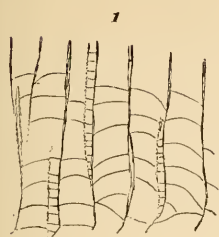
JAMES TYPES OF ORDOVICIAN BRYOZOA.

FOR EXPLANATION OF PLATE SEE PAGE 64.



JAMES TYPES OF ORDOVICIAN BRYOZOA.

FOR EXPLANATION OF PLATE SEE PAGE 65.



JAMES TYPES OF ORDOVICIAN AND SILURIAN BRYOZOA.

FOR EXPLANATION OF PLATE SEE PAGES 65, 66.

