etc. This scale makes it possible, and frequently desirable, to recognize half sizes.

The following species exhibit typically the various sizes of acanthopores:

No. 0. *Homotrypa grandis* Bassler and *Homotrypa alta* n. sp. In this size there is no central lumen and the acanthopore presents an indistinct, "fuzzy" appearance.

No. 1. *Heterotrypa prolifica* Ulrich, and *Homotrypa communis* Bassler.

No. 2. *Heterotrypa affinis* (Ulrich), and *Homotrypella hospitalis* (Nicholson).

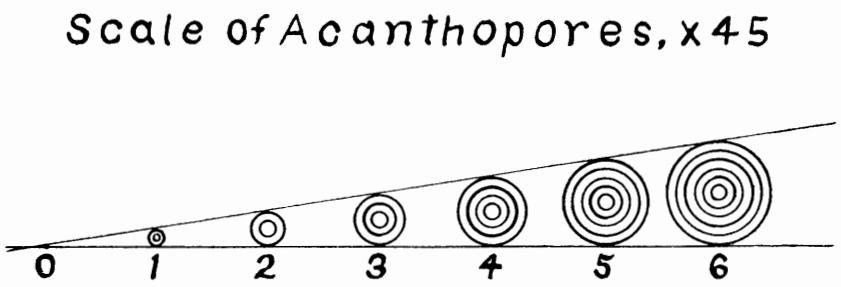
No. 3. *Homotrypa nodulosa* Bassler, and *Dekayia aspera* Edwards and Haime.

No. 4. *Homotrypa flabellaris spinifera* Bassler, and *Dekayia aspera* Edwards and Haime.

No. 5. This size is not typically developed in any species so far described, but acanthopores of this size are sometimes found in several species of *Dekayia*.

No. 6. *Lioclema spineum* Bassler. We have a specimen of *Dekayia*, probably a new species, which has all seven sizes, and all intermediate sizes.

Most species provided with acanthopores have two or three sizes. The size of most common occurrence is No. 1.



PART V. DESCRIPTION OF NEW SPECIES.

AMPLEXOPORA GRANULOSA n. sp.

Plate I, Figs. 1-1c.

Zoarium ramose or subramose, 8 to 10 mm. in diameter, the branches short and irregular, sometimes anastomosing. Surface nearly smooth, with medium-sized maculæ consisting of smaller

zoœcia and mesopores surrounded by zoœcia larger than the average; maculæ very little elevated above the general surface, about 9 in one sq. cm.

Tangential sections show the zoœcia to be subpolygonal to oval, moderately thick walled, each aperture surrounded by a thin, light-colored cingulum; about 8 zoœcia in 2 mm. The zoœcial walls are made up of a light-colored material in which are embedded numerous dark, fuzzy granules. These granules are commonly arranged in transverse rows. Under high magnification each granule shows a light-colored nucleus. In longitudinal sections the granules are seen to be in parallel, vertical rows. Acanthopores are apparently absent, none of our slides showing any. There are occasionally, however, indefinite structures which may be acanthopores. Mesopores are restricted to the Maculæ. The mesopores have the same wall structure as the zoœcia, and may be only young zoœcia.

Longitudinal sections show that the zoœcia in the axial region have thin, crinkled walls, and are crossed by diaphragms from one to two tube diameters apart. In the mature region the zoœcial walls are considerably thickened, and exhibit the usual median, black line. Diaphragms are close-set in the mature region, many of them being curved and infundibuliform.

This species does not sufficiently resemble any described species to require comparison. The only associated species of the genus is *Amplexopora pumila* n. sp., from which it differs in having no acanthopores. It was probably derived from *Amplexopora robusta*, which occurs over 100 feet lower in the section.

Occurrence: Rather abundant in the lower 25 feet of the Liberty, in Cuts 16 and 17, on the Big Four Railroad, near Weisburg, Ind.

Amplexopora Pumila n. sp.

Plate II, Figs. 1-1e.

Zoarium irregularly ramose, consisting of short, knotted branches from 3 to 8 mm. thick, and 3 or 4 cm. long. Surface nearly smooth, with slightly raised maculæ composed of large zoœcia and a few mesopores; about 8 maculæ in 1 sq. cm. Zoœcia polygonal, thin-walled at the surface; mesopores few, scattered among the ordinary zoœcia as well as in the maculæ.

In tangential sections the zoœcia are seen to be subpolygonal in form, with medium thick walls, 7 or 8 in 2 mm. The double zoœcial wall consists of two very light-colored rings of tissue separated by

a dark, granular line. These rings are not cingula, but parts of the true zoœcial walls. The granules in the median line vary in number and size and are not arranged in transverse rows, as in *Amplexopora granulosa*. Mesopores are few in number and have the same wall structure as the zoœcia; they are probably only young zoœcia.

The acanthopores vary much in size and number, there being ordinarily about 3 in 10 zoœcia. In size they range from No. 0 to 2, averaging about size 1. They are indefinite in outline and shape, fading out into the median line. The lumen is not clear and well-defined, but only somewhat lighter in color than the surrounding tissue.

The zoœcia in the axial region have the usual thin, flexuous walls, and are crossed by diaphragms about their own diameter apart. As the mature region is reached the walls become considerably thickened, and the diaphragms about three times as numerous, many of them being curved.

The large, indistinct acanthopores are occasionally seen in longitudinal sections, but are never conspicuous. The dark line between adjacent zoœcia is quite distinct, not straight and uniform, but irregularly crinkled and varied in thickness, and of a granular structure.

This species bears some resemblance to *Amplexopora pustulosa*, but may be distinguished by the small, irregular, smooth zoarium, the granulose intermural line, and larger and fewer acanthopores. The only associated species is *A. granulosa*, which differs from *A. pumila* in the absence of acanthopores, the presence of a cingulum, the wide intermural line with granules in transverse rows, and the absence of mesopores.

Occurrence: Rather abundant in the upper 15 feet of the Waynesville and lower 25 feet of the Liberty, in Cuts 14, 16 and 17, on the Big Four Railroad, near Weisburg, Indiana.

AMPLEXOPORA SEPTOSA MACULOSA n. var.

Plate III, Figs. 1-1c.

Zoarium robust, ramose, about 10 mm. in diameter and 4 or 5 cm. long, branching every 2 or 3 cm. Surface with elevated, subsolid, flat-topped maculæ about 1 mm. in diameter, composed of mesopores or very small zoœcia surrounded by zoœcia considerably larger than the average; 12 maculæ in 1 sq. cm. These maculæ constitute the main distinguishing characteristic between this va-

riety and *A. septosa* and its other varieties, all of which have maculæ on a level with the general surface of the zoarium, and composed of larger zoœcia and a few open mesopores.

Tangential sections show that the zoœcia are thick-walled, although at the surface the walls are usually thin and the zoœcia polygonal, and separated by a definite dark median line; 8 zoœcia in 2 mm. There is usually no cingulum present in the zoœcia, as is ordinarily the case with the variety *A. septosa multispinosa.* The acanthopores are numerous, 5 or 6 surrounding a zoœcium about 2/3 the size of No. 1, that is 1/30 mm. in diameter, sometimes inflecting the zoœcial walls. The outlines of the acanthopores are indistinct; the lumen is extremely small and seldom showing, but sometimes appearing clear and well-defined. The maculæ are seen to be composed of mesopores either completely filled with secondary tissue or possessing a thick cingulum. Communication pores are sometimes present in large numbers.

The zoœcia in the axial region have thin, irregularly crinkled walls and are usually without diaphragms, although an occasional very thin one is present. In the curve from the immature to the mature region the zoœcial walls are considerably thickened and there begins a close-set series of diaphragms which become more and more crowded till a point about half way from the submature region to the surface is reached, at which point the diaphragms suddenly stop and only an occasional one is inserted from there on to the surface. In the type specimen there appears to have been a rejuvenation after maturity was reached and several diaphragms are again inserted. The median dark line is quite distinct, and nearly straight, as ordinarily seen. In good slides under a high power of the microscope (320 diameters) this median line is seen to be composed of curved, transverse rows of granules, and is not a double, or even single, plate separating adjacent zoœcia and along which the walls tend to split. This variety agrees in all respects with *A. septosa multispinosa,* except the presence of the prominent, subsolid, elevated maculæ.

Occurrence: Common in the upper 70 feet of the Eden and lower 50 feet of the Maysville, in Cuts 1, 2, 3, 4 and 5, on the Big Four Railroad, near Guilford, Indiana.

Amplexopora Septosa Minima n. var.

Plate IV, Figs. 1-1d.

Zoarium small, ramose, 2-5 mm. in diameter and 3 or 4 cm. long, branching frequently. Surface smooth, with small, incon-

spicuous maculæ composed of large zoœcia and a few mesopores, not raised above the general level of the surface.

In tangential sections the zoœcia are seen to be thin-walled, with no cingulum, the dark median line showing quite plainly; 8 or 9 zoœcia in 2 mm. Acanthopores are numerous, 5 or 6 surrounding a zoœcium, about 1/3 the size of No. 1, that is, 1/60 mm. in diameter, with a clear, well-defined lumen. Mesopores few, scarcely more numerous in the maculæ than elsewhere.

Diaphragms numerous in the submature region, absent in the mature, and absent or few in the axial region; walls crenulated. Walls somewhat thickened in the mature region.

This variety differs from *A. septosa* in having smaller zoaria, thinner walls and smaller acanthopores which do not inflect the zoœcial walls.

Occurrence: Common in the upper 70 feet of the Eden and lower 50 feet of the Maysville, in Cuts 1, 2, 3, 4 and 5, on the Big Four Railroad, near Guilford, Ind.

Atactopora Intermedia n. sp.

Plate IV, Figs. 2, 2a; Plate V, Figs. 1-1d.

Zoarium parasitically attached to *Orthoceras,* no basal epitheca, about 20 sq. cm. in area and 1 mm. thick, and made up of superimposed layers. The surface presents prominently raised subsolid monticules, which are slightly elongated in the direction of the longitudinal axis of the *Orthoceras* and in rows in the same direction, about 15 occupying the space of 1 sq cm. Zoœcia floriform, thin-walled at the surface, indented by the small but conspicuous acanthopores.

Tangential sections show the zoœcia to be very irregular in shape, indented by the numerous conspicuous acanthopores, about 9 zoœcia in 2 mm. Each zoœcium is surrounded by a very thin dark line, the interzoœcial tissue consisting of irregular granular material, slightly lighter in color than the zoœcial wall. Acanthopores very abundant, 4 or 5 surrounding each zoœcium, No. 1 in size. The maculæ are made up of irregularly concentric tissue, enclosing a few acanthopores. Mesopores are practically absent.

In the longitudinal section the zoœcia are thick-walled, the acanthopores very conspicuous with a clear canal, which is somewhat irregular in size but not increasing in size as the surface is approached. Diaphragms numerous in the lower half of each zoœcium, usually absent in the outer half. Cystoid diaphragms are pres-

ent in some of the tubes. The zoœcia are at first prone, but soon turn at right angles, and then proceed direct to the surface. The maculæ are composed of aborted zoœcia and acanthopores, as described by Ulrich.*

This species presents several very interesting features. It is very similar to *Atactopora hirsuta,* except in possessing numerous diaphragms in the lower portion of the tubes. It resembles *Atactoporella* in possessing cystiphragms in some of the zoœcia. We do not, however, attach even specific importance to the sporadic development of cystiphragms, inasmuch as we have found them in at least nine genera, exclusive of the Monticuliporidæ. In a subsequent paper, now in preparation, we shall suggest an explanation of these structures.

This species also resembles very closely several species of *Spatiopora,* but the total absence of a lunarium would indicate that it is not a Ceramoporoid.

Occurrence: Rare in the McMicken division of the Eden, in Cut 3, on the Big Four Railroad, near Guilford, Ind.

Ceramoporella Triloba n. sp.

Plate VI, Figs. 1-1c.

Zoarium growing parasitically upon other bryozoans (*Heterotrypa ulrichi*), with no epitheca, forming large masses by superimposition of layers. Each layer is less than 1 mm. in thickness. The type specimen is 5 cm. long and about 2 cm. in diameter.

Surface nearly smooth, with maculæ slightly raised or depressed. Maculæ composed of smaller, distorted zoœcia and mesopores. Zoœcia irregularly trilobed, with a strongly arching lunarium. On unweathered surfaces minute acanthopores are discernable. Mesopores are numerous.

In tangential sections the zoœcia are seen to be roughly trilobed, with moderately thin walls; 7 zoœcia in 2 mm. Mesopores rather abundant, oval or irregular in shape. Structures exactly like the acanthopores in some Trepostomata, and which we consider to be true acanthopores, are common, though irregularly distributed among the zoœcia. They are about half the size of No. 1, that is 1/40 mm. in diameter. Lunaria prominent, horseshoe shaped, occupying one-third of the zoœcial circumference, the ends projecting slightly into the zoœcial cavity. Opposite the lunarium is another very small crescent-shaped, light-colored structure very sim-

*Jour. Cin. Soc. Nat. Hist., VI, p. 246.

ilar to the lunarium but much smaller. These structures occur also in several other Ceramoporoids.

In longitudinal sections the walls are seen to be irregular in structure, rather thin, with no mural pores or large granules. Diaphragms thin, one or two in each tube. Acanthopores not conspicuous, but typically developed, with comparatively wide canals and thin walls.

This species is closely related to *Ceramoporella distincta,* but has fewer mesopores, differently shaped zoœcia and more prominent lunaria. It resembles *Crepipora* in the distinct lunaria with projecting ends, but the mesopores are not collected into maculæ, and the lunarium overarches more than in that genus. It is distinguished from *Ceramoporella ohioensis* by the prominent, horseshoe-shaped lunarium.

Occurrence: Rare in the McMicken member of the Eden, in Cut 3, on the Big Four Railroad, near Guilford, Ind.

Ceramporella Tubulosa n. sp.

Plate VI, Figs. 2, 2a; Plate VII, Figs. 1-1c.

Zoarium parasitically attached to foreign bodies, in the type specimen to a species of *Orthoceras,* covering over 30 sq. cm. and having a thickness of about 1 mm. There is no epitheca.

Surface smooth, with maculæ composed largely of irregular mesopores, neither elevated nor depressed and scarcely distinguishable. Zoœcia oval, surrounded completely by irregular mesopores. Lunarium not elevated. Numerous minute acanthopores may be seen on unweathered surfaces.

Tangential sections present a bizarre appearance. The zoœcia are regularly oval in shape, all orientated the same way, 1/4 mm. long and 1/6 mm. wide, about 6 in 2 mm., including mesopores. Walls of medium thickness. Lunarium pronounced, occupying a little less than one-half the zoœcial circumference, the ends not projecting into the zoœcial cavity. Mesopores abundant, very irregular in shape, separating the zoœcia the distance of their shorter diameter and in the same direction; usually also separating the zoœcia in the direction of their longer diameter. The most noticeable thing in tangential sections is the numerous acanthopores. They occupy for the most part the angles between the mesopores. They are sometimes much more abundant than in the section figured (Plate VII, Fig. 1), there being as many as ten or more to a

zoœcium. They are about half the size of No. 1, or 1/40 mm. in diameter, though they vary somewhat in size.

Longitudinal sections show very few diaphragms, these structures averaging less than one to a tube. The acanthopores are perfectly typical, with wide canal and thin, laminated walls. Diaphragms occasionally cross the tube of the acanthopore.

This species most closely resembles *Ceramporella granulosa,* but has fewer diaphragms, more mesopores, and absolutely lacks the large granules which are such a conspicuous feature of longitudinal sections of that species. The two species also occupy different horizons. We do not agree with Ulrich that the "small dark spots, precisely like acanthopores in tangential sections,"* are simply the cross-sections of granules, but hold that they are cross-sections of true acanthopores. Our specimens of *Ceramoporella granulosa* show these granules as well as acanthopores, from which they are easily distinguished by differences in structure.

Ceramoporella tubulosa resembles *Ceramoporella distincta* externally, but tangential sections of the two are quite different.

Occurrence: Rare in the upper 25 feet of the Eden in Cut 3, on the Big Four Railroad, near Guilford, Ind.

Heterotrypa Microstigma n. sp.

Plate VIII, Figs. 1-1c.

Zoarium ramose or subramose, about 10 mm. thick and 6 cm. long. Surface nearly smooth, with very small, subsolid maculæ composed only of mesopores, surrounded by zoœcia slightly larger than the average; 15 maculæ in 1 sq. cm. Maculæ averaging about 1 mm. in diameter, sometimes slightly elongated transversely to the zoarium. Zoœcia medium thick walled, subpolygonal. No mesopores show at the surface except in the maculæ. Acanthopores not showing at the surface.

Tangential sections show the zoœcia to be subcircular, very thick walled, 9 zoœcia in 2 mm. Mesopores absent, except in the maculæ, where they are usually nearly closed by a secondary deposit of tissue. The zoœcial aperture is surrounded by a thick ring of light-colored tissue. To this structure which is found in many species of Trepostomata, we apply the name "cingulum." The cingulum is typically developed in *Amplexopora cingulata* Ulrich. Immediately surrounding the cingulum is a thin dark line, the true zoœcial

* Geol. Surv. Ill., VIII, p. 466.

wall. The intermural tissue is light-colored, and finely granular. Acanthopores small, No. 1 in size, and abundant, from 20 to 25 in 10 zoœcia; sometimes slightly inflecting the zoœcial walls. The zoœcia and acanthopores are quite regular in size and arrangement.

In longitudinal sections the zoœcia in the axial region are seen to be crossed by diaphragms averaging 3 tube diameters apart. In the mature region the zoœcia are very thick walled and provided with diaphragms less than one tube diameter apart. Mesopores are rarely seen in these sections.

The character which distinguishes this species from associated species of *Heterotrypa* is the minute, subsolid maculæ. Other differences are indicated on the chart, pages 417, 418.

Occurrence: Rather rare in the Waynesville, in Cut 13, on the Big Four Railroad, near Weisburg, Ind.

Homotrypa Alta n. sp.

Plate IX, Figs. 1-1c; Plate X, Figs. 1-1c.

Zoarium robust, ramose, or slightly compressed, 6 to 10 mm. in diameter and 4 or 5 cm. long, branching about every 2 cm. Surface perfectly smooth, with numerous subsolid, stellate maculæ, which are neither raised nor depressed, composed of small mesopores surrounded by zoœcia somewhat larger than the average. The maculæ have a tendency to be drawn out in the direction of the longitudinal axis of the zoarium; 10 maculæ in 1 sq. cm. At the surface the zoœcia are polygonal to oval with medium thick walls, and the acanthopores rarely show.

As seen in tangential sections the zoœcia are polygonal, medium thick walled, with oval apertures; 10 zoœcia in 2 mm. The aperture is surrounded by a ring of dark tissue, succeeded by a lighter ring, and this is in turn surrounded by a second dark ring of granular tissue. Ordinarily there is a median line of light-colored tissue, but occasionally this is absent, in which case the median line is made up of the second, granular zoœcial wall. Mesopores are practically absent, except in the maculæ, but there are occasional small zoœcia which might be mistaken for mesopores, but differ from mesopores in having walls exactly like the large zoœcia. The maculæ are composed of mesopores which have almost always been filled by a deposit of light-colored schlerenchyma. Acanthopores common, 4 in 10 zoœcia, very minute, number 0 in size, with no central lumen. Communication pores are sometimes present.

In longitudinal sections the zoœcia have wavy walls and no diaphragms in the axial region. The zoœcia turn sharply outward in the submature region and proceed direct to the surface. Mature region deep, 1.5 to 2 mm. from the submature region to the surface. A series of 5 or 6 cystiphragms is developed in the bend of the submature region. A close-set series of diaphragms extends from the immature region to the surface. Cystiphragms are frequently interpolated near the surface, where the diaphragms are variously curved. Rarely in the submature region an acanthopore about number 1 in size appears, but never reaches the surface.

This species is most closely related to *Homotrypa grandis* Bassler, from the Lorraine of Tennessee, but differs in having only about a tenth as many acanthopores, and in wall structure. The specimen figured on Plate IX, Fig. 1c seems to be intermediate between these two species; the tangential section, however, is different (Plate X, 1c).

Occurrence: Common in the Mt. Hope-Fairmount in Cuts 2 and 4 on the Big Four Railroad, near Guilford, Ind.

Homotrypa Glabra n. sp.

Plate XI, Figs. 1-1d.

Zoarium small, ramose, 2 to 5 mm. in diameter and 2 or 3 cm. long. Surface smooth, with solid, stellate maculæ composed of mespores which have been completely filled with schlerenchyma. Zoœcia thick walled, their apertures oval.

In tangential sections the zoœcia are seen to be thick walled, the zoœcial apertures oval and largely filled with a secondary deposit of schlerenchyma, most of the thickening being on the upper side of the zoœcium. Zoœcial walls granular, much as in *Homotrypa cylindrica,* with a light streak of intermural tissue. Acanthopores rare, minute, number 0 in size, and indistinct. Mesopores absent. About 9 zoœcia in 2 mm.

Longitudinal sections show the zoœcia in the axial region to have thin, crinkled walls, and no diaphragms. Four or five cystiphragms appear in the submature region but there are none in the mature region. Occasionally a diaphragm or two is present in the mature region. Some of the zoœcia are without cystiphragms. The zoœcial walls are greatly thickened in the mature region, most of the thickening being on the upper side. The zoœcia emerge obliquely to the surface. Acanthopores are almost

wanting in longitudinal sections, but occasionally one of about $\frac{1}{3}$ the size of number 1 is present in the submature region. These acanthopores do not appear to reach the surface.

This species is not sufficiently similar to any described species of *Homotrypa* to require comparison. The most nearly related form seems to be *Homotrypa exilis* Ulrich, from the lower third of the Trenton shales at Minneapolis, Minn.

Occurrence: Rare in the McMicken in Cut 2 on the Big Four Railroad, near Guilford, Ind.

Homotrypa Spinea n. sp.

Plate XII, Figs. 1-1c; Plate XIII, Figs. 1-1d.

Zoarium subramose to subfrondescent, about 5 mm. thick, 10 mm. wide and 4 to 6 cm. long. Surface ordinarily smooth, with stellate maculæ of mesopores surrounded by zoœcia larger than the average. Well-preserved surfaces show the projecting ends of the numerous large acanthopores; but in most of our specimens these are broken off. Zoœcia polygonal, medium thick walled. Mesopores are usually absent except in the maculæ.

In tangential sections the zoœcia are subpoygonal to oval, with thick walls; 9 zoœcia in 2 mm. Each zoœcial aperture is surrounded by a dark ring of tissue, then a lighter ring and finally by a second dark ring. The median line between adjacent zoœcia is dark in some places, but ordinarily there is a line of light-colored tissue between the second set of dark rings. Mesopores are practically absent except in the maculæ. Deep sections, or sections from immature zoaria, show a considerable number of small mesopores. The acanthopores are rather large, from number 1 to 2 in size, 4 in 10 zoœcia.

The zoœcia in the axial region are without diaphragms, their walls thin and crinkled. A considerable number of large acanthopores appear in the axial region and proceed to the surface, bending with the zoœcia, though sometimes they cut across the zoœcia and maintain a straight course. The zoœcia turn with an increasing curvature after they reach the immature region, and emerge at the surface almost at right angles. The walls become considerably thickened in the mature region. A close-set series of cystiphragms and diaphragms is developed from the immature region to the surface.

The internal characters of this species are quite constant. No associated species resembles it very closely in internal characters.

Homotrypa flabellaris spinifera Bassler resembles it zoarially, but *H. spinea* is readily distinguished by the thicker walls, smaller acanthopores and the absence of diaphragms in the axial region.

Occurrence: Rather common in the Mt. Hope-Fairmount in Cuts. 2, 4, 5 and 7, on the Big Four Railroad, near Guilford, Ind.

Mesotrypa Orbiculata n. sp.

Plate XIV, Figs. 1-1b.

Zoarium discoidal or hemispherical, 10 to 15 mm. in diameter and 2 to 5 mm. thick, with a concave base, growing parasitically upon brachiopod shells; there is no basal epitheca. The zoarium is made up of two or three superimposed layers or successive rejuvenations with thickening of the walls and maximum development of acanthopores, exactly as found in the genus *Stigmatella*. We do not attach even varietal significance to this feature, which is merely due to rejuvenation and is common to all genera of Trepostomata.

The surface is smooth, with the ordinary maculæ of large zoœcia and mesopores. The zoœcia are subcircular, 7 in 2 mm. and separated from each other by angular mesopores. Conspicuous acanthopores occur between adjacent zoœcia. They are regularly of size number 1, 20 in 10 zoœcia. Several diaphragms are developed in the young part of each zoœcium, some of them being curved, but are practically absent in the mature part of the zoœcium. The mesopores are provided with a close-set series of diaphragms throughout their length.

This species most nearly resembles *Mesotrypa patella* (Ulrich), which is also found in the Richmond. It may, however, be disdinguished by the larger acanthopores of *M. orbiculata*. *Mesotrypa* (?) *spinosa* Ulrich, from the Black River of Minnesota, is also a closely related form, but has many more cystiphragms and diaphragms, and no mesopores at the surface.

Occurrence: Common in the middle of the Arnheim, in Cut 10 on the Big Four Railroad, near Harmon's station, Ind.

Nicholsonella Peculiaris n. sp.

Plate XIII, Fig. 2; Plate XIV, Fig. 2, 2a.

Zoarium irregularly frondescent, 3 mm. thick, about 2 cm. wide and 4 cm. long. Surface smooth, having maculæ which are slightly depressed, composed of 6 or 8 large zoœcia separated from each other by large, irregular mesopores. Maculæ 2 or 3 mm. in dia-

meter, about 10 in 1 sq. cm. The zoœcia are circular, medium thick-walled, the angles between them occupied by mesopores.

Tangential sections present a pretty appearance. The zoœcial apertures are nearly circular and surrounded by a cingulum of light-colored tissue; 8 or 9 zoœcia in 2 mm. The true zoœcial wall is an irregular, dark line, enclosing numerous, very minute acanthopores. These acanthopores are number 0 in size and rarely show the central canal; 8 or 10 surround a zoœcium. Communication pores are occasionally present.

Irregular mesopores occupy the angles between the ordinary zoœcia. The zoœcia of the maculæ have no cingula, consequently their apertures are larger than the average. They are more or less completely separated by large, extremely irregular mesopores. The mesopores are not hazy or indefinite, but clear-cut, as if they were merely spaces between the zoœcia. The mesopores, rather than the zoœcia, are strongly inflected by the acanthopores. The structure of the walls, as well as the arrangement of zoœcia, mesopores and acanthopores, is the most irregular of any species we have seen.

The zoœcia in the axial region are without diaphragms, their walls thin and wavy. They curve gradually till they reach the submature region, whence they proceed direct to the surface. One or two diaphragms are developed in the mature region. The mesopores have a chain-like appearance, very similar to those of *Stigmatella catenulata* n. sp.

This species, which has all the generic characters of *Nicholsonella*, bears a close resemblance to *Stigmatella*, and raises the question whether *Nicholsonella* should not be replaced in the family Heterotrypidae.

The irregular structure and arrangement of parts makes this species easy to recognize and to distinguish from other species of *Nicholsonella*.

Occurrence: Rare in the Arnheim, in Cut 11 on the Big Four Railroad, near Harmon's station, Ind.

Peronoporella new genus.

Compressed, flabellate Monticuliporidæ, having a much abbreviated axial region but no median lamina. Zoœcia oval or petaloid, commonly indented by the abundant, rather large acanthopores, which give to the surface a hirsute appearance. Mesopores numerous, crossed by numerous diaphragms, sometimes

closed at the surface. No monticules, but inconspicuous maculæ of larger zoœcia and mesopores are present.

This genus is distinguished from *Homotrypa* by its abundant mesopores, from *Peronopora* by the absence of a median limina, and from *Atactoporella* by its frondescent form. *Peronoporella* is distinguished from *Homotrypella*, to which it is evidently most closely related, by the narrow axial region and the presence of cystiphragms all the way from the axial region to the surface. The longitudinal section is very similar to that of *Peronopora*, except that there is no median lamina, and there is a longer immature region in *Peronoporella*. The zoarium is also like that of *Peronopora*, with which it has probably been confused, but it can usually be distinguished by the less regular arrangement of zoœcia and mesopores and the conspicuous acanthopores of *Peronoporella*.

Genotype: *Peronoporella dubia* n. sp.

Peronoporella Dubia n. sp.

Plates XV, XVI and XVII.

Zoarium compressed, frondescent or laminar, 6 or 8 cm. long, 5 or 6 cm. broad and about 2 mm. thick. Surface smooth, no monticules, but about 9 inconspicuous maculæ in 1 sq. cm. Maculæ only slightly elevated above the general surface, composed of 5 or 6 zoœcia slightly larger than the average and separated by large, irregular mesopores. The maculæ are about 2 mm. in diameter and 3 mm. apart.

The zoœcia at the surface are oval or irregularly petaloid, inflected by the numerous acanthopores, and usually separated more or less completely from each other by irregular mesopores. The conspicuous acanthopores give to the surface a granulose appearance. Sometimes the mesopores are closed at the surface, but in ordinary specimens and in weathered specimens they more or less completely surround the zoœcia. The zoœcial walls are thick at the surface.

Tangential sections near the surface show that the zoœcia are oval or irregularly petaloid in shape, thick-walled, about 8 in 2 mm. Mesopores are few on account of their being closed by the thickening of the zoœcial walls and the enlargement of the acanthopores. The zoœcial walls are amalgamated, having no distinct boundary; and the intermural deposit is light-colored, corresponding in position to the mesopores deeper down (Plate XV, Fig. 1 b.)

In the typical tangential section (Plate XV, Figs. 1, 1c) the zoœcia are oval, indented by the acanthopores, and separated from each other at the angles by numerous oval mesopores. The crescentic edges of one or more cystiphragms occupy each zoœcial aperture. The walls are of medium thickness, and consist of a dark ring next to the aperture, surrounded by lighter tissue. Occasionally there is a second, indistinct, interrupted dark line separating two zoœcia, but not comparable to the dark median line of the Integrata. Three or four acanthopores having a diameter of about one-fourth the zoœcial aperture, or a little larger than number 1, surround a zoœcium. In deeper sections they are slightly smaller and in shallower sections slightly larger than in ordinary sections. They have a central lucid canal surrounded by a very dark ring, which is in turn surrounded by successively lighter concentric rings. The outer limits of the acanthopores are not clearly defined, where they fade into the mural tissue. Deeper sections show thinner walls, more numerous and larger mesopores and somewhat smaller acanthopores (Plate XV, Fig. 1a). Communication pores, similar to those found in *Homotrypa* and many other genera, are occasionally present in tangential sections.

In longitudinal sections the immature region is seen to be about one-fifth as broad as the whole zoarium. The zoœcia are at first almost parallel to the surface, thin-walled and crossed by a few remote diaphragms. They gradually bend toward the surface till the submature region is reached, where they bend more abruptly outward and proceed in a straight line to the surface and emerge at right angles to the latter.

Numerous cystiphragms are developed in the immature region, on the upper or distal side of the zoœcia, and extend almost to the surface in an increasingly crowded series. They also become smaller as they approach the surface. There are a few diaphragms in the immature region of the zoœcia, but usually none in the mature region. The mesopores are provided with a close-set series of diaphragms from the immature region to the surface.

Acanthopores are numerous in the longitudinal section, of rather large size and with a clear central canal. They are ordinarily straight, beginning in the immature region and increasing slightly in size till they reach the surface. Sometimes, where they have been protected by an overgrowth, the acanthopores extend some distance (one or two zoœcial diameters) above the general level of the surface. In this case they consist only of the central canal and the thin dark tube immediately surrounding it. We have

observed this same feature in many other species, and it throws much light on the structure and function of acanthopores. Ordinarily this tenuous tube is broken off near the surface, and we do not see the complete acanthopore.

A remarkable feature of the acanthopores of *Peronoporella* is their occasional irregularity as seen in longitudinal sections. Very frequently, instead of proceeding in a straight line, they are bent in the shape of a hook, or in other unusual forms (Plate XVI, Fig. 1a). Then they appear to be rejuvenated and proceed toward the surface, sometimes showing several successive dislocations. Almost every longitudinal section shows these hooked acanthopores. They indicate that as the zoarium grew these tubes, which extended above the surface, were sometimes accidentally broken off or bent and were immediately rejuvenated. So far these peculiarly shaped acanthopores have not been detected in any genus except *Peronoporella*. We do not, however, at present, consider this feature as constituting a generic or even a specific character.

This species resembles species of *Peronopora* very closely, both in zoanial habit and in longitudinal sections, but the absence of any median lamina in over 50 longitudinal and cross-sections examined convinces us that it is not a *Peronopora*. Figures of *Peronopora vera* for comparison are given on Plate XVII, Figs. 2, 2a.

Occurrence: Common in the Bellevue in the Borrow Cut and abundant in the Arnheim in Cuts 10 and 11, on the Big Four Railroad near Harmon's station, Ind.

Stigmatella Alcicornis n. sp.

Plate XVIII, Figs. 1-1e.

Zoarium compressed, frondescent or subramose, about 2 mm. thick, 2 or 3 cm. high and about the same distance in width. Around the margin there are short, subramose branches, giving to the zoarium the appearance of the antlers of the moose. The surface is nearly smooth, having about 10 slightly raised maculæ in 1 sq. cm. The maculæ are composed of larger cells and a few mesopores. The zoœcia at the surface are thin-walled and polygonal.

The zoœcia, in tangential sections, are thin-walled, polygonal and separated in some places by an interrupted dark line; 7 or 8 zoœcia in 2 mm. Acanthopores are very small, between num-

ber 0 and 1 in size, about 10 occurring in 10 zoœcia. Mesopores are usually absent.

Longitudinal sections show that the zoœcia have thin walls throughout, with very little thickening in the mature region. The zoœcial walls are more or less crinkled. Diaphragms are absent, except a single one occasionally in the young part of the zoœcium. The acanthopores are not conspicuous, but have a clear, sinuous canal; they are numerous in the periphery and rare in the axial region.

The only associated bryozoan with which this species might be confused is the very thin form of *Heterotrypa frondosa*, but the larger zoœcia, thinner walls and absence of mesopores will distinguish *S. alcicornis*.

Occurrence: Rather common in the Fairmount, in the upper 15 feet of Cut 5 on the Big Four Railroad, near Guilford, Ind.

Stigmatella catenulata n. sp.

Plate XIX, Figs. 1-1c.

Zoarium robust, subramose, 1.5 to 2 cm. in diameter and 5 or 6 cm. long. Surface nearly smooth, with low, round monticules or large maculæ, composed of mesopores and large zoœcia. Zoœcia subcircular, with medium thin walls. Mesopores are usually restricted to the clusters, but sometimes, on immature branches, there may be a small area in which mesopores are numerous.

Tangential sections show the zoœcia to be subpolygonal and thin walled, with a light-colored intermural line; 9 zoœcia in 2 mm. Where there are mesopores the zoœcia are smaller, but there is the same number in 2 mm., including mesopores. The acanthopores are small but conspicuous, about half the size of number 1, that is, 1/40 mm. in diameter, about 10 in 10 zoœcia. They are situated at the angles of junction of the zoœcia and never inflect the zoœcial wall. Mesopores are usually few or absent in sections near the surface, but occasionally a section will show a region of numerous mesopores, especially if the section is deep or taken from an immature branch.

Diaphragms are absent in the axial region and there are only one or two in the mature region. The zoœcial walls are only slightly thickened in the mature region, which is 2 or 3 mm. in depth. The chain-like mespores are the noticeable feature of longitudinal sections. They begin in the submature region and ordinarily do not reach the surface. Where the diaphragms cross

the mesopores there is a constriction, giving to the mesopores the appearance of chains or strings of beads. The zoœcial walls are nearly straight or only slightly flexuous.

This species is evidently most closely related to *Stigmatella interporosa* Ulrich and Bassler, which it resembles, but it may be distinguished from that species by its more rebust habit of growth, thicker mature region and less numerous mesopores and greater development of chain-like mesopores.

Occurrence: Rather common in the Arnheim, in Cuts 10 and 11, on the Big Four Railroad near Harmon's station, Ind.

STIGMATELLA INCRUSTANS n. sp.

Plate XIX, Fig. 2; Plate XX, Figs. 1, 1a.

Zoarium incrusting foreign bodies, in the type specimen attached by an epitheca to a cast of *Orthoceras;* irregular in growth, 4 or 5 cm. long and 2 to 3 cm. wide, and from 1 to 5 mm. in thickness, and composed of several superimposed layers. The surface is strongly monticulated, 10 monticules in 1 sq. cm.

In tangential sections the zoœcia are very thin-walled, polygonal, 8 in 2 mm. Mesopores are practically absent. Acanthopores are conspicuous, situated at the angles or in the walls between adjacent zoœcia, sometimes strongly inflecting the zoœcial walls; 10 acanthopores in 10 zoœcia and in size ranging from number 0 to 1.

The zoœcia are at first prone, but quickly assume an erect position and proceed in undulating curves to the surface. Diaphragms are almost absent, except in the successive mature regions, which makes the whole section appear to have numerous diaphragms.

This species differs from *Stigmatella nicklesi* Ulrich and Bassler, to which it seems to be most closely related, in zoarial habit, in possessing prominent conical monticules, and in having fewer acanthopores which vary considerably in size. It differs from *Stigmatella clavis* (Ulrich) in the same respects. This form also resembles *Cyphotrypa wilmingtonensis* Ulrich and Bassler, but there is no doubt of its being a *Stigmatella* as the latter genus is at present defined.

Occurrence: Rare in the lower Liberty, in Cut 17 on the Big Four Railroad, near Weisburg, Ind.

STIGMATELLA SESSILIS n. sp.

Plate XIX, Fig. 3; Plate XX, Figs. 2-2b.

Zoarium discoidal, about 15 mm. in diameter and 3mm. thick in the center, growing parasitically upon foreign objects. There is no basal epitheca.

The zoœcia, as shown by tangential sections, are polygonal, their apertures oval or circular, 10 zoœcia in 2 mm. Surrounding the aperture is a ring of very light-colored schlerenchyma, which is in turn surrounded by a very thin dark ring. The median line is usually light in color, but is absent in some places, in which case the two dark rings constitute the median line. Mesopores are practically absent. Acanthopores are numerous, 10 in 10 zoœcia, quite constant in size, about 2/3 the size of number 1, that is 1/30 mm. in diameter. The lumen is clear.

The zoœcia at first are crossed by thin diaphragms, their own diameter or less apart. In this region there is also a considerable number of chain-like mesopores. In the remaining portion of the zoœcia the diaphragms are twice their diameter apart. At several successive levels, 4 in the type specimen, the acanthopores and walls show the characters of maturity. At these levels there is one diaphragm, occasionally 2, in each tube, at the same height in adjacent zoœcia. That these levels represent successive stages of maturity is proven by the specimen, for the growth is interrupted completely in one part of the zoarium at these four levels. This characteristic of rejuvenation and overgrowth is not confined to the genus *Stigmatella*. It is a common feature of a good many species of Trepostomata, and we consider it as an inadequate basis upon which to found a genus. We consider *Stigmatella* as a valid genus; but we rely chiefly upon the thin walls, small acanthopores, few diaphragms and the presence of mesopores for its recognition.

Stigmatella sessilis differs from *S. nicklesi* Ulrich and Bassler, which it closely resembles, in internal characters, in zoarial habit, and in having thicker walls and smaller acanthopores.

Occurrence: Rare in the Fairmount, in Cut 7, on the Big Four Railroad, near Manchester Station, Ind.