

University of Montana

ScholarWorks at University of Montana

Graduate Student Theses, Dissertations, &
Professional Papers

Graduate School

1933

Some cryptostomatous Bryozoa from the Tranverse Group of Michigan

Andrew Hamilton McNair
The University of Montana

Follow this and additional works at: <https://scholarworks.umt.edu/etd>

Let us know how access to this document benefits you.

Recommended Citation

McNair, Andrew Hamilton, "Some cryptostomatous Bryozoa from the Tranverse Group of Michigan" (1933). *Graduate Student Theses, Dissertations, & Professional Papers*. 7068.
<https://scholarworks.umt.edu/etd/7068>

This Thesis is brought to you for free and open access by the Graduate School at ScholarWorks at University of Montana. It has been accepted for inclusion in Graduate Student Theses, Dissertations, & Professional Papers by an authorized administrator of ScholarWorks at University of Montana. For more information, please contact scholarworks@mso.umt.edu.

NON-CRYPTOGAMIC BRYOZOA
FRONTIER TRAVELERS GROUP OF MICHIGAN

by

Andrew H. McHair, Jr.

Submitted in partial fulfillment of the
requirement for the degree of
Master of Arts.

State University of Montana

1933

Approved:

Charles F. Weiss

Chairman of Examining Committee

W. G. Bateman

Chairman of Graduate Committee

UMI Number: EP37869

All rights reserved

INFORMATION TO ALL USERS

The quality of this reproduction is dependent upon the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if material had to be removed, a note will indicate the deletion.



UMI EP37869

Published by ProQuest LLC (2013). Copyright in the Dissertation held by the Author.

Microform Edition © ProQuest LLC.

All rights reserved. This work is protected against unauthorized copying under Title 17, United States Code



ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

CONTENTS

	Page
Acknowledgements - - - - -	1
Introduction - - - - -	1
Historical review of previous work on Cystodictyonacea from Traverse Group - - - - -	3
Technique of observation and study - - - - -	4
General statement concerning anatomy of Cystodictyon- acea from Traverse Group- - - - -	5
Artificial keys for identification of Families of Cryptostomata and genera of Cystodictyonidae- - - - -	10
Description and discussion of super-family Cystodicty- onacea, new super-family- - - - -	13
Descriptions of families and genera- - - - -	14
Descriptions of species- - - - -	20
Faunal chart - - - - -	30
List of locations- - - - -	51
Stratigraphic conclusions- - - - -	52
Bibliography - - - - -	55
Plates and explanation of plates - - - - - (after)	60

ACKNOWLEDGMENTS

The author wishes to express his sincere appreciation to the men who have so greatly aided him during the course of this study: To Dr. C. F. Deiss, Jr. for his untiring help, direction, suggestions and encouragement the author is irredeemably indebted; to Dr. W. C. Case, Director, Museum of Paleontology at the University of Michigan, and to Dr. R. A. Smith, Director of the Michigan Geological Survey, for the use of the Bryozoa material discussed in this paper; and to Dr. W. P. Clark of the University of Montana for criticism and suggestions concerning the names proposed for new species.

INTRODUCTION

Fossil Bryozoa have not been used for geologic time-markers as extensively as have other organisms. Many paleontologists and stratigraphers have neglected the Bryozoa because of their small size, and of the supposition that the preparation of thin sections for microscopic study is needed for the identification of these fossils. A supposition largely inferred because thin sections are necessary to the understanding of the Trepostomata and other groups of these organisms described in paleontologic literature. Bryozoa are particularly valuable as stratigraphic

horizon markers because it is possible to identify species of them from minute fragments, relatively complete specimens not being necessary as in the case of Brachiopods, Pelecypods, etc.

The purpose of this paper is to describe the anatomy of one group of these interesting and relatively neglected fossils, to point out their taxonomic and stratigraphic relationships, and to describe and figure the species characteristic of the Devonian rocks of Michigan. The investigation was made with the hope that data obtained from a careful study of a particular group of Bryozoa from the Devonian strata of Michigan would aid in the solution of some of the stratigraphic problems of these rocks.

The material studied was collected from the Middle Devonian strata (Traverse Group) in the northern part of the Southern Peninsula of Michigan during the summer of 1926, by a field party of the Michigan Geological Survey, and Dr. E. O. Ulrich, of the United States Geological Survey.

The names given to the new species are provisional because all of the publications in which these Bryozoa have been described are not in the State University Library, nor could this literature be borrowed from research libraries. In the near future the writer hopes to examine the publications which have not been available.

HISTORICAL REVIEW OF PREVIOUS WORK ON CYSTODICTYONACEA
FROM TRAVERSE GROUP

The earliest paper in which fossil Bryozoa from Michigan were described is Alexander Winchell's report¹, published in 1866. Winchell described Cystodictya sulcata on page 92 of this report. In 1890 E. O. Ulrich² described two new species, Scalaripora approximata, from Alpena, and S. separata, from Thunder Bay. These are the only known species of bifoliate Cryptostomata described from Michigan.

Pohl³ in 1929 mentioned a form of Cystodictya which closely resembles C. gilberti (Neek) as being common to the Traverse Group of Ohio and the Bell shale of Michigan. The form referred to by Pohl is probably Cystodictya varicopora, sp. nov. described in this paper (p. 24, Pl. I, Figs. 6, 7). Inasmuch as these three papers constitute the entire literature on the Cystodictyonacea of Michigan it is apparent that these forms have never been carefully studied, and this partly explains the fact that the species of Cystodictyonacea

-
1. A. Winchell, Report on the Lower Peninsula of Michigan, p. 92, 1866, cited in Mickles and Hassler, Synopsis of American Fossil Bryozoa, Bulletin, United States Geological Survey, No. 173, p. 226, 1900.
 2. E. O. Ulrich, Geological Survey of Illinois, VIII, pp. 507, 509, Pl. xliii, 2-3, 1890.
 3. E. R. Pohl, The Middle Devonian Traverse Group of Rocks in Michigan, from the Proceedings of the United States National Museum, no. 2311, Vol. 78, Art. 14, p. 30, 1929.

in this paper are new.

TECHNIQUE OF OBSERVATION AND STUDY

The cystodictyonacid Bryozoa are identified upon external characters. Consequently it is essential that the surface of the specimens be clean. A number of methods of cleaning the material were tried. Soaking the specimens in solutions of potassium hydroxide, dilute hydrochloric acid, or sodium bicarbonate all proved unsuccessful. The most effective results were obtained by moistening the specimens in water and then brushing them with a short bristled brush. When the stiffness of bristles used was approximately that of a medium tooth brush considerable clay was removed. The polish produced on the surface of the specimens by brushing was reduced by washing the specimens in xylol.

Most of the illustrations in this paper are photomicrographs. In order to reduce glare on the specimens and to bring out minute details of their structure a thin film of ammonium chloride was blown upon their surfaces.

The specimens are best examined with a binocular microscope because of the depth produced by stereoscopic perspective. A magnification of ten diameters is sufficient for general examination, but a greater magnification is necessary for making micrometer measurements and for studying

the smaller structures.

The preparation of thin sections is unnecessary for the identification of species of these Bryozoa, because they are identified upon surface characters; however, for the determination of internal structures and for specimens which are embedded in a matrix which cannot be removed, thin sections are indispensable.

GENERAL STATEMENTS CONCERNING ANATOMY OF
CYSTODICTYONACEA FROM TRAVERSE GROUP

Ulrich⁴ long ago pointed out that the internal anatomy of the Cystodictyonidae showed great uniformity and therefore was of little value in classification. He also noted that zoarial peculiarities must be used as criteria for identification. It is equally true that the genera of the other families of the Cystodictyonacea must also be identified on zoarial characters. Despite the fact that the Cystodictyonacea are probably more easily studied than any other morphological group of Bryozoa, very little work has been done with them except by Hall and Simpson⁵ in their "Corals and Bryozoa", and by Ulrich⁶ in his "Paleozoic

4. E. O. Ulrich, Geological Survey of Illinois, VIII, p. 347, 1890.

5. J. Hall and G. Simpson, Paleontology of New York, VI, Corals and Bryozoa, 298 pp., 1887.

6. E. O. Ulrich, Op. cit., pp. 265-689.

Bryozoa".

The genera of the fauna from the Traverse Group belong to the family Cystodictyonidae with the exception of Ptilodictya and Intrapora. These belong respectively to the Ptilodictyonidae and Stictoporellidae.

Members of the Cystodictyonidae have a zoarium made of two or three layers of zooecia growing back to back, thus producing bifoliate or trifoliate expansions, which in the forms here studied, branch regularly. The genera of the Cystodictyonidae found in the Traverse Group are separable into two divisions: first, those which are flattened in cross section, represented by such genera as Cystodictya or Taeniopora; and second, those which are triangular in cross section, represented by such genera as Phractopora, Scalariopora, or Prismopora. In the first group the apertures are disposed in regular longitudinal ranges. In Cystodictya the formation of new ranges is accomplished in two ways. The most common method is the one in which apertures in one range become alternately separated transversely until two new ranges are formed. In the other method the ridges between ranges of apertures bifurcate and a new range of apertures develops in the space between the newly formed ridges. The number of new ranges formed does not materially increase the width of the branches. In Cystodictya alternata (Pl. II, Fig. 4,) the width of the branches is

controlled by bifurcation, most of the newly formed ranges continuing into new branches. Sometimes several ranges terminate at the edge of a branch in the form of sharp or rounded spur-like projections, as in Cystodictya bifidiplicata (Pl. III, Fig. 1) and C. apiculata (Pl. IV, Figs. 3-4). In Cystodictya obliqua (Pl. I, Fig. 4), and C. attenuata (Pl. I, Fig. 1), the ranges cross the branches obliquely and terminate at the margins or at the edges of the branch.

The apertures are generally surrounded by a narrow elevated peristome, which is often raised on one side into a crescent shaped lunarium. The presence or absence of lunaria on small fragments is not a specific character. Lunaria are restricted to the older portions of the zoarium on some of the larger and more complete specimens. It is inferred from this condition that lunaria are developed normally only in the older life-stages of a zooid. In Cystodictya, lunaria are always situated on the edge of the peristome nearest the margin of the branch. This arrangement is interpreted as an adaptation toward efficiency of food getting and respiration by causing currents of water to be sent in from the marginal zooids of the branch toward those in the central parts.

The surface of the branch is divided into two areas; a central poriferous area, and a marginal nonporiferous area. The nonporiferous area of Cystodictya varies in cross sec-

tion from rounded to sharply angular. The margin in Taeniopora is always angular and sharp; in profile a cross section of a branch appears almost rhomboidal in outline.

The second group of the Cystodictyonidae from the Devonian of Michigan, embracing the genera Phractopora, Scalaripora and Prismopora, are characterized by having branches which are triangular in cross section. This condition originates by three bifoliate ridges growing together along a central axis.

In Phractopora and Scalaripora the faces of the branches are sharply concave and are traversed by secondary ridges producing cup-shaped depressions on the surface. The margins of a branch are nonporiferous and at irregular intervals are projected toward the center of the branch as shallow depressed noncelluliferous troughs or maculae. Phractopora occasionally exhibits in the central portion of the cup-shaped depressions a noncelluliferous groove, which appears to be entirely isolated from the nonporiferous area at the margin.

The specimens of Prismopora found in this fauna are so poorly preserved that it is impossible to make specific identifications, hence no species of this genus are described and nothing is noted concerning its anatomy.

The family Ptilodictyonidae is represented in the fauna studied by one species of the genus Ptilodictya. The

zoarium of Ptilodictya consists of falciform segments, which articulate with a basal expansion. The proximal end on one specimen of Ptilodictya subfalcata, sp. nov. (Pl. VIII, Fig. 2) is pointed, and probably represents the articulation of the frond with a basal expansion.

The size, shape and arrangement of the apertures gradually change from the proximal end to the broader, flatter, distal portion of the frond. The apertures are small, elliptical in outline, longitudinally arranged in the proximal end; and are larger, rhombic to hexagonal in outline, and arranged in intersecting curved series in the distal portion.

The family Stictoporellidae is represented in the Traverse fauna by two species of the genus Intrapora. The zoaria in these two species differ greatly, being ramose in Intrapora acanthopora, and appearing to be a broad expansion in Intrapora crebripora. In both species the zoecia grow back to back from a median mesotheca. The distinctive characteristic of Intrapora is the presence of mesopores between the apertures. The mesopores are angular, and elongated parallel to the edge of the branch in Intrapora acanthopora (Pl. VIII, Fig. 5) whereas the mesopores are sub-angular to almost circular in Intrapora crebripora (Pl. VIII, Figs. 7-8). The walls of the apertures in Intrapora acanthopora have one or more low nodes, which in

thin sections show typical structures of acanthopores (Pl. VIII, Fig. 6). In the descriptions of Intrapora known to the writer acanthopores are not mentioned. It is believed that this is the first instance in which these structures are observed in Intrapora. The edges of the branch in Intrapora acanthopora are occupied by elongate angular mesopores.

ARTIFICIAL KEYS FOR IDENTIFICATION OF FAMILIES OF
CRYPTOSTOMATA AND GENERA OF CYSTODICTYONIDAE.

The following keys were made from tabulated charts constructed by analyzing the generic and family descriptions. The purpose of the keys is to separate the genera in such a manner as to avoid any confusion between the more closely related forms. Generic keys from the Stictoporellidae and Ptilodictyonidae have not been included because these families are each represented by only one genus in the Traverse fauna. Identification of these genera is easily made from descriptions. Keys for species of the genera found in this fauna have not been made because the publications in which all the specific descriptions are given are not available in the library at the State University of Montana.

Artificial Key for Identification of Families of
Cryptostomatous Bryozoa

- I. Zoaria a reticulate expansion, not articulated:
- Z. Zoecia more or less tubular; often with diaphragms:
- B. Branches free or anastomosing, dissepiments absent -----PHYLLOPORINIDAE.
- ZZ. Zoecia not tubular; primitive portion oblong, quadrate, or hexagonal in outline:
- B. Branches with nonporiferous dissepiments -----FENECTELLIDAE.
- BB. Branches without nonporiferous dissepiments (Zoaria of strong central stems giving off numerous, smaller, lateral branches from their opposite margins) -----ACANTHOCLADIIDAE.
- II. Zoaria of subcylindrical segments or branches:
- S. Zoaria segmented -----ARTHROSTYLIIDAE.
- SS. Zoaria not segmented -----RHABDOMESONTIDAE.
- III. Zoaria bifoliate, occasionally trifoliate, sometimes articulate:
- P. Peristomes present:
- L. Lunaria absent:
- z. Zoecia prone along basal membrane -----RHINOPORIDAE.
- zz. Zoecia not prone along basal membrane:
- x. Zoaria articulate -----PTILOBICTYONIDAE.
- xx. Zoaria not articulate -----STICTOPORALLIDAE.
- LL. Lunaria present, directed away from nonporiferous margins -----CYSTOBICTYONIDAE.

PP. Peristomes absent -----RHINIDICTYONIDAE.

NOTE. The Cycloporidae and Sphragioporidae, poorly described Mississippian and Pennsylvanian families are not included in the above key.

Key to Genera of Family Cystodictyonidae

- I. Zoaria ramose:
- B. Branches elliptical to flattened in cross section:
- Z. Zoaria with elliptical or circular fenestrules -----COSCIINIUM.
- ZZ. Zoaria without fenestrules:
- M. Mesopores present between apertures -----SEMIOFORA.
- MM. Mesopores absent between apertures -----CYSTODICTYA.
- BB. Branches triangular in cross section:
- T. Faces of branches not crossed by salient transverse ridges -----PRISMOPORA.
- TT. Faces of branches crossed by transverse ridges -----SCALARIFORA.
- BBB. Branches rhomboidal in cross-section -----TAENIOFORA.
- II. Zoaria a thin foliaceous expansion:
- S. Surface marked by sterile maculae:
- A. Apertures oval or circular, in quincunx order -----CERAMELLA.
- AA. Apertures sub-elliptical, in linear series between longitudinal ridges, lunarium on side of aperture nearest margin of branch -----DICHOTRYPA.

33. Surface marked by salient ridges or crests, uniting so as to form larger or smaller cup-shaped cavities:

A. Apertures on ridges growing in opposite directions from a mesotheca -----GLYPTOPORA.

AA. Apertures are relatively more rounded and larger than Glyptopora. The junction angles are celluliferous and thicker than any other part of the leaves -----PHRACTOPORA.

III. Zoaria of four or more vertical leaves, arranged in a cruciform or stellate manner -----EVACTINOPORA.

IIII. Zoaria of lateral rectangular branches -----THAMNOTRYPA.

IIIII. Zoaria ensiform, with a pointed base, margins striated -----PTILOCELLA.

IIIIII. Zoaria segmented, arising from cylindrical rootlets -----ACROGENIA.

DESCRIPTION AND DISCUSSION OF SUPER-FAMILY CYSTODICTYONACEA new super family

Super-family Cystodictyonacea, super-fam. nov. (Provisional)

Zoaria continuous or jointed; consisting of two or three layers of zoecia arising from mesotheca and growing back to back; forming flattened or triangular branches, or irregular expansions traversed by ridges. Apertures surrounded by peristomes or sloping areas, Median tubuli present or absent. Range, Ordovician to Permian.

Among the families of Bryozoa belonging to the Order

Cryptostomata Vine⁷ the Cystodictyonidae, Rhinidictyonidae, Ptilodictyonidae and Stictoporellidae are all characterized by a bifoliate zoaria. This condition is produced by a back to back arrangement of the zooecia which arise from a mesotheca, and which easily distinguished these families from those in which the zooecia open on one side only (Fenestellidae, Acanthocladiidae, Phylloporinidae); or from families in which the zooecia radiate about a central axis (Arthrostylidae, Rhabdomesontidae). Although there are no members of the Rhinidictyonidae in the Traverse Group, this family is placed in the Cystodictyonacea because of its zoarial character. Additional study of members of the families of the Rhinoporidae and Cycloporidae may also place them in the Cystodictyonacea.

DESCRIPTIONS OF FAMILIES AND GENERA

Family Cystodictyonidae Ulrich

Ulrich, Geological Survey of Illinois, Vol. VIII, Pt. II, Section VI, p. 335 (1890).

Description from Ulrich.-----"Zoaria consisting of two or three layers of cells grown together back to back, forming thin foliate expansions or triangular branches. Primi-

7. K. Zittel, Textbook of Paleontology, 2nd ed., p. 339, 1913.

tive cells semicordate or obovate-acuminate in outline, arranged in longitudinal series between vertical double plates. Primitive aperture subcircular, being somewhat truncated on the posterior side. As growth proceeds the aperture is drawn out shaft-like, forming a tubular vestibule, and the longitudinal plates become obsolete. Superficial aperture with peristome and more or less developed lunarium. Interspaces between zoecia and vestibules occupied by vesicular tissue, the vesicles more or less completely filled with a minutely perforated calcareous deposit near the surface. Margin of zoarium sharp or rounded, and like the basal portion, noncelluliferous."

Genus Cystodictya Ulrich

Ulrich, Journal Cincinnati Society of Natural History, V, pp. 152, 170 (1882).

Ulrich, Geological Survey of Illinois, VIII, pp. 385 (1890).

Ulrich's description of 1890.-----"Zoaria ramose, bifoliate, the branches acutely elliptical in cross section, with sub-parallel, sharp, nonporiferous, striated, granulose, or smooth margins. Zoecia apertures generally arranged in longitudinal series between ridges, sometimes in more pronounced oblique rows. Apertures sub-elliptical, partially closed in the fully matured condition with a more or less developed lunarium, that is always situated on the side

nearest to the margin of a branch. Interspaces finely striated, granulose, or smooth, and never with pits or cells, excepting when worn." Genotype: Cystodictya ocellata Ulrich. Range, Upper Helderberg to Coal Measures.

Genus Taeniopora Nicholson

Nicholson, Geological Magazine, new series, decade II, Vol. I, p. 121 (1874).

Original description.-----"Polyzoary calcareous, composed of a flattened linear expansion, which branches dichotomously, and is celluliferous on both sides. Each side of the polyzoary is furnished with a strong median ridge or keel, which has a longitudinal direction, and separates the frond into two lateral halves. The cells have very prominent apertures, and are arranged in from three to five longitudinal rows on each side of the central keel; the cells of contiguous rows alternating, so that a series of short oblique rows of cells are produced, which diverge from the keel like the barbs of a feather. The margins of the polyzoary are usually plain and non-celluliferous, and the cells are not separated by longitudinal striae or elevated ridges. No fenestrules are present, and the entire frond forms a continuous expansion, within which the cells are immersed." Genotype: Taeniopora exigua Nicholson. Range, Devonian.

Genus Scalaripora Hall

Hall, Transactions Albany Institute, Vol. X, p.159 (1883).

Hall and Simpson, Paleontology of New York, Vol. VI,
p. xxi (1887).

Description from Hall and Simpson.-----"Zoarium consisting of groups of triangular prismatic branches, celluliferous on each face. Sides of branches concave and crossed by transverse, elevated, celluliferous scalae. Cells tubular, arising from the radiating mesothecae of the branches and from the mesothecae of the scalae. Margins of branches and scalae non-celluliferous." Genotype: Scalaripora scalariformis Hall. Range, Devonian.

Genus Phractopora Hall

Hall, Transactions of Albany Institute, Vol. X, p. 154 (1883).

Hall and Simpson, Paleontology of New York, Vol. VI,
p. xvii (1887).

Description from Hall and Simpson.-----"Zoarium explanate, free or incrusting, frequently contorted, celluliferous on one or both faces. Surface elevated at irregular intervals into prominent crests. Cells tubular, without septa. Intercellular structure vesiculose near the base, septate above." Genotype: Phractopora cristata Hall.
Range, Devonian, Mississippian.

Genus Prismopora Hall

Hall, Transactions Albany Institute, Vol. X, pp. 158,
193 (1833).

Hall and Simpson, Paleontology of New York, Vol. VI,
p. xxi (1837).

Description from Hall and Simpson.-----"Zoarium ramose,
consisting of triangular branches, frequently forming
irregular groups. Branches with the sides equal or unequal,
concave; celluliferous on each side. Cells tubular, arising
from mesial plates which extend from the center of the
branch to each angle. Intercellular tissue vesiculose."

Genotype: Prismopora triquetra Hall. Range, Devonian-
Carboniferous.

Family Ptilodictyonidae Mittel

Nickles and Bassler, American Fossil Bryozoa, Bulletin
United States Geological Survey, No. 173, p. 45 (1900).

Not Zittel, Text-book of Paleontology, 2nd ed., p. 344
(1913).

Description from Nickles and Bassler.-----"Zoarium
bifoliate, composed of two layers of zooecia, grown to-
gether back to back, usually jointed, at least at the base,
and forming leaf-like expansions or compressed branching or
inosculating stems; mesotheca without median tubuli;
zooecia usually have hemisepta and semielliptical orifices;
apertures usually ovate, surrounded either by a sloping area

or a ringlike peristome; vestibules separated by thick walls."

Genus Ptilodictya Lonsdale

Lonsdale, Murchison's Silurian System, p. 676 (1839).

Ulrich, Geological Survey of Illinois, Vol. VIII, p. 390 (1890).

Description from Ulrich.-----"Zoaria segmented, consisting of a small, radially striated basal expansion which is attached to foreign bodies, and has at the center of the upper surface a socket for articulation with the sub-solid extremity of the erect and unjointed frond. Frond commonly lanceolate or falciform, sometimes a broad undulating expansion, at other times dichotomously branched with margins parallel. Proximal extremity longitudinally striated, pointed or wedge-shaped. Lateral margins of frond acute, non-celluliferous, smooth or obliquely striated. Small monticules usually present in the large species. Zoecia with subcircular or elliptical superficial apertures, surrounded by a sloping area of quadrate, rhombic or hexagonal outline. Apertures arranged in a plumose manner, with longitudinal series in the center and, diverging from these on each side, oblique lateral rows; or simply in regular diagonally intersecting series. Both hemisepta usually well developed." Genotype: Flustra lanceolata Lonsdale. Range, Silurian and Devonian.

Family Stictoporellidae Nickles and Bassler

Nickles and Bassler, Synopsis of American Bryozoa, Bulletin United States Geological Survey, No. 173, p. 46 (1900).

Original description.-----"This family differs from the Ptilodictyonidae mainly in that the zoarium is not articulated but grows upward from, and is continuous with a spreading base."

Genus Intrapora Hall

Hall, Transactions Albany Institute, X, p. 157 (1833).

Hall and Simpson, Paleontology of New York, Vol. VI, p. xxii (1887).

Nickles and Bassler, Synopsis of American Bryozoa, Bulletin United States Geological Survey, No. 173, p. 47 (1900).

Amended description of Nickles and Bassler.-----"Zoarium ramose, from a spreading base, branches compressed, dividing dichotomously; zooecia tubular, at first parallel to the mesotheca, then bend abruptly outward; apertures oval, with peristome; interspaces with minute angular pits, the openings of numerous tabulated mesopores; the interspaces sometimes solid, the mesopores having been closed by a deposit of horizontally laminated calcareous tissue." Genotype: Intrapora puteolata Hall. Range, Devonian, Mississippian.

DESCRIPTIONS OF SPECIES*

Genus Cystodictya Ulrich

For generic description see page 15.

Cystodictya attenuata, sp. nov.

Plate I, Figs. 1, 1', 2.

Zoarium of dichotomizing branches; distance between bifurcations unknown.

Branches straight or slightly curved, flat; width from 3 to 5 mm.; average thickness 0.8 mm.

Apertures open directly; subcircular to elliptical in outline; those near the margin slightly larger than those in central portion of branch; length from 0.17 to 0.20 mm.; average width 0.14 mm.; eight occur in 3 mm. longitudinally; separated longitudinally by more than length of aperture; separated transversely by approximately width of aperture. Peristomes elevated, narrow, sharp; when perfect rim nearest basal portion of branch lip-like. Lunaria unknown. Apertures in one range become alternately separated transversely thus forming two new ranges. Eight to 11 ranges occur transversely.

Ridges between ranges wavy in early portions due to transverse crowding by apertures; distinct, rounded; gen-

*The types of all of the species described in this paper are preserved in the Museum of Paleontology, University of Michigan, Ann Arbor, Michigan.

erally terminating at edges of branches to produce sinuous serrated margins; separated transversely by average distance of 0.33 mm.

Margin nonporiferous; sharply rounded in cross section; extremely narrow; apertures present close to edge.

Remarks: This species is distinguished from C. obliqua, sp. nov. by the narrow nonporiferous margin which is traversed by ridges, and by the sharpness of the branches in cross section. Hall's descriptions of C. incisurata Hall^B applies to C. attenuata. However Hall's description is so generalized that it could apply to nearly all other species of Cystodictya. C. attenuata shows the following differences when compared with the figures given by Hall of C. incisurata; the ridges are always thin and terminate at the edge of the branch; and the peristomes are elevated on the edge nearest the proximal end of the branch. Because of these two differences the Michigan form is described as a new species.

Localities and Horizons.-----Loc. 9, zone 1; Loc. 14, middle zone; Loc. 17, shale zone; Loc. 29, zone 8 and top.*

B. J. Hall and G. Simpson, Faunontology of New York, Vol. VI, pp. 241-243, Pl. LX, Figs. 1-18 (1937).

* All locations are those of the party of the Geological Survey of Michigan of 1926. See page 51 for list and description of locations.

Cystodictya obliqua, sp. nov.

Plate I, Figs. 3, 3', 4, 5.

Zoarium of dichotomizing branches; distance between bifurcations unknown.

Branches straight or slightly curved; usually flat but may be twisted; width from 3 to 5 mm.; average thickness 1 mm.

Apertures open directly; elliptical in outline; those near margin slightly larger than those in central portion of branch; length from 0.14 to 0.19 mm.; average width 0.14 mm.; seven occur in 3 mm. longitudinally; separated longitudinally by more than length of aperture; separated transversely by less than width of aperture. Peristomes prominent, broad; equally elevated; on old specimens the marginal side of peristomes elevated into lunaria. Apertures in one range become alternately separated transversely, thus producing two new ranges. Eight to 14 ranges occur transversely.

Ridges between ranges almost straight; prominent; separated transversely by average distance of 0.33 mm.; terminate at inner edge of nonporiferous margins; new ridges arise between new ranges.

Margin nonporiferous; width moderate; gently rounded in cross section; outer edges smooth or sinuous or depressed nodose.

Remarks: This species is distinguished from C. attenuata,

sp. nov. by rounder and broader nonporiferous margin, and by absence of ridges on the margin. C. obliqua is distinguished from C. lyrifera, sp. nov. by presence of oblique ranges and ridges, lower peristomes, weaker lunaria, and by absence of the fork-shaped method of branching.

Localities and Horizons.-----Loc. 9, zone 1; Loc. 10, zone 3; Loc. 14, middle zone; Loc. 17, shale zone; Loc. 29, top zone; Loc. 33, Bell shale; Loc. 49.

Cystodictya variopora, sp. nov.

Plate I, Figs. 6, 7, 7'.

Zoarium of alternate branches; distance between divergence of new branches, on same edge approximately 7 mm.

Branches curved, flat; width from 2.5 to 3.6 mm.; average thickness 0.40 mm.

Apertures open directly; circular to elliptical in outline; conspicuously larger and more circular near the proximal ends of branches than near distal ends; length from 0.19 to 0.22 mm.; width from 0.11 to 0.17 mm.; seven occur in 3 mm. longitudinally; separated longitudinally by approximately length of aperture; separated transversely by approximately width of aperture. Peristomes delicate, thin; summit attains nearly same elevation as top of ridges between apertures. Lunaria minute and inconspicuous. Apertures in one range become alternately separated transversely, thus producing two new ranges. Seven to 18 ranges occur trans-

versely.

Ridges between ranges sub-angular; narrow at apex, broadening toward base; generally do not occupy entire space between ranges; average distance between ridges 0.28 mm.

Margin nonporiferous; sharply rounded in cross section; width moderate; strongest on concave edges of branches immediately after bifurcation.

Remarks: This species is distinguished from C. alternata, sp. nov. by possessing thinner branches, more delicate peristomes and two sizes of apertures on the distal and proximal portions of the branches. The absence of strong peristomes and lunaria, the narrower and thinner branches distinguish C. varionora from C. diversa, sp. nov. It is distinguished from C. gilberti Meek, by narrower and thicker branches, and by larger apertures on base of new branches.

Locality and Horizons.-----Loc. 29, zones 6 and top.

Cystodictya alternata, sp. nov.

Plate II, Figs. 1, 1', 2, 3, 4.

Zoarium an alternately branching expansion; distance between divergence of new branches on same edge, depends upon position within zoaria, varies from 4 to 8 mm.

Branches curved; flat; width from 2 to 5 mm.; average thickness 0.8 mm.

Apertures open directly; sub-circular to elliptical in outline; average length 0.23 mm.; average width 0.14 mm.;

nine occur in 13 mm. longitudinally; generally separated longitudinally by less than length of aperture, closest together during formation of new ranges; separated transversely by less than width of aperture. Peristomes sharp, thin. Lunaria generally present, strong. Apertures in one range become alternately separated transversely, thus producing two new ranges. Most new ranges continue into secondary branches. Eight to 13 ranges occur transversely.

Ridges between ranges straight, prominent, rounded; sometimes striated; new ridges arise between new ranges; separated transversely by average of 0.23 mm.

Margin nonporiferous; width moderate; rounded in cross section; occasionally striated.

Remarks: This species is distinguished from C. variopora, sp. nov. by thicker branches, stronger lunaria, peristomes and ridges, and by absence of two sizes of apertures on the branches: from C. apiculata, sp. nov. by the absence of sharp spur-like projections from the margins of branches, by stronger peristomes and lunaria, and by relatively greater width of branches.

Location and Horizon.-----Loc. 29, top zone.

Cystolictya minuta, sp. nov.

Plate II, Figs. 5, 5', 6.

Zoarium of bifurcating branches, arising from a spreading base; distance between divergence of new branches on

same edge varies from 1.5 to 3.5 mm.

Branches nearly straight, flat; width from 0.8 to 2 mm.; average thickness 0.5 mm.

Apertures elliptical in outline; occasionally a few in center of branch open obliquely, marginal ones always direct; average length 0.13 mm.; average width 0.09 mm.; eight occur in 3 mm. longitudinally; generally separated longitudinally by more than length of aperture; separated transversely by less than width of aperture. Peristomes low, broad. Lunaria unknown. Six to 10 ranges occur transversely.

Ridges between ranges of apertures generally inconspicuous; average distance between ridges 0.14 mm.

Margin nonperiferous; narrow, rounded, occasionally sharp; locally apertures occur on edge of branch.

Remarks: This species is readily distinguished from any other known species in the Michigan Devonian by its very small size. It is distinguished from C. limata Hall and Simpson by less transverse space between apertures and by shorter distance between points of bifurcation; from C. linearis Hall by greater distance between points of bifurcation and relatively greater width of nonporiferous margin.

Localities and Horizons.-----Loc. 14, middle zone;
Loc. 29, zones 6 and top.

Cystodictya ramifera, sp. nov.

Plate II, Figs. 7, 8, 8', 9.

Reservoir of diverging branches.

Branches of two sizes; primary ones are larger and dichotomize at intervals of 13 to 15 mm.; average width 2.7 mm.; secondary ones smaller, more numerous; diverge from the primary branches at intervals of approximately 3.5 mm.; average width 1.4 mm.; length of branch unknown; average thickness of both kinds of branches 0.7 mm.

Apertures open directly; elliptical in outline; average length 0.22 mm.; width from 0.14 to 0.22 mm.; eight occur in 3 mm. longitudinally; separated longitudinally by more than length of aperture; separated transversely by approximately width of aperture; marginal ones larger and more rounded at proximal portions of branches. Peristomes generally inconspicuous; stronger ones raised on anterior and posterior ends of apertures, thus producing a depressed area between any two apertures longitudinally. Lunaria small, well defined; disposed nearly in plane of top of aperture. Eleven to 13 ranges of apertures occur transversely on primary branches. Number of ranges on secondary branches unknown; three to four ranges are present at bifurcations.

Ridges almost obsolete near divergence of new branches, and more prominent between points of divergence.

Margin nonperiferous, rounded; widest between secondary

branches.

Remarks: The presence of large primary and small secondary branches distinguishes this species from all others of Cystodictya found in this fauna except C. megalopora, sp. nov. The chief differences between these two species are the presence of large oocystia, relatively greater width of apertures, and the absence of ridges between ranges of apertures in the latter form.

Locality and Horizon.-----Loc. 49.

Cystodictya bifidiplicata, sp. nov.

Plate III, Figs. 1, 1', 2.

Zoecia of dichotomizing branches: distance between bifurcations from 12 to 15 mm.

Branches curved, flat; width from 3 to 4 mm.; average thickness 1 mm. Occasionally margins of branches extended into rounded spur-like projections by termination of several ranges of apertures.

Apertures open directly; elliptical in outline; those near margin slightly larger and more circular than those in central portion of branch; average length 0.22 mm.; average width 0.12 mm.; eight occur in 3 mm. longitudinally; separated longitudinally by more than or less than length of aperture; separated transversely by approximately width of aperture. Peristomes inconspicuous, consequently apertures open almost even with floor of grooves in which they occur.

Lunaria weak; usually present as irregular swellings. New ranges of apertures developed in two ways: most commonly apertures in one range become alternately separated transversely, thus producing two new ranges; occasionally ridges between ranges bifurcate, a new range occupying space between two new ranges thus formed. Eight to 12 ranges occur transversely.

Ridges between ranges high, round, conspicuous, sometimes striated; width of ridges nearly equals width of aperture; new ridges formed by branching, or arise between new ranges of apertures; average distance between ridges 0.23 mm.

Margin nonporiferous; rounded in cross section; gently curved; broad on concave portions of branch after bifurcation.

Remarks: The size and bifurcation of the ridges; uniformly dichotomizing branches, and low peristomes distinguish C. bifiduplicata from all others of Cystodictya found in the Traverse Group.

In this species some of the apertures are covered by a secondary deposit of calcium carbonate.

Locality and Horizon.-----Loc. 29, zone 6.

Cystodictya diversa, sp. nov.

Plate III, Figs. 3, 4, 4'.

Zoarium a frequently branching frondescent expansion; distance between divergence of new branches on same edge varies from 4 to 8 mm.

Branches irregular, curved; width from 4 to 6 mm.; thickness from 0.7 to 0.85 mm.

Apertures open directly; elliptical in outline; average length 0.20 mm.; width from 0.11 to 0.17 mm.; eight occur in 3 mm. longitudinally; separated longitudinally by less than to more than length of aperture; separated transversely usually by less than width of aperture. Peristomes sharp; on marginal ranges elevated on side of aperture nearest margin. Lunaria prominent, strongest development on marginal ranges. Apertures in one range become alternately separated transversely, thus producing two new ranges. Occasionally four or five ranges terminate at edge of branch as small rounded projections. Nine to 17 ranges occur transversely.

Ridges between ranges of apertures low, generally inconspicuous; average distance between ridges 0.20 mm.

Margin nonporiferous; rounded to angular in cross section; sometimes striated.

Remarks: Cystodictya diversa is distinguished from C. variopora, sp. nov. by stronger peristomes and lunaria, by greater thickness and width of branches. It is distinguished from C. gilberti Week described by Hall and Simpson⁹ by relatively smaller apertures; by lower peristomes and less promi-

9. J. Hall and G. Simpson, Paleontology of New York, Vol. VI, p. 90, Pls. xxvii, Figs. 30-35; xxviii, Figs. 21, 22. (1887).

nent ridges.

Location and Horizon.----Loc. 49.

Cystodictya gracilia, sp. nov.

Plate III, Figs. 5, 5', 6.

Zoarium of narrow dichotomizing branches, distance between points of bifurcation varies from 10 to 13 mm.

Branches straight to slightly curved, flat; width from 1.8 to 2.0 mm.; average thickness 0.40 mm.

Apertures open directly; elliptical in outline; those near the margin larger and more circular than those in central portion of branch; average length 0.20 mm.; average width 0.14 mm.; seven occur in 3 mm. longitudinally; separated longitudinally by more than length of aperture; separated transversely by less than width of aperture. Peristomes sharp, usually elevated on side toward margin. Lunaria relatively numerous, irregularly distributed, resulting in part from weathering of specimens. Apertures in one range become alternately separated transversely, thus producing two new ranges. Five to seven ranges occur transversely.

Ridges between ranges of apertures, low, narrow, inconspicuous; new ridges arise between new ranges; terminate at inner edge of nonporiferous margin; average distance between ridges 0.23 mm.

Margin nonporiferous, narrow; sharply angular in cross section; apertures occasionally close to edge of branch.

Remarks: Although the known specimens of this species are imperfectly preserved, they can be readily distinguished from other species of Cystodictya by their far spaced, nearly straight, relatively narrow branches.

Locality and Horizons.----loc. 8, zones 1 and 2.

Cystodictya megalopora, sp. nov.

Plate IV, Figs. 1, 2, 2'.

Zoarium of diverging branches.

Branches of two sizes; the primary ones are larger and dichotomize at intervals of more than 13 mm.; average width 3 mm.; secondary ones smaller, more numerous, diverge from primary branches at intervals of approximately 4 mm.; average width 2.5 mm.; length of branch unknown; average thickness of both kinds of branches 0.3 mm.

Apertures open directly; elliptical in outline; average length 0.20 mm.; average width 0.15 mm.; nine occur in 3 mm. longitudinally; separated longitudinally by approximately length of aperture; separated transversely by approximately width of aperture. Peristomes low, inconspicuous. Lunaria small. Ten ranges of apertures occur transversely on primary branches. Number of ranges on secondary branches unknown; four to five ranges are present at bifurcation. A number of irregularly distributed, enlarged round pores are developed at distal end of branch; average diameter 0.23 mm.; situated at top of low, broad cones, which apparently cover the normal

apertures; average diameter of cone base supporting pores 1 mm. It is inferred that these pores are enlarged zooecial apertures because all stages between normal apertures and the largest pores are present; and that they represent the oecia in which reproductive individuals lived.

Transverse space between ranges not occupied by ridges.

Margin nonporiferous; rounded in cross section; widest between secondary branches.

Remarks: Cystodictya megalopora is distinguished from C. ranifera, sp. nov. by the presence of large prominent oecia, and by absence of ridges between ranges of apertures.

Locality and Horizon.-----Loc. 49.

Cystodictya apiculata, sp. nov.

Plate IV, Figs. 3, 4, 4'.

Moarium of dichotomizing branches; distance between divergence of new branches on same edge varies from 5 to 12 mm.

Branches straight to curved, flat; width from 2 to 3 mm.; average thickness 0.75 mm. Occasionally margins of branches extended into sharp spur-like projections by termination of several ranges of apertures and ridges.

Apertures open directly; elliptical in outline; those near margin slightly larger and more circular than those in central portion of branch; length from 0.17 to 0.20 mm.; average width 0.14 mm.; seven to 10 occur in 3 mm. longi-

tudinally; separated longitudinally by less than length of aperture, being closer together during formation of new ranges; separated transversely by less than width of aperture. Peristomes prominent, narrow. Lunaria inconspicuous. Apertures in one range become alternately separated transversely, thus producing two new ranges. Seven to 10 ranges occur transversely.

Ridges between ranges low, broad; new ridges arise between new ranges; commonly terminate in spur-like projections at branch margins; average distance between ridges 0.27 mm.

Margin nonperiferous, smooth, narrow; angular in cross section; strongest development in angle of bifurcation.

Remarks: Cystodictya apiculata, is distinguished from C. alternata, sp. nov. by presence of straighter, relatively narrower branches, by sharper spur-like projections on margins, and by lower peristomes; from C. gracilia, sp. nov. by more frequent branching.

Locations and Horizons.-----Loc. 29, top zone; Loc. 31, Bell shale.

Cystodictya lyriflora, sp. nov.

Plate IV, Figs. 5, 6, 6'.

Coarium of dichotomizing branches; distance between bifurcations varies from 5 to 15 mm.

Branches flat; curved after bifurcation, then straighten

and become approximately parallel; width from 2 to 3 mm.; average thickness 0.85 mm.

Apertures open directly; circular to elliptical in outline; those near margin larger and more circular than those in central portion of branch; from 0.14 to 0.25 mm. in length; width from 0.14 to 0.19 mm.; seven occur in 3 mm. longitudinally; separated longitudinally by more than length of aperture; separated transversely by less than width of aperture. Peristomes narrow, prominent. Lunaria projected upward from peristomes. Apertures in one range become alternately separated transversely, thus producing two new ranges. Seven to 11 ranges occur transversely.

Ridges between ranges straight to sinuous, prominent, sharply rounded; occupy the entire space between ranges; arise between new ranges of apertures and are sinuous when first formed; do not terminate at margins but become obsolete between the first and second marginal ranges; distance between ridges from 0.20 to 0.28 mm.

Margin nonporiferous, rounded, narrow; edges of branch smooth or wavy or sub-serrate.

Remarks: Cystodictya lyrifica, sp. nov. is distinguished from C. obliqua, sp. nov. by the forked method of branching, by the termination of ridges before they reach nonporiferous margin, and by absence of oblique ranges of apertures: from C. gracilia, sp. nov. by curved instead of nearly straight

branches, by stronger peristomes and lunaria.

Localities and Horizons.-----Loc. 9, zone 1; Loc. 17, shale zone; Loc. 23, zones 6 and top; Loc. 49.

Genus Taeniopora Nicholson

For generic description see page 16.

Taeniopora marginata, sp. nov.

Plate IV, Figs. 7, 7'.

Zoarium of dichotomizing branches; distance between bifurcations unknown.

Branches almost straight; average width 2.5 mm.; median portion occupied by prominent keel. Keels on new branches originate just before bifurcation, and represent one of enlarged ridges which occur between ranges of apertures; keel of older branch gradually diminishes in size after development of new branches.

Apertures open directly near keel, obliquely near margins; elliptical in outline; varies from 0.14 to 0.20 mm.; width from 0.07 to 0.14 mm.; marginal ones larger; ten occur in 3 mm. longitudinally; three to six ranges occur transversely on each side of keel; spaces between ranges near center sometimes occupied by slightly elevated ridges. Transverse series of apertures separated by shallow troughs or grooves, most conspicuous between bifurcations; extending from margin inward, and make approximately an angle of 80 degrees with median keel. Peristomes most conspicuous on

marginal ranges. Lunaria unknown.

Margins nonporiferous, broad, flat; thin in cross-section; outer edges sharply rounded.

Remarks: Taeniopora marginata is distinguished from T. altidorsata, sp. nov. by much higher keel; from T. exigua Nicholson (not Hall) by having a broad nonporiferous margin; from T. exigua Nicholson described and figured by Hall¹⁰, by method of branching and mode of origin and termination of median keel.

Locality and Horizon.-----Loc. 9, zone 1.

Taeniopora altidorsata, sp. nov.

Plate IV, Fig. 8, 8'.

Zoarium unknown.

Branches with low median keel; rhombic in cross section; width varies from 1 to 2.4 mm.; distance between points of branching, and type of branching unknown.

Apertures small, sub-circular; diameter from 0.12 to 0.20 mm.; small near central portion of branch, becoming larger near margins; situated on elevated transverse ridges; arranged also in longitudinal ranges; space between longitudinal ranges often occupied by low ridges; sometimes by depressions; deep grooves occur between transverse rows, terminate at nonporiferous margin; nine apertures occur in

10. J. Hall and G. Simpson, Paleontology of New York, Vol. VI, p. 263, Pl. LXII, Figs. 15-26 (1837).

3 mm. longitudinally; twelve in 3 mm. transversely; three to four ranges of apertures occur on each side of median keel. Peristomes prominent; ring-like; on marginal apertures often higher on side opposite from margin. Lunaria unknown.

Margin nonporiferous, broad, thin; sharply rounded on outer edges.

Remarks: Taenionera altidorata is distinguished from T. marginata, sp. nov. by having a much lower median keel.

Locality and Horizon.-----Loc. 14, middle zone.

Genus Scalaripora Hall

For generic description see page 17.

Scalaripora serrata, sp. nov.

Plate V, Figs. 1, 2, 3, 3'.

Zoarium unknown.

Branches triangular in cross section; straight to slightly curved; distance between points of branching unknown; width of face approximately 3 mm.; all faces sub-equal in width; crossed by moderately deep grooves at right angles to main axis of branch, and by prominent, straight ridges, separated from 1.3 to 1.4 mm. Ridges on sides of branches alternate in position, producing serrated edges on branches.

Apertures circular in outline; average diameter 0.27 mm.; irregularly arranged; situated in grooves and extending to top of ridges and to edges of branches. Peristomes and lunaria

absent. Mouths of zoecia terminate at level of branch surface.

Margins on branches absent.

Remarks: This species differs from others by Scalaripora found in this fauna by its small size and serrate margins; from S. separata Ulrich by presence of larger apertures and serrate margins; from S. scalariformis Hall by less concave faces and larger and more numerous apertures; from S. subconcava Hall by wider faces, less numerous ridges and larger apertures.

Location and Horizon.-----Loc. 35.

Scalaripora semiannulata, sp. nov.

Plate V, Figs. 4, 4'.

Zoarium unknown.

Branches triangular in cross section; straight to slightly curved; distance between points of branching unknown; width of narrower face 5 mm.; of broader face 7 mm.; faces of branch concave; crossed by prominent straight or curved ridges, commonly at right angles to axis of branch; distance between ridges unknown.

Apertures circular in outline; open directly or slightly obliquely; average diameter 0.20 mm.; arranged in irregular intersecting linear series. Peristomes low, slightly elevated toward distal end of branch; on some apertures peristomes incomplete toward the proximal end, and relatively much ele-

vated toward distal end.

Margin nonporiferous, extending centrally as shallow grooves or maculae, thus defining near margins raised celluliferous areas or monticules.

Remarks: This species is distinguished from other species of Scalariopora found in this fauna by wider branches, and incomplete peristomes on some of the apertures.

Locality and Horizon.-----Loc. 9, zone 1.

Scalariopora superconcava, sp. nov.

Plate V, Figs. 5, 5', 6.

Zoarium unknown.

Branches triangular in cross section; straight to slightly curved; distance between points of branching unknown; width of narrower face approximately 4 mm.; of broader face approximately 6 mm.; faces deeply concave; crossed by straight or slightly curved, conspicuous ridges. Ridges from 4 to 6 mm. apart; almost at right angles to axis of branch; coincide in position on the three sides so that thinnest portion of branch occurs almost midway between ridges.

Apertures open directly; circular in outline; average diameter 0.20 mm.; spaces between apertures usually less than diameter of aperture; irregularly arranged. Peristomes and lunaria absent, possibly due to worn condition of specimens.

Margin nonporiferous; projected toward center of faces

midway between ridges as maculae; otherwise narrow; crests of ridges also nonporiferous.

Remarks: The absence of peristomes, position of maculae midway between ridges and relative large size of branches distinguish this species from others of Scalaripora found in this fauna.

Locality and Horizon.-----Loc. 9, zone 1.

Scalaripora sinuata, sp. nov.

Plate VI, Figs. 1, 2, 2'.

Zoarium unknown.

Branches triangular in cross section; straight to slightly curved; edges sinuous; distance between points of branching unknown; width of branches approximately 3 mm.; faces of branch sub-equal in width; flat or concave; crossed by straight to slightly curved prominent ridges which are at right angles to axis of branch. Ridges arranged irregularly; distance between ridges unknown.

Apertures circular in outline; open directly; diameter 0.29 mm.; arranged in a linear intersecting series; eleven occur in 3 mm. along any series; spaces between apertures usually less than diameter of aperture, occasionally occupied by shallow circular pits. Peristomes low, outer side gently sloping away from aperture. Lunaria unknown.

Margin nonporiferous, at intervals from 2 to 2.5 mm. extends a short distance inward from margin as maculae, thus

grouping marginal apertures into clusters of monticules; apertures absent on crests of transverse ridges.

Remarks: The size of the branch and apertures, the irregular arrangement of ridges, and uneven width of non-poriferous margin distinguish this species from others of Scalaripora found in this fauna.

Locality and Horizon.-----loc. 9, zone 1.

Genus Phractopora Hall

For generic description see page 17.

Phractopora irregularata, sp. nov.

Plate VI, Figs. 3, 4, 4'.

Zoarium an elongate, irregular expansion; unequally triangular in cross section; traversed at irregular intervals by prominent transverse ridges; width of largest face from 4 to 9 mm. A broad expansion occurs at distal end of zoaria.

Apertures open directly; circular in outline; average diameter 0.20 mm.; arranged in irregular, diagonally intersecting linear series; separated by approximately diameter of aperture. Spaces between apertures slightly depressed, occasionally pitted. Peristomes low and broad. Lunaria unknown, probably absent.

Margin nonporiferous, narrow; directed inward toward center of face at intervals from 3 to 10 mm., thus producing maculae; maculae occasionally occur in central portion of ex-

pansions. Crests of ridges nonporiferous.

Remarks: Phraetopora irregulata, sp. nov. differs from other species of Phraetopora in the Traverse fauna in its more regular and thinner zoaria, and by its broad, flat palmate expansion.

Locality and Horizon.-----Loc. 47.

Phraetopora involventia, sp. nov.

Plate VI, Figs. 5, 6.

Plate VII, Figs. 1, 2, 3.

Zoarium an irregular incrusting expansion, which gives rise to free irregular branches. Surface crossed by straight or curved, occasionally bifurcating ridges; greatest width of expansions 10 mm., usually narrower; cups formed by ridges sometimes shallow and flat, sometimes deep and sharply curved.

Type of, and distance between branching unknown.

Apertures open directly; circular in outline; average diameter 0.22 mm.; usually separated by less than, but occasionally by spaces more than diameter of apertures; arranged in irregular linear series; not surrounded by peristomes; interspaces sometimes slightly higher than apertures.

Margin nonporiferous; occasionally directed inward toward center of cup as shallow troughs or maculae. Crests of ridges nonporiferous.

Remarks: The broken segments of the specimens which show

an incrusting habit are perforated parallel to their long axis by a small tubular cavity. The zooecia surrounding this cavity are unilaminar, becoming bifoliate only near the ridges. These segments have broken triangular edges which probably represent the bases of free branches. The exact zoarial pattern cannot be ascertained from the fragmentary specimens.

Phractopora involventia, sp. nov. is the only species of Phractopora found in the Michigan Traverse that is incrusting.

Locality and Horizon.-----Loc. 9, zone 1.

Phractopora lacunosa, sp. nov.

Plate VII, Figs. 4, 5.

Zoarium an irregular expansion; roughly triangular in cross-section; crossed by prominent curved ridges; approximately parallel to each other; from 2.5 to 6 mm. apart. Spaces between ridges celluliferous, concave; cup-like. Ridges sometimes bifurcate and anastomose to produce small, irregularly distributed celluliferous areas.

Type of branching unknown.

Apertures open directly; circular in outline; average diameter 0.20 mm.; irregularly arranged; approximately one diameter apart. Peristomes low, thin. Lunaria unknown.

Margin of expansion and crests of ridges nonporiferous; occasionally marginal nonporiferous area projected toward center of cups to form maculae.

Remarks: Phractopora lacunosa is distinguished from other species of Phractopora found in the Traverse by the type of curved ridges and by its irregularly triangular profile in cross section.

Localities and Horizons.-----Loc. 47; Loc. 49.

Phractopora alveata, sp. nov.

Plate VII, Figs. 6, 7, 8.

Zoarium an irregular expansion; traversed by two sets of ridges. One set prominent, curved, approximately parallel; 2 to 5 mm. apart; crossed transversely by a second set of lower ridges, approximately 10 mm. apart. The depressed area between two sets of ridges more elongate on the thinner portions of zoaria than on thicker and more massive portions.

Branches unknown; ends of expansion that have been broken off are roughly triangular in outline.

Apertures open directly; circular in outline; average diameter 0.20 mm. approximately one diameter apart; irregularly arranged. Peristomes low, thin. Lunaria unknown.

Margin and crests of ridges nonporiferous. Maculae rare, occasionally present as elongate shallow grooves near center of cups.

Remarks: This species is readily distinguished from others of Phractopora found in this fauna by the shape and location of the cups and their bounding ridges.

Locality and Horizon.-----Loc. 47.

Genus Ptilodictya Lonsdale

For generic description see page 19.

Ptilodictya subfalcata, sp. nov.

Plate VIII, Figs. 1, 2, 3.

Scarium unknown. Frond falciform; cylindrical at proximal end; rapidly expanding and flattening toward distal end; approximately 9 mm. in width and 1 mm. in thickness at a distance 10 mm. from base; one edge of frond almost straight; opposite strongly curved; basal portion pointed and apparently articulated in a socket of basal expansion or of another segment.

Apertures in distal part of frond rhomboidal to polygonal to sub-circular in outline; arranged in obliquely intersecting curved linear series; average diameter 0.20 mm.; 15 occur in 3 mm. along any series. In proximal region apertures elliptical in outline; average length 0.17 mm.; average width 0.8 mm.; separated longitudinally by less than length of aperture; separated transversely by more than, or less than width of aperture. Apertures gradually increase in size and change in shape from proximal to distal region. Ridges between apertures occupied by one or two rows of slightly elevated nodes; nodes stronger in distal than in proximal portion.

Edges of frond round to subangular; occupied by apertures.

Remarks: This is the only species of Ptilodictya found

in the Traversa fauna.

Localities and Horizons.-----Loc. 29, top zone; Loc. 31, Bell shale.

Genus Intrapora Hall

For generic description see page 20.

Intrapora acanthopora, sp. nov.

Plate VIII, Figs. 4, 5, 5', 6.

Zoarium of dichotomizing branches; distance between bifurcations unknown.

Branches flat; sometimes slightly twisted; thickness from 0.5 to 0.7 mm.; width from 2.4 to 4 mm.; secondary branches same width as primary ones.

Apertures open directly; oval in outline; average length 0.23 mm.; average width 0.14 mm.; seven occur in 3 mm. longitudinally; arranged in poorly defined intersecting linear series; generally isolated by angular mesopores which are elongate parallel to margin of branch. Peristomes low, thin; bearing one or more small nodes, similar in structure to acanthopores. Lunaria unknown.

Margin nonporiferous; sharp in cross-section; occupied by mesopores but not by apertures.

Remarks: This species differs from I. crebripora, sp. nov. by having a ramose zoaria.

Locality and Horizon.-----Loc. 31, Bell shale.

Intrapora crebripora, sp. nov.

Plate VIII, Figs. 6, 7.

Zoarium a spreading expansion, average thickness
0.55 mm.

Branching unknown.

Apertures sub-circular to sub-angular in outline; open directly; average diameter 0.20 mm.; arranged in intersecting linear series; walls in contact occasionally, usually separated by one to three angular or sub-oval mesopores. Walls of apertures and mesopores thick, granular; upper edge uneven in height, sharply carinated in places. Acanthopores wanting.

Margin unknown, due to broken condition of expansion.

Remarks: This species is easily distinguished from Intrapora acanthopora, sp. nov. by immensely thicker walls of apertures and mesopores, by more massive zoeria, and by absence of elongate mesopores.

Locality and Horizon.-----Loc. 49.

LIST OF LOCATIONS

Locations

8. Gravel Point, Lake Michigan shore one and one-half miles west of Charlevoix, secs. 28 and 29, T. 34 N., R. 8 W.
9. Quarry of the Charlevoix Rock Products Co., NW¹ Sec. 28, T. 34 N., R. 8 W.
10. Charlevoix City quarry, now used as a dump ground. Immediately south of the center of E-W. road, on the N. line of Sec. 33, T. 34 N., R. 8 W.
14. Quarry of the Petoskey Portland Cement Co.
17. Antrim Lime Co. quarry, SE. $\frac{1}{4}$ Sec. 1, T. 34 N., R. 8 W.
29. Abandoned quarry on shore of Black Lake, near the State Park
31. Quarry of the Michigan Limestone and Chemical Co. at Calcite, near Rogers City, Michigan
33. Exposure at Partridge Point
38. Quarry at Rockport, Michigan
46. Shale bank on the south side of Thunder Bay River one-half mile east of the Three (Four) Mile Dam
47. Shale bank on the south side of the Thunder Bay River at the Seven Mile Dam
49. Abandoned quarry of a cement company near El Cajon Beach

STRATIGRAPHIC CONCLUSIONS

The strata composing the stages of the Michigan Traverse Group cannot be correlated with deposits in other provinces from evidence furnished by the Cystodictyonacea; nor can the strata on the east side be correlated with those on the west side of the Southern Peninsula of Michigan on the evidence furnished by these Bryozoa. Absence of correlation in the latter case can be explained by several different factors: by insufficient numbers of Bryozoa; by the long vertical ranges of several of the species studied; or by the fact that many species which are common on one side of the peninsula are not known from the opposite side.

The cystodictyonacid bryozoa collected from the Traverse Group constitute a new fauna which cannot be compared with similar bryozoa faunas from other regions. The bryozoa of the Traverse are allied more closely to the Hamilton forms of New York than to any other known fauna. The similarities of the Hamilton and Traverse bryozoa are of generic value, there being no species in common to these two groups of rocks.

The absence of species of the Traverse fauna in regions outside of Michigan other than possibly Ohio, seem to sub-

stantiate Pohl's¹¹ suggestion that:

"The Traverse faunas have no close relatives in strata having known southern connections. The Traverse stages are furthermore paleontologically isolated from even the Middle Devonian formations which were deposited in the same general region, which in the case of the Hamilton beds overlap the former. Precise information bearing on Middle Devonian remains found in the Arctic and the northern Canadian Provinces is lacking and specific lists are far from complete. The generic types are, however, sufficiently well known to indicate the connection of the Traverse forms with a northern origin."

Cystodictya attenuata, sp. nov., C. obliqua, sp. nov.,

and C. lyrifica, sp. nov., occur in the "blue shale" of Locations 9, 14, 17 and zones 6 and "top" of Location 49. However, none of these beds are correlated upon evidence offered by these species. Rather, the writer believes, that these were recurrent species, which invaded the Traverse Basin whenever conditions favorable for their existence prevailed. Deiss¹² noted this phenomena in his study of the Fenestellidae of the Traverse Group. This conclusion is strengthened by the fact that Cystodictya alternata, sp. nov., C. apiculata, sp. nov., and Ptilodictya subfalcata, sp. nov. do have long vertical ranges, occurring in the Bell shale at

11. E. B. Pohl, The Middle Devonian Traverse Group of Rocks in Michigan, Proceedings United States National Museum., Vol. 76, Art. 17, pp. 33-34, 1929.

12. C. F. Deiss, Description and Stratigraphic Correlation of the Fenestellidae from the Devonian of Michigan. Contributions from Museum of Paleontology, University of Michigan, Vol. III, No. 13, p. 270, 1932.

Locations 31 and 33 and at the top of Location 29.

Not many species of Cystodictyonacea were collected from the Bell shale in the two localities in which this shale occurs, a fact which probably explains the absence of the same species in these two localities.

The evidence furnished by the study of these Bryozoa when used with that afforded by other fossils from the Traverse Group may aid in solving the ultimate problems of stratigraphy of these rocks.

BIBLIOGRAPHY

Bassler, R. S. A Study of the James Types of Ordovician and Silurian Bryozoa. United States National Museum, Proceedings, Vol. 30, pp. 1-66, Washington, 1906.

Redescribes the type specimens originally described by James, contains no Devonian forms.

-----The Bryozoa Fauna of the Rochester Shale.
Bulletin, United States Geological Survey, No. 292,
136 pp. Washington, 1906.

Describes and discusses a number of Silurian Bryozoa; but no Devonian forms.

-----The Early Paleozoic Bryozoa of the Baltic Provinces. Bulletin, United States National Museum, No. 77, 362 pp. Washington, 1911.

Contains descriptions and plates of Trepostomatous Bryozoa, but no members of the Cystodictyonacea.

Catalog and Table of Contents of the Publications of The Michigan Geological and Biological Survey with a List of Publications of the United States Geological Survey Relating to Michigan. 1838-1920. B. A. Smith, State Geologist, Lansing, 1922.

A very helpful catalog of the geologic literature of Michigan.

Condra, Geo. E. New Bryozoa from the Coal Measures of Nebraska. American Geologist, Vol. 30, pp. 337-359. Minneapolis, 1902.

Contains original descriptions of two species of Cystodictya. There are no Devonian forms mentioned.

-----The Coal Measure Bryozoa of Nebraska.

Nebraska Geological Survey, Vol. 2, pp. 11-163. 1903.

Contains descriptions of three species of Cystodictya. There are no Devonian species mentioned.

Deiss, C. F. A Description and Stratigraphic Correlation of the Fenestellidae from the Devonian of Michigan. Contributions from the Museum of Paleontology, University of Michigan, Vol. III, no. 13, pp. 233-275, Ann Arbor, 1932.

Proposes tentative correlations of zones within the Traverse Group and contains descriptions and figures of the Fenestellid Bryozoa from these rocks.

Grabau, A. W. Geology and Paleontology of Eighteen Mile Creek and the Lake Shore Sections of Erie County, New York. Part II. Paleontology. Bulletin of the Buffalo Society of Natural Sciences, Vol. VI, pp. 13-99, Buffalo, 1899.

Primarily a handbook for amateurs, contains a number of shortened descriptions of Hall and Simpson's Bryozoa, a glossary, bibliography and notes on methods of collecting and preparing fossils for study.

Hall, James, and Simpson, George. Corals and Bryozoa from the Lower Helderberg, Upper Helderberg and Hamilton Groups. Geological Survey of the State of New York. Paleontology, Vol. VI, 298 pp. Albany, 1887.

Contains many descriptions and figures of Devonian Bryozoa. Unfortunately the descriptions in many instances are vague, the figures diagrammatic, and offer little assistance in the identification of species.

Hall, James. Continuation of descriptions of Bryozoa not printed in Volume VI, Paleontology of New York, for the Report of the State Geologist. Tenth Annual Report of the State Geologist (of New York) for the year 1890, Albany, 1891, pp. 37-57. This report also forms part of the Forty-Fourth Annual Report of the New York State Museum, Albany, 1891, pp. 67-87.

Contains discussions of the following forms:

Cystodictya (Stictopora) linata, C. (Stictopora) subrigida, C? (Stictopora) recta, C. (Stictopora) bifurcata, Prismopora dilata, P. lata, Taeniopora (Stictopora) subcarinata, all of Hall, and Taeniopora (Stictopora) recubans Hall and Simpson. There are no illustrations.

Newcomb, H. B. Middle Devonian Unconformity in Michigan. Bulletin of the Geological Society of America, Vol. 41, pp. 725-738. New York, 1930.

Contains correlations of Devonian strata in Michigan and describes an unconformity below Hamilton beds in western and southwestern Michigan.

Nicholson, H. A. Descriptions of New Fossils from the Devonian Formation of Canada. The Geological Magazine, or, Monthly Journal of Geology. Edited by H. W. Woodward. New Series, Decade II. Vol. I. London, 1874.

Contains original descriptions of Taenionora exigua, T. penneformis, and Cystodictya (Ptilodictya) meeki. The descriptions are accurate but the plates cannot be used in identification of the species.

Nickles, J. M. and Bassler, R. S. A Synopsis of American Fossil Bryozoa including Bibliography and Synonymy. Bulletin United States Geological Survey, No. 173. 663 pp., Washington, 1900.

This indispensable bulletin contains a complete and accurate bibliography of material on Bryozoa up to date of its publication; lists of invalid genera and species; and notes on classification, collection and study.

Parks, W. A. and Dyer, W. S. Stratigraphy and Paleontology of Toronto and Vicinity, Part II, the Molluscoidea. Ontario Department of Mines, 13th Annual Report, Vol. XXX, Pt. VII, Toronto, 1921.

Only one Cryptostomatous Bryozoa is described in

this paper. All of the forms mentioned are Ordovician and Silurian in age.

Pohl, E. R. The Middle Devonian Traverse Group of Rocks in Michigan, A Summary of Existing Knowledge. Smithsonian Institution, United States National Museum, No. 2811, from Proceedings of the United States National Museum, Vol. 75, Art. 14, pp. 1-34, Washington, 1922.

This paper offers the most probable correlation of the Traverse Group. Descriptions of the various stratigraphic units making up the Traverse Group are given. Faunal lists are included.

Prout, H. A. Descriptions of Polyzoa from the Paleozoic Rocks. Geological Survey of Illinois, Vol. II, Paleontology, pp. 412-423, Springfield, 1866.

Contains original descriptions of four species of Glyptopora from the Mississippian rocks of Illinois.

Simpson, George B. A Handbook of the Genera of the North American Paleozoic Bryozoa with an Introduction upon the Structure of Living Species. Fourteenth Annual Report of the State Geologist (of New York) for the year 1894, Albany, 1895 (1897), pp. 407-608. The report of the State Geologist also forms part of the Forty-eighth Annual Report of the New York State Museum, Albany, 1895 (1897), with the same paging.

Most of the work in this volume is inaccurate. The

descriptions and classifications of families and genera are both inaccurate and vague. However, the morphological discussion of the polypide is excellent.

Ulrich, E. O. Paleozoic Bryozoa. Geological Survey of Illinois, Vol. 8; Geology and Paleontology, Text, Part II, Paleontology of Illinois, Section 6, pp. 283-673. Plates in separate volume. Springfield, 1890.

The most creative and comprehensive treatise on the principles of classification, identification and anatomy of American Paleozoic Bryozoa. Contains descriptions and figures of two species of Scalarinora from the Traverse Group of Michigan.

Heller, Stuart. The Paleozoic Faunas. Geological Survey of New Jersey, Paleontology, Vol. III, 462 pp., Trenton, 1903.

Describes two species of *Ptilodictya* and one of *Escharopora*, there are no Devonian forms mentioned.

Mittel, K. von. Text-Book of Paleontology. Edited by C. R. Eastman, Vol. I, Second Ed., pp. 339-347., London, 1913.

Contains shortened descriptions of the common genera of Cryptostomata.

EXPLANATION OF PLATE I

- page
- Fig. 1. Cystodictya attenuata, sp. nov..... 21
- Portion of branch showing prominent, thin ridges; size and disposition of apertures; and narrow, sinuous, nonporiferous margin. Magnified 6 diameters.
- Location 9, zone 1.
- Fig. 1'. Cystodictya attenuata, sp. nov.
- Cross section of specimen shown in fig. 1, showing profile of branch. Magnified 6 diameters.
- Location 9, zone 1.
- Fig. 2. Cystodictya attenuata, sp. nov.
- Portion of branch immediately below a point of bifurcation, showing mode of formation of new ridges and ranges; and the distant spacing of apertures. Magnified 6 diameters.
- Location 9, zone 1.
- Fig. 3. Cystodictya obliqua, sp. nov..... 23
- Portion of branch showing strong, oblique ridges; well developed peristomes; and relatively narrow nonporiferous margin. Magnified 6 diameters.
- Location 9, zone 1.

Fig. 3'. Cystodictya obliqua, sp. nov.....

Cross section of specimen shown in fig. 3, showing profile of branch. Magnified 6 diameters.

Location 9, zone 1.

Fig. 4. Cystodictya obliqua, sp. nov.

Portion of broad branch, showing delicate ridges; peristomes; and depressed nodose non-poriferous margin. Magnified 6 diameters.

Location 9, zone 1.

Fig. 5. Cystodictya obliqua, sp. nov.

Portion of branch above a bifurcation, showing low ridges and smooth margins. Magnified 6 diameters.

Location 9, zone 1.

Fig. 6. Cystodictya variopora, sp. nov..... 24

Portion of frond showing alternate method of branching. Magnified 2 diameters.

Location 29, top zone.

Fig. 7. Cystodictya variopora, sp. nov.

Small portion of specimen shown in fig. 6, showing large apertures near base of secondary branches, small ones in central portion of branch; and sub-angular edge of nonporiferous margin. Magnified 6 diameters.

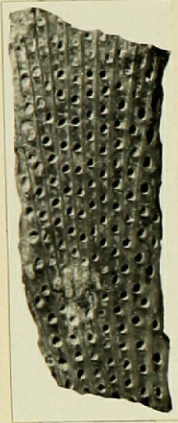
Location 29, top zone.

Fig. 7'. Cystodictya variopora, sp. nov..... page
24

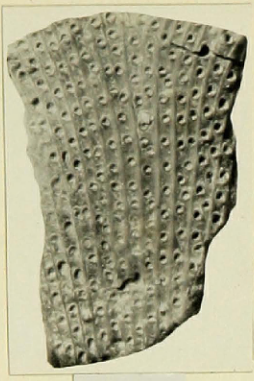
Cross section of upper part of specimen
shown in fig. 7, showing relative breadth
and depth of branches. Magnified 6 diameters.

Location 29, top zone.

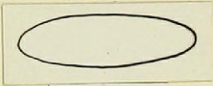
PLATE I



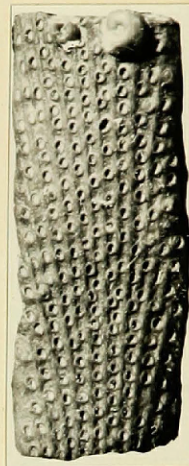
1



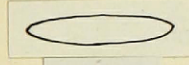
2



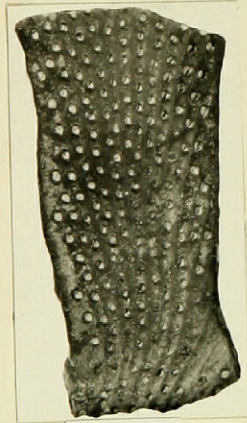
3'



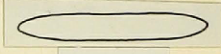
3



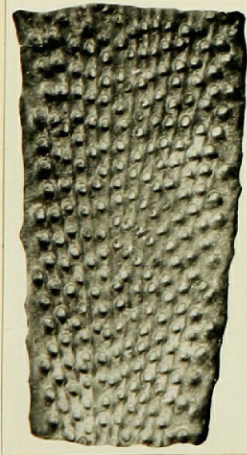
1'



5



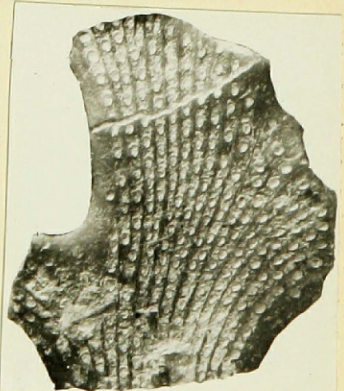
7'



4



6



7

EXPLANATION OF PLATE II

- page
- Fig. 1. Cystodictya alternata, sp. nov..... 25
A small fragment showing alternate branching; strong peristomes and lunaria; and rounded nonporiferous margins. Magnified 6 diameters.
Location 29, top zone.
- Fig. 1'. Cystodictya alternata, sp. nov.
Cross section of specimen shown in fig. 1, showing profile of branch. Magnified 6 diameters.
Location 29, top zone.
- Fig. 2. Cystodictya alternata, sp. nov.
Portion of a frond showing distance between branching. Magnified 2 diameters.
Location 29, top zone.
- Fig. 3. Cystodictya alternata, sp. nov.
Portion of a frond showing more closely spaced branches than in fig. 2. Magnified 2 diameters.
Location 29, top zone.
- Fig. 4. Cystodictya alternata, sp. nov.
Portion of branch showing sub-circular

apertures and the mode of formation of
new ranges and ridges. Magnified 6 diameters.

Location 29, top zone.

Fig. 5. Cystodictya minuta, sp. nov..... 26

Portion of a zoarium showing base; and
method of branching. Magnified 6 diameters.

Location 29, top zone.

Fig. 5'. Cystodictya minuta, sp. nov.

Cross section of specimen shown in
fig. 5, showing profile. Magnified 6
diameters.

Location 29, top zone.

Fig. 6. Cystodictya minuta, sp. nov.

Portion of specimen shown in fig. 5, show-
ing elliptical, minute, apertures; low peri-
stomes; and moderate ridges. Magnified 14
diameters.

Location 29, top zone.

Fig. 7. Cystodictya ramifera, sp. nov..... 28

Portion of specimen shown in fig. 9,
showing small lunaria; low ridges; and
broad, rounded nonporiferous margin. Mag-
nified 14 diameters.

Location 49, top zone.

Fig. 8. Cystodictya ramifera, sp. nov.....

Portion of specimen shown in fig. 9,
showing elliptical apertures in central por-
tion of branches and sub-circular ones near
junction of secondary branches. Magnified
6 diameters.

Location 49, zone 1.

Fig. 8'. Cystodictya ramifera, sp. nov.

Cross section of left branch of specimen
shown in fig. 8, showing rounded edges of
branch. Magnified 6 diameters.

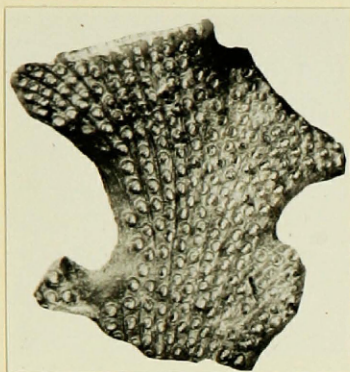
Location 49, zone 1.

Fig. 9. Cystodictya ramifera, sp. nov.

Portion of zoarium showing method of for-
mation of primary and secondary branches.
Magnified 2 diameters.

Location 49, zone 1.

PLATE II



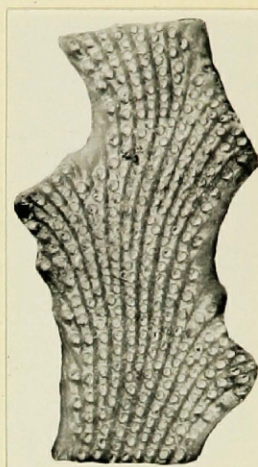
1



2



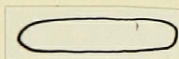
3



4



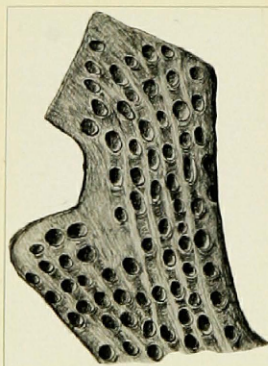
5



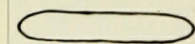
1'



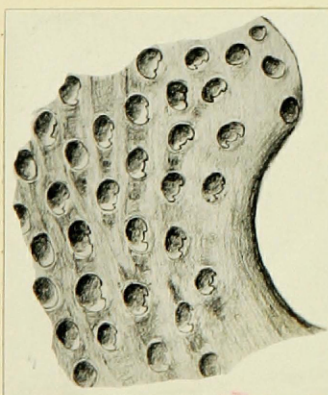
5'



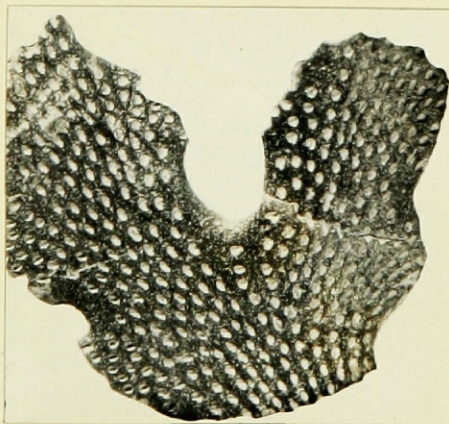
6



5''



7



8



9

EXPLANATION OF PLATE III

- | | <u>page</u> |
|--|-------------|
| Fig. 1. <u>Cystodictya bifidiplicata</u> , sp. nov..... | 29 |
| Portion of branch showing bifurcation;
coarse bifurcating ridges; broad, rounded
nonporiferous margins with several large
rounded projections which bear apertures.
Magnified 6 diameters. | |
| Location 29, zone 6. | |
| Fig. 1'. <u>Cystodictya bifidiplicata</u> , sp. nov. | |
| Cross section of middle part of speci-
men shown in fig. 1, showing profile. Mag-
nified 6 diameters. | |
| Location 29, zone 6. | |
| Fig. 2. <u>Cystodictya bifidiplicata</u> , sp. nov. | |
| Portion of zoarium showing type of
branches and distance between bifurcation
of new branches. Magnified 2 diameters. | |
| Location 29, zone 6. | |
| Fig. 3. <u>Cystodictya diversa</u> , sp. nov..... | 30 |
| Portion of zoarium showing branches
expanding distally. Magnified 2 diameters. | |
| Location 49, zone 1. | |

Fig. 4. Cystodictya diversa, sp. nov.....

Portion of specimen shown in fig. 3, showing weak ridges; low peristomes; and broad nonporiferous margin. Magnified 14 diameters.

Location 49, zone 1.

Fig. 4'. Cystodictya diversa, sp. nov.

Enlarged cross section of one branch of specimen shown in fig. 3, showing profile. Magnified 6 diameters.

Location 49, zone 1.

Fig. 5. Cystodictya gracilia, sp. nov..... 32

Portion of specimen shown in fig. 6, showing low, rounded ridges; and occasional apertures near edge of branch. Magnified 14 diameters.

Location 8, zone 1.

Fig. 5'. Cystodictya gracilia, sp. nov.

Cross section of specimen shown in fig. 5, showing sharp edges. Magnified 6 diameters.

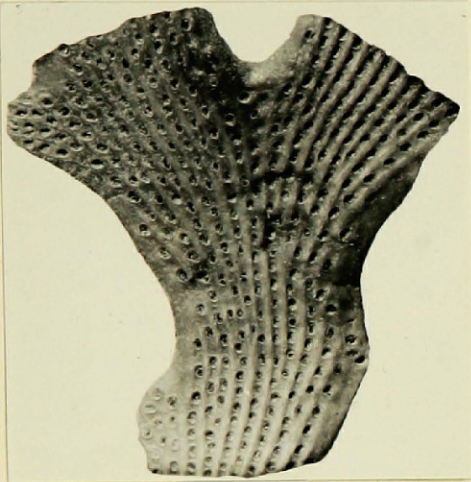
Location 8, zone 1.

Fig. 6. Cystodictya gracilia, sp. nov.

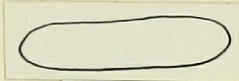
Portion of branch showing position of nearly straight far-spaced branches. Magnified 2 diameters.

Location 8, zone 1.

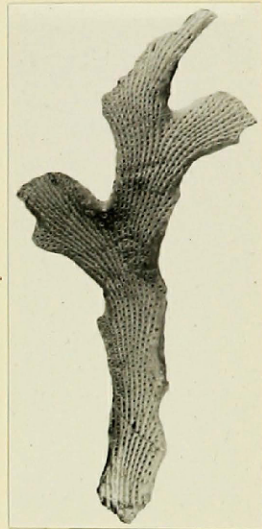
PLATE III



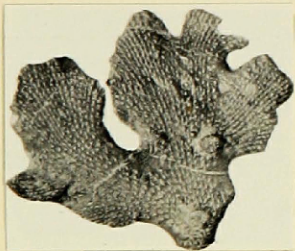
1



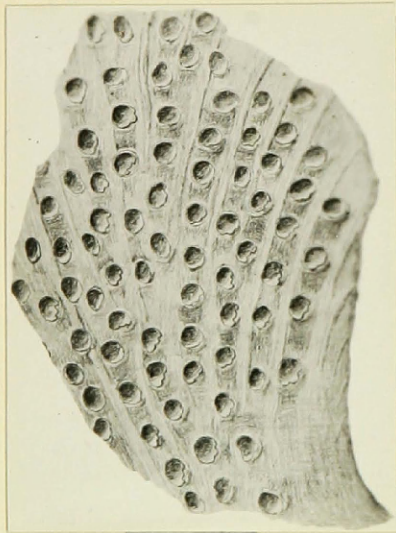
1'



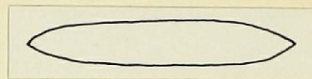
2



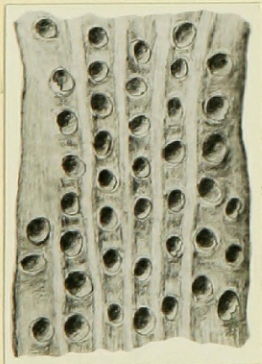
3



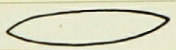
4



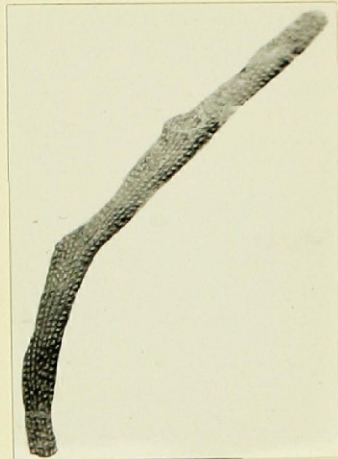
4'



5



5'



6

EXPLANATION OF PLATE IV

- | | <u>page</u> |
|---|-------------|
| Fig. 1. <u>Cystodictya megalopora</u> , sp. nov..... | 33 |
| Portion of zoarium showing method of branching. Magnified 2 diameters. | |
| Location 49. | |
| Fig. 2. <u>Cystodictya megalopora</u> , sp. nov. | |
| Portion of specimen shown in fig. 1, showing large oocidia. Magnified 6 diameters. | |
| Location 49. | |
| Fig. 2'. <u>Cystodictya megalopora</u> , sp. nov. | |
| Cross section of specimen shown in fig. 2, showing profile. Magnified 6 diameters. | |
| Location 49. | |
| Fig. 3. <u>Cystodictya apiculata</u> , sp. nov..... | 34 |
| Portion of frond showing alternate branching; and spur-like projections from edge of branch. Magnified 6 diameters. | |
| Location 29, top zone. | |
| Fig. 4. <u>Cystodictya apiculata</u> , sp. nov. | |
| Portion of branch showing low ridges and delicate peristomes. Magnified 6 | |

diameters.

Location 29, top zone.

Fig. 4'. Cystodictya apiculata, sp. nov..... 34

Cross section of specimen shown in
fig. 4, showing profile. Magnified 6
diameters.

Location 29, top zone.

Fig. 5. Cystodictya lyrifica, sp. nov..... 35

Portion of zoarium showing forked type
of bifurcation. Magnified 2 diameters.

Location 17, shale zone.

Fig. 6. Cystodictya lyrifica, sp. nov.

One branch of specimen shown in fig. 5,
showing type of ridges; and peristomes with
high lunaria. Magnified 6 diameters.

Location 17, shale zone.

Fig. 6'. Cystodictya lyrifica, sp. nov.

Cross section of specimen shown in
fig. 6, showing profile. Magnified 6
diameters.

Location 17, shale zone.

Fig. 7. Taeniopora marginata, sp. nov..... 37

Portion of zoarium showing sharp, strong
keels; wide nonporiferous margin; and oblique
grooves separating transverse ranges of aper-

tures. Magnified 6 diameters.

Location 9, zone 1.

Fig. 7'. Taeniopora marginata, sp. nov..... 37

Cross section of specimen shown in
fig. 7, showing thin margins and strong sharp
keels. Magnified 6 diameters.

Location 9, zone 1.

Fig. 8. Taeniopora altidorsata, sp. nov..... 38

Portion of branch showing type of aper-
tures, and low keel. Magnified 10 diameters.

Location 14, middle zone.

Fig. 8'. Taeniopora altidorsata, sp. nov.

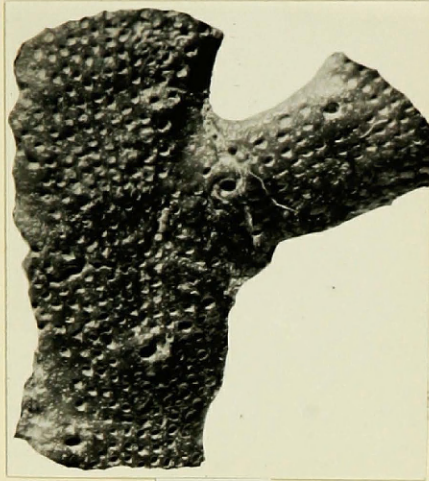
Cross section of specimen shown in fig. 8,
showing rhombic profile and low rounded keels.

Location 14, middle zone.

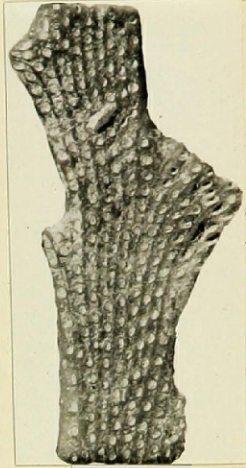
PLATE IV



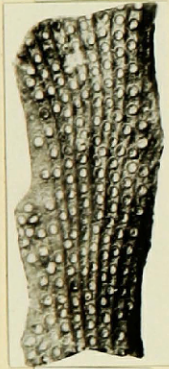
1



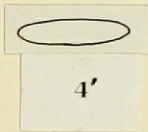
2



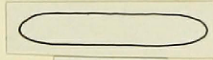
3



4



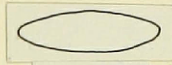
4'



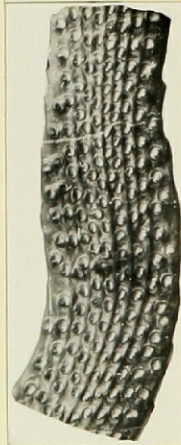
2'



5



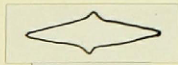
6'



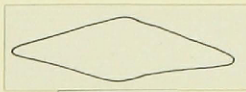
6



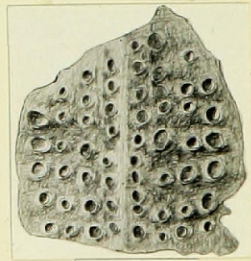
7



7'



8



8

EXPLANATION OF PLATE V

- | | <u>page</u> |
|---|-------------|
| Fig. 1. <u>Scalaripora serrata</u> , sp. nov..... | 39 |
| View of two faces of branch showing serrate edge produced by alternate position of ridges. Magnified 6 diameters. | |
| Location 35. | |
| Fig. 2. <u>Scalaripora serrata</u> , sp. nov. | |
| Portion of specimen shown in fig. 1, showing irregularity in size and arrangement of apertures. Magnified 14 diameters. | |
| Location 35. | |
| Fig. 3. <u>Scalaripora serrata</u> , sp. nov. | |
| One face of specimen shown in fig. 1, showing curved branch. Magnified 6 diameters. | |
| Location 35. | |
| Fig. 3'. <u>Scalaripora serrata</u> , sp. nov. | |
| Cross section of specimen shown in fig. 3, showing profile of branch and faces sub-equal in width. Magnified 6 diameters. | |
| Location 35. | |
| Fig. 4. <u>Scalaripora semiannulata</u> , sp. nov..... | 40 |
| One face of branch, showing maculae; nonporiferous margin; and transverse ridge. | |

Magnified 6 diameters.

Location 9, zone 1.

Fig. 4'. Scalaripora semiannulata, sp. nov..... 40

Cross section of specimen shown in fig. 4, showing irregularity in profile of concave faces. Magnified 6 diameters.

Location 9, zone 1.

Fig. 5. Scalaripora superconcava, sp. nov..... 41

One face of specimen shown in fig. 6, showing irregular arrangement of apertures, and maculae disposed midway between ridges.

Magnified 6 diameters.

Location 9, zone 1.

Fig. 5'. Scalaripora superconcava, sp. nov.

Cross section of specimen shown in fig. 6, showing unequally concave faces. Magnified 6 diameters.

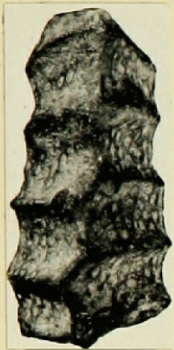
Location 9, zone 1.

Fig. 6. Scalaripora superconcava, sp. nov.

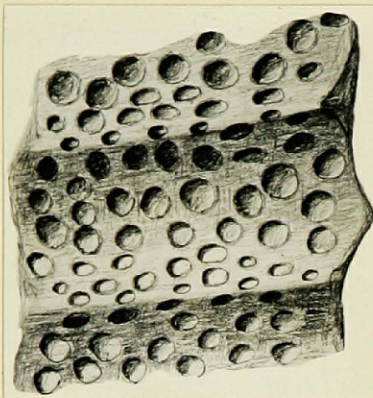
View of two faces of branch, opposite in position from faces shown in fig. 5, showing position of ridges, and the deeply concave faces. Magnified 6 diameters.

Location 9, zone 1.

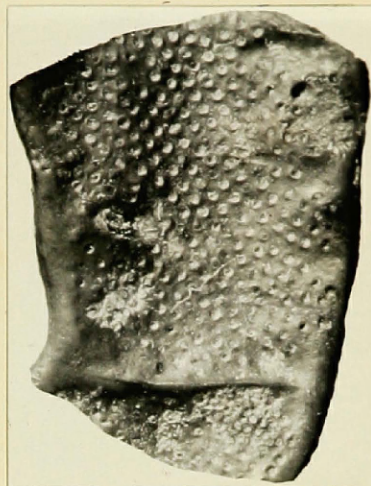
PLATE V



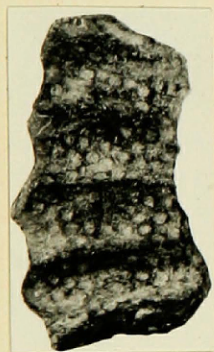
1



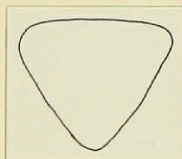
2



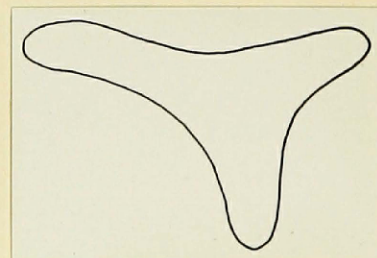
4



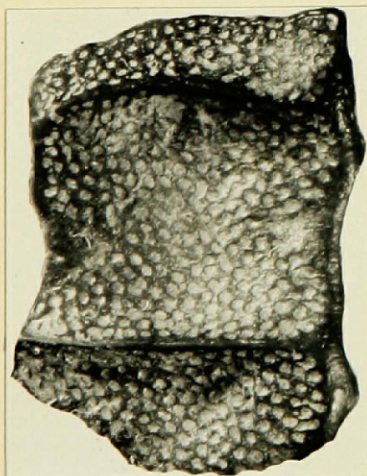
3



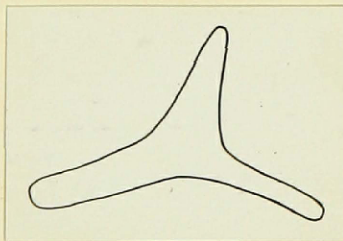
3'



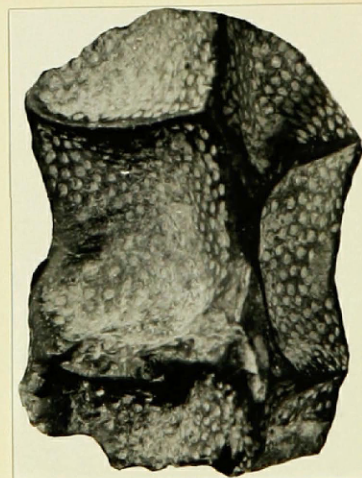
4'



5



5'



6

EXPLANATION OF PLATE VI

- page
- Fig. 1. Scalaripora sinuata, sp. nov..... 42
A concave face of branch showing non-poriferous margin, maculae, and sinuous edge of branch. Magnified 6 diameters.
Location 9, zone 1.
- Fig. 2. Scalaripora sinuata, sp. nov.
A flat face of specimen shown in fig. 1, showing irregular outline of branch. Magnified 6 diameters.
Location 9, zone 1.
- Fig. 2'. Scalaripora sinuata, sp. nov.
Cross section of specimen shown in fig. 2, showing flat and concave faces. Magnified 2 diameters.
Location 9, zone 1.
- Fig. 3. Phractopora irregulata, sp. nov..... 43
Portion of specimen shown in fig. 4, showing arrangement of apertures; maculae and nonporiferous margin. Magnified 14 diameters.
Location 47.

Fig. 4. Phractopora irregulata, sp. nov..... page
43

Portion of zoarium showing expansion of frond and irregular distribution of ridges. Magnified 2 diameters.

Location 47.

Fig. 4'. Phractopora irregulata, sp. nov.

Enlarged cross section of specimen shown in fig. 4, showing unequal width of faces. Magnified 6 diameters.

Location 47.

Fig. 5. Phractopora involventia, sp. nov..... 44

Nonincrusting branch showing curved, irregular faces and ridges. Magnified 6 diameters.

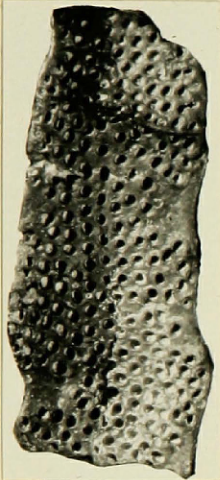
Location 9, zone 1.

Fig. 6. Phractopora involventia, sp. nov.

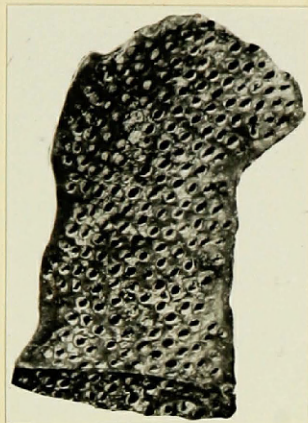
The opposite side of specimen shown in fig. 5, showing united ridges, and concave faces. Magnified 6 diameters.

Location 9, zone 1.

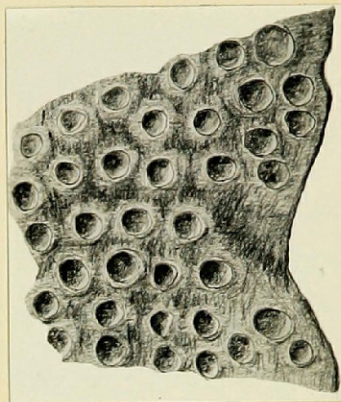
PLATE VI



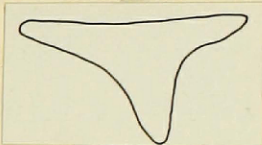
1



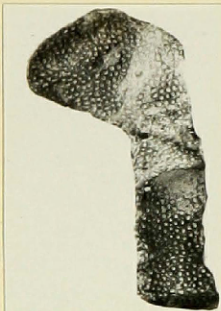
2



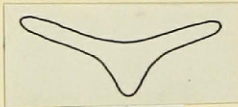
3



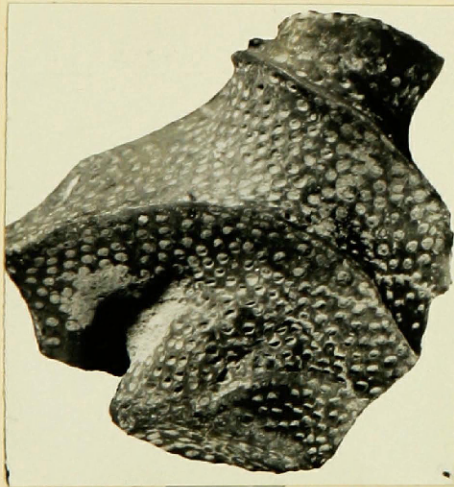
2'



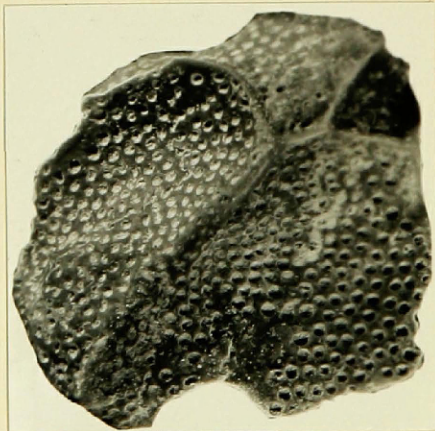
4



4'



5



6

EXPLANATION OF PLATE VII

- | | <u>page</u> |
|---|-------------|
| Fig. 1. <u>Phractopora involventia</u> , sp. nov..... | 44 |
| Nonincrusting branch showing flat faces
and united ridges. Magnified 6 diameters.
Location 9, zone 1. | |
| Fig. 2. <u>Phractopora involventia</u> , sp. nov. | |
| Portion of branch, showing unilaminate
zooecia surrounding a central cavity and ridges
composed of two sets of zooecia growing back
to back. Magnified 6 diameters.
Location 9, zone 1. | |
| Fig. 3. <u>Phractopora involventia</u> , sp. nov. | |
| Small portion of incrusting branch showing
differences in upper (U) and lower (L) parts in
the diameter of central cavity. Magnified 6
diameters.
Location 9, zone 1. | |
| Fig. 4. <u>Phractopora lacunosa</u> , sp. nov..... | 45 |
| One side of branch, showing irregularly
curved ridges and nonporiferous margin. Mag-
nified 2 diameters.
Location 47. | |

Fig. 5. Phractopora lacunosa, sp. nov..... page
45

Opposite sides of specimen shown in fig. 4, showing irregular arrangement of faces. Magnified 2 diameters.

Location 47.

Fig. 6. Phractopora alveata, sp. nov..... 46

A massive portion of zoarium, showing curved, sub-parallel ridges joined by other ridges. Magnified 2 diameters.

Fig. 7. Phractopora alveata, sp. nov.

Portion of zoarium showing trough-like celluliferous faces crossed by low transverse ridges. In the specimen the longitudinal ridges are actually higher than transverse ones, although in fig. 7, the opposite condition appears to be the case. Magnified 2 diameters.

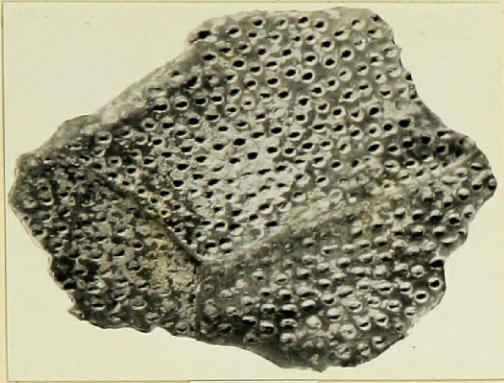
Location 47.

Fig. 8. Phractopora alveata, sp. nov.

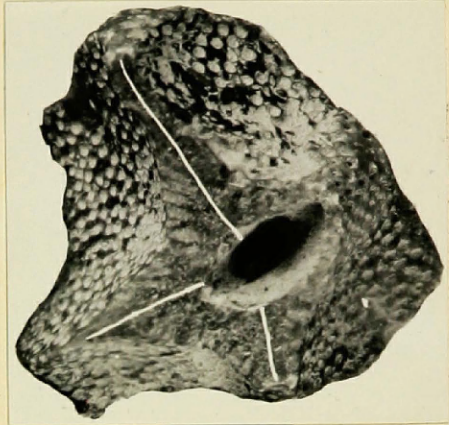
Portion of one face of specimen shown in fig. 7, showing irregular arrangement of apertures; maculae in central portion of face; and nonporiferous margin. Magnified 4 diameters.

Location 47.

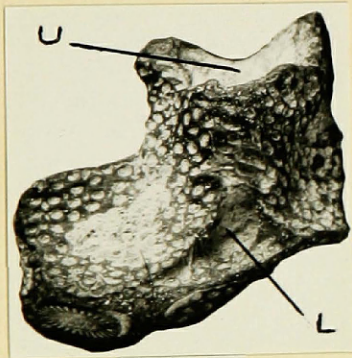
PLATE VII



1



2



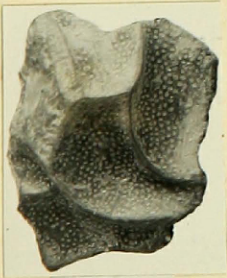
3



4



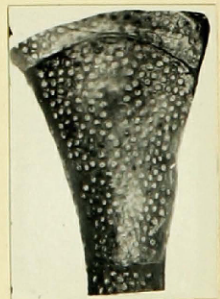
5



6



7



8

EXPLANATION OF PLATE VIII

- | | <u>page</u> |
|--|-------------|
| Fig. 1. <u>Ptilodictya subfalcata</u> , sp. nov..... | 47 |
| Specimen shown in fig. 2, showing change in arrangement of apertures from proximal to distal ends of frond. Magnified 6 diameters. | |
| Location 29, top zone. | |
| Fig. 2. <u>Ptilodictya subfalcata</u> , sp. nov. | |
| Portion of zoarium showing shape of nearly complete frond. Magnified 2 diameters. | |
| Location 29, top zone. | |
| Fig. 3. <u>Ptilodictya subfalcata</u> , sp. nov. | |
| Fragment from distal portion of frond, showing variation in shape of apertures, and nodes on walls of apertures. Magnified 6 diameters. | |
| Location 29, top zone. | |
| Fig. 4. <u>Intrapora acanthopora</u> , sp. nov..... | 48 |
| Drawing of small portion of specimen shown in fig. 5, showing elliptical apertures; angular mesopores; and acanthopores on walls of apertures. Magnified 14 diameters. | |
| Location 31, Bell shale. | |

Fig. 5. Intrapora acanthopora, sp. nov.....

Portion of branch showing type of branching. Magnified 6 diameters.

Location 31, Bell shale.

Fig. 5'. Intrapora acanthopora, sp. nov.

Cross section of portion of specimen shown in fig. 5, showing profile. Magnified 6 diameters.

Location 31, Bell shale.

Fig. 6. Intrapora acanthopora, sp. nov.

Thin section showing circular, hollow acanthopores, and elliptical zooecia. Magnified 20 diameters.

Location 31, Bell shale.

Fig. 7. Intrapora crebripora, sp. nov..... 49

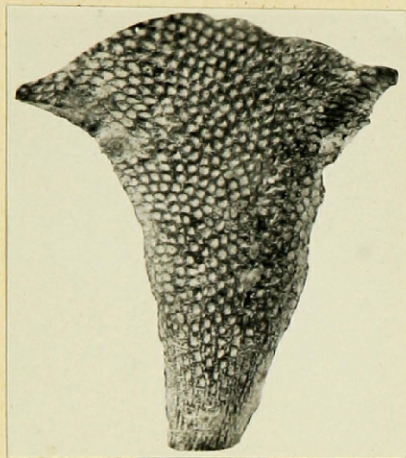
Portion of zoarium, showing circular apertures and angular mesopores. Magnified 6 diameters.

Location 49.

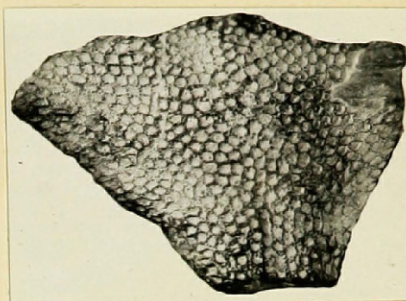
Fig. 8. Portion of specimen shown in fig. 7, showing circular apertures, angular mesopores, and thick walls of apertures and mesopores. Magnified 12 diameters.

Location 49.

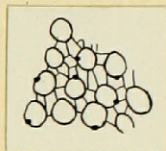
PLATE VIII



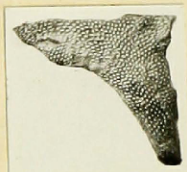
1



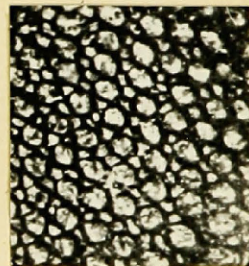
3



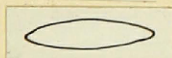
4



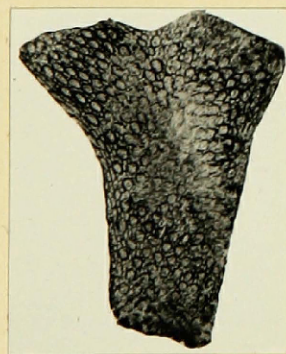
2



8



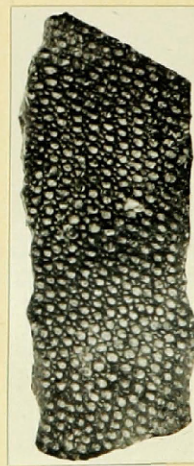
5'



5



6



7