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OF THE
CINCINNATI
SOCIETY OF NATURAL HISTORY.

PUBLISHING COMMITTEE:

S. A. MILLER, F. W. LANGDON,
C. F. LOW, J. F. JUDGE,
GEO. W. HARPER.

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THE JOURNAL

OF THE

CINCINNATI SOCIETY OF NATURAL HISTORY.

VOL. V. CINCINNATI, APRIL, 1882. No. 1.

PROCEEDINGS OF THE SOCIETY.

TUESDAY EVENING, *January* 3, 1882.

President Dr. R. M. Byrnes in the chair. Present, 25 members.

Peter G. Thompson was elected a member.

Dr. Warder read a paper on the Virginia creeper. Prof. Harper recommended cold water as an antidote for the poison of *Rhus toxicodendron.*

Donations were announced as follows:

From Department of Interior, 2 vols. and 1 pamphlet; from Smithsonian Institution, Proc. U. S. Nat. Mus.; from Henry De Saussure, a memoir on *Hymenoptera*; from J. P. Lathrop, a collection of fossils; from Joseph F. James, 21 birds' eggs, and 22 plants.

TUESDAY EVENING, *February* 7, 1882.

President Dr. R. M. Byrnes in the chair, and 16 members present.

Mr. Hubbell Fisher was appointed to confer with the Smithsonian Institution in regard to zoological specimens.

A. E. Heighway, Jr., was appointed to confer with Mr. John Robinson iń regard to zoological specimens.

Dr. Langdon exhibited two parasites of the family *Ixodidæ*, which were presented to the Society by Dr. Alex. M. Johnston.

The following donations were announced:

From C. L. Metz and F. W. Langdon, thirty-six specimens pathological human bones, from the Madisonville cemetery; from H. N. Powers, one pamphlet; from Prof. Otis T. Mason, three pamphlets on anthropology; from Peabody Museum, one

pamphlet on palæolithic implements; from Signal Service Bureau, Weather Review for November, 1881; from the Smithsonian Institution, proceedings of the United States National Museum for December, 1881; from R. Buchanan, Jr., proceedings of the American Association for the Advancement of Science, eighteenth meeting; from George Dimmock, one pamphlet on diptera; from Dr. J. King, seed of japonica; from G. M. Austin, insects, seeds and fossils; from J. H. and B. M. Seaman, three specimens of wood; from Gov. D. H. Jerome, of Lansing, Mich., Vol. IV. Michigan Geology; from the Department of Agriculture, report for 1880; from W. M. Linney, four pamphlets on Kentucky Geology; from A. E. Heighway, Jr., three specimens of *Sigillaria.*

TUESDAY EVENING, *March* 7, 1882.

President Dr. R. M. Byrnes in the chair, and 20 members present.

Col. J. W. Abert read an interesting paper on the *Cephalopoda*, illustrated with colored drawings and black-board sketches.

Joseph A. Williams, J. H. Seaman and B. M. Seaman were elected members.

On motion of J. W. Shorten, a committee of five was appointed to take steps toward securing for the Society a commodious fire-proof building. The Committee consists of J. W. Shorten, Len. A. Harris, Julius Dexter, A. J. Howe, and G. W. Harper.

The following donations were announced:

Mr. E. Gest, cabinet of fossils and minerals; G. W. Harper, five fossils; Chas. G. Boerner, collection of fossils; G. W. Hornsher, nine fossils; R. Buchanan, portfolio of Alpine plants; Jacob Bauer, the lower jaw of a boar; W. H. Bean, slab of *Zygospira modesta*; Miss Carrie Kemper, a specimen of *Unio lens*; and some books from the Smithsonian Institution, Public Library, etc.

Report of Committee in memory of Prof. J. B. Chickering:

Our Society has been adding, lately, quite rapidly to its death roll. Prof. J. B. Chickering, who was for many years a member, is no more. He was a man identified with all good works—those which tend to the elevation and culture of the people. In all the relations of life he was exemplary: as a husband and father he was faithful and provident—as an educator he was enthusiastic and successful—he was an enterprising citizen—a consistent Christian. The events of his life were kindly furnished to the Committee by Prof. W. H. Venable, his friend and associate teacher, which are embodied in this report.

Josiah B. Chickering was born August 10, 1827, at New Ipswich, New Hampshire, and died in Cincinnati, 1881, aged fifty-four years. He was a direct descendant from Deacon Nathaniel Chickering, who was born at Dedham in 1677. J. B. Chickering's grandfather served in the Revolutionary war, and his father, Captain Abner Chickering, was an officer in the army during the war of 1812-15. Abner was the

only brother of Jonas Chickering, celebrated for his skill and enterprise in the manufacture and improvement of piano-fortes.

Mr. Chickering's mother was of French ancestry; her maiden name was Boutelle. To her were born four children—three sons and one daughter—all yet living, except the subject of this writing.

J. B. Chickering spent the first years of his life on a New England farm, where he was trained to habits of hardihood, frugality and industry. When but eight years of age he lost his father. Then fell upon the boy the hard necessity of self-support, and the filial duty of relieving his widow mother. We suspect he had but few holidays. Take eight from fifty-four and it leaves forty-six. So many years did J. B. Chickering toil in this "working-day world."

The farm was Mr. Chickering's primary school, and from it he learned much that was practical and that gave practical direction to his after work. When he reached the age of sixteen he resolved, with his mother's consent, to go forth from the home of his boyhood and try his fortunes alone in the struggling world. The cash capital with which this confident Yankee lad began life was *forty-two cents.*

The winter of 1843 found young Chickering an eager pupil in the *Appleton Institute*, a good classical and scientific academy, in his native township. Not having money to pay for his tuition, he gave honest work for useful education. Part of the time he rang the academy bell, and may we not believe that a task so regular helped to fix upon him the habits of punctuality and regularity which became the very wings of his success in later years. He could never tolerate tardiness or neglect of set duties.

For about six years Chickering attended school at intervals, working, we are told, and can easily believe, on an average eighteen hours a day. He graduated at the head of his classes. The continuity of his study was broken by the necessity of earning money, to which end he found employment in the winters of 1846, '47, '48, '49, in teaching district schools. He was licensed in November, 1846, and again in November, 1847, "to teach the scholars in District No. 2," in the town of Leonminster. In 1849 the School Committee of Gardner found him "qualified to teach the South East School." While teaching at Gardner he was in his twenty-third year. Afterward he was employed for a time in Rev. David Perry's family school for boys, near Boston.

Mr. Chickering pursued his studies after graduating at Appleton Institute, but he never completed that rather indefinite intellectual labor called taking a college course. The title of A. M. was bestowed

on him several years ago as an honorable recognition of his actual services as an educator. In the autumn of 1852 Mr. Chickering came to Cincinnati as private tutor in the family of Miles Greenwood. At the end of eighteen months he opened a private school in Avondale, where he continued until 1855, in which year he started his academy in Cincinnati.

On the 15th of July, 1857, he married Miss Sarah M. Brown, of Harvard, Mass. This marriage was blessed with five children, one daughter and four sons.

There has passed away from us a man whose life struggle and success is worthy of the highest commendation. He is but another example of what "pluck" and not "luck" is capable of accomplishing in this land of ours. As our late lamented President remarked, "I never meet an ambitious, poor boy without a feeling of profound reverence, for I wonder what possibilities may be buttoned up under that ragged coat." The Committee, on behalf of the Society, tenders its deepest sympathy with the family of the deceased, and suggests that a copy of the JOURNAL, containing this memorial, be forwarded to them.

GEO. W. HARPER,
J. W. HALL, Jr., } *Committee.*
JOHN MICKLEBOROUGH.

Report in memory of David Bolles:

David Bolles was born in 1799, in Union, Tolland county, Conn. He removed to Litchfield, in his native State, in 1817, and in 1832 came to Cincinnati, where he resided until his decease. His long residence and prominent business habits secured for him an extensive and favorable acquaintance in the city and surrounding country. He engaged in cutting and ornamental work in marble and granite, where he displayed artistic taste and accurate and faithful execution. He was one of the officers of the Western Academy of Natural Sciences, and when its effects were turned over to this Society he became a life member, and took a deep interest in our welfare during the remainder of his life. He made a collection of fossils and other specimens of natural history, much of which he was compelled to dispose of to satisfy pressing necessities, during a long-continued affliction that pressed upon him toward the close of his life. He was an honest and kind man, who sought comfort in the observation and study of nature's laws, and will ever be remembered for his good qualities by all who knew him.

R. B. MOORE,
U. P. JAMES, } *Committee.*
O. D. NORTON,

ON THE ANTENNÆ AND TROPHI OF LEPIDOPTEROUS LARVÆ.

By V. T. Chambers.

The trophi of insects in their adult or imago state have been much considered in the classification of the class ever since Fabricius constructed what is known as the cibarian system. But so far as I have been able to learn, very little attention has been given to those of the larvæ. The general form of the body of the larva, the number and position of the legs and prolegs, and similar facts of superficial structure, have received due attention, but, owing, perhaps, to their minute size, and the supposed difficulty of the examination, the mouth parts have not received much attention.

It is not my purpose to propose a system of classification, but the facts and conclusions stated in this paper are the results of observations upon the mouth parts of hundreds of species of *Heterocera* (*Macro* and *Micro*) and of a few *Rhopalocera*, and are offered as suggestions to systematists of the Lepidoptera, and may aid somewhat in their classification, especially in that of the Tineina. These do not constitute a family in the sense that the *Noctuidæ*, *Geometridæ*, etc., are families. The *Tineina* is a large group of many families, some of which seem to me to be as far removed from each other in a natural system as they are from any of the *Macro-heterocera*. The old division by Stephens of the group into *Teneidæ* and *Hyponomeutidæ* was a thoroughly vicious and artificial one, and I believe is not now adopted by those who are familiar with the group. It would be, perhaps, even more unnatural to put them all in a single group of *Tineidæ*. Mr. Stainton's system, in which the name *Teneidæ* is retained for the restricted family containing *Tinea*, and its allies, is the best classification of the group with which I am acquainted. Of course it is not perfect, and it is with a view to suggesting some amendments to it—not of substituting another for it—that I offer the suggestions contained herein.*

A surprising uniformity of structure obtains among the trophi of Lepidopterous larvæ. To what causes this is due I shall not now inquire. It can not be to the influence of external conditions acting upon the growth or development of larvæ, else the most various condi-

* I have sometimes been asked why I use the name *Tineina* instead of *Tineidæ*. I trust the above remarks afford a sufficient answer. Besides "Tineina" is the term adopted by the Editors of "The Natural History of the Tineina," the standard work upon this group.

tions are capable of producing identical structures, and sometimes the same conditions are capable of producing the most varied structures. Thus, as an example of the first case, I need only allude to the fact that there is so little difference between the antennæ and mouth parts of the larvæ of some of the highest groups feeding externally on vegetation, and others feeding in leaves on the soft parenchyma, or boring in hard woody tissue, or in woolen goods, etc. Of the second case (the same conditions with diverse structures), take a larva of *Lithocolletis*, feeding in an oak leaf, and of a *Tischeria*, feeding in the same leaf, as not infrequently occurs. The burrows or mines may resemble so much that only an expert would observe the difference: both species feed only in leaves of the same species of plant, or in those of closely related species of the same genus; the entire larval and pupal life of each is spent in its mine or burrow; and all of this has been equally true of their ancestors for untold ages; yet how diverse are some of their structures: witness fig. 19, the maxilla of the *Tischeria*, totally unlike any other known maxilla of a lepidopterous larva, and much like the same organ in some *Coleoptera*—compare this I say with fig. 20, the same organ in the *Lithocolletis* larva, and differing only in the minutest details from that of a carpet-eating *Tinea*, fig. 25, or *Platysamia cecropia*, fig. 26. Such instances might be multiplied indefinitely, not only as to the maxillæ, but as to all the trophi, and more especially as to the larval antennæ, as to which there is still more uniformity than is found in the trophi. The figures (plates 1, 2 and 3) are selected from a great many dissections so as to show the greatest amount of diversity that I have found in these organs, in the whole order; and yet, with the exception of half a dozen genera, what uniformity of form and structure is found, and how very little that form and structure seems to depend on the external conditions of existence of the larva. Perhaps the greatest differences are to be found, as might be expected, in the mandibles; and yet even here compare figs. 33 and 34 (mandibles of the *Lithocolletis* and *Tischeria* feeding in the soft parenchyma of the same leaf) with fig. 35 (mandible of *Prodoxus* feeding in the hard wood of *Yucca* stems). Indeed, the mandible of *Lithocolletis* seems in proportion to the size of the larva as powerful an instrument as that of *Pieris* (fig. 45) or *Tinea* (fig. 39), and is more formidably armed with teeth than that of an *Arctia* (fig. 42). The mandible of *Lithocolletis* is better comparable with that of *Thiridopteryx* (fig. 41), while that of *Bedellia somnutentella* (fig. 40) is armed with a double row of teeth placed obliquely to each other, and is one of the most formidable man-

dibles that I have met with among Lepidoptera, and all of this armature is for the sake of chewing the soft parenchyma of the leaves of the morning glory; while *Solenobia* feeding on tough dry lichens has the mandibles (not figured) very similar to those of *Laverna* (fig. 38), of which various species, with really identical trophi, feed in leaves, in flowers, or on the pith of stems. But all this is by the way and foreign to my present purpose. I have referred above to the uniformity which prevails in these structures in all grades of Lepidopterous larvæ. One rule, however, seems constant, namely, that precisely those structures which are most imperfect in the larvæ are most highly developed in the imago. Thus in the imago the labrum, mandibles and labium are obsolete or rudimentary; and these are precisely the organs which attain the greatest development in the larvæ; whilst the maxillæ and maxillary and labial palpi receive their greatest development in the imago, and the least in the larvæ, and in some of the lower forms are at first entirely wanting. In the imago one or both pairs of palpi, and the maxillæ, vary in the degree of development from an almost rudimentary condition to one in which sometimes one, sometimes another, and frequently all of them are of large size, and diverse forms and clothing; whilst in the larvæ there is no such variety; but with the exception of the maxillæ in the genera *Cemiostoma* and *Tischeria*, a wonderful sameness of form is preserved throughout the order (see figs. 14 and 20–26). So with the antennæ, which are essentially the same in all Lepidopterous larvæ, as I think will be made evident further on.

Elsewhere* I have given an account of the changes which take place in the trophi of certain *Tineid* larvæ, but a brief recapitulation of the leading facts seems necessary here. They are as follows: In the genera, *Phyllocnistis*, *Lithocolletis*, *Leucanthiza*, *Coriscium*, *Gracillaria*, and *Ornix*, the larvæ leave the egg with the trophi imperfect; the maxillæ, maxillary palpi, labial palpi, and spinneret, are entirely absent, unless in *Ornix* and *Gracillaria* the maxillæ may be said to be present in a very rudimentary condition. Mr. Dimmock (*Psyche*, *loc. cit.*) thinks that in *Gracillaria syringella* the maxillæ are represented by two bristles or setæ on each side of the labium at its base, which are represented in *Ornix* by what I have called (*loc. cit.*) the latteral tines (see fig. 17). I have seen these bristles in other species of *Gracillaria*, though I have not had an opportunity of examining them in *G. syrin-*

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*American Entomologist, new series v. 1, p. 255; Jour. Cin. Soc. Nat. Hist, v. 2, p. 71 Psyche, v. 2, pp. 81, 137 and 227. See also a paper by Mr. Dimmock, in Psyche, v. 3, p. 99.

gella. It is quite probable that Mr. Dimmock is right in regarding them as rudimentary maxillæ and their palpi; but if this is so, still in the other genera above named no trace of their organs has been discovered, unless a minute bulb, 1-2000th of an inch long on the neck of the labium in *some only* of the *lower* or *flat* larvæ of *Lithocolletis* represents it. But Mr. Dimmock was influenced somewhat by the fact that in *Gracillaria* there are two bristles on each side representing the two lobes of the maxillæ. In the species of *Lithocolletis* just referred to, there is only a single little bulb, no bristle, while in *Ornix*, as shown in the figure, there are three, which perhaps may indicate that instead of maxillæ these processes may be the result of a division of the labrum like that which is found in *Tischeria*, *Antispila*, *Aspidisca*, and *Nepticula*, as shown in figs. 68-76. I incline, however, to the belief that Mr. Dimmock is right in considering them to be the degraded remains of the maxillæ.

However this may be, at the first or some subsequent moult, the larvæ exchange this rudimentary, or as I have elsewhere called it, "first" form of trophi, for the "second" or ordinary form in which all of the organs are present. This change takes place at different moults in different genera, or even in different species of the same genus. Thus in *Gracillaria*, *Coriscium* and *Ornix* it takes place at the first moult; in those species of *Lithocolletis*, in which the form of the larvæ is cylindrical (cylindrical group), it takes place at the third moult; in *Lithocolletis ornatella*, and in the flat group of *Lithocolletis*, and in the genus *Leucanthiza*, at the fifth moult, and in the genus *Phyllocnistis* at the moult (4 ?), at which it passes into the last larval stage. As above stated, in this second or ordinary form, all of the organs of the mouth are present, but in the flat *Lithocolletis* larvæ, and in *Phyllocnistis*, some of them are in a very rudimentary or degraded state. In *Phyllocnistis* this is the case with all of the organs except the spinneret; indeed, I have not been able to detect the mandibles in *Phyllocnistis* in its last larval stage. Fig. 1 represents the antennæ of *Phyllocnistis* in the "first form," and fig. 2 in the second; fig. 56 the labrum in the first form, fig. 57 in the second; and the labial palpi and maxillæ which are absent in the first form are, in the second, rudimentary, as also are the antennæ. Fig. 31 represents the mandible of *Coriscium* in the first form, and that of *Phyllocnistis* in that form is almost identical; figs. 3 and 4 represent the antennæ of a *Lithocolletis* of the flat group, in the first and second forms respectively; figs. 5 and 6 those of a *Lithocolletis* of the cylindrical group; figs. 29 and 30 are

the mandibles of *Lithocolletis* of the flat group, in the first and second forms; figs. 32 and 33 those of the cylindrical group of the same genus. When reference is made herein to the "first form," and the "second" or "ordinary form,'' it is to forms like these. In all of the pupæ of species which leave the egg with larvæ of the first form, the anal hooklets by which the pupa is anchored in its cocoon are lateral instead of terminal; that is, they are placed on the sides of the anal segment instead of at its apex. These pupæ also have the head beaked in front, and numerous serrations on each side of the beak in some genera. But this armature of the head is not peculiar to species which are known to leave the egg with the first form of trophi. Since *Pronuba*, *Prodoxus*, the pupæ of the clearwings, and some other pupæ, also have the head beaked, and *Bedellia somnutentella* has the beak of a remarkable size, and it certainly never has trophi of the first form. Prof. Comstock, in his valuable Report as Entomologist of the Agricultural Department, has many interesting observations on larvæ and pupæ of *Lithocolletis*, and seems to consider this armature of the head and anal segment as especially adapted to the uses of the insect in making its exit from the mine, and certainly it does answer a very useful purpose in that way; but whether it has been especially developed for that purpose by the conditions of existence, or in any other way, will at least admit of doubt. The pupæ of *Lithocolletis ornatella*, and *Leucanthiza amphicarpeæfoliella*, and nearly all species of *Gracillaria*, *Ornix* and *Coriscium* leave their mines before pupating, and pupate in little cocoons, and need these anal and cephalic structures no more than any other insect which pupates in a cocoon. *Bedellia somnutentella* does not even leave anything that may be called a coccoon, but pupates simply suspended in a silken web (recalling somewhat to mind the pupæ of *Lyonetia*). *Pronuba yuccasella* pupates under ground: yet all of these have the capital beak, and the *Gracillaria* have also the lateral armature of the anal segment, and no good reason is seen why these genera should possess these structures any more than the thousands of other pupæ which inhabit cocoons, and are destitute of such armature. On the other hand, the pupæ of various species of *Laverna*, *Tischeria*, and countless others which live in mines or in stems, or like *Cemiostoma* or *Nepticula*, simply in cocoons, have the heads round and blunt, without beak or serrations, and the anal armature at the apex of the abdomen, as is usual in moths and butterflies, and structures like those of *Lithocolletis*, *Gracillaria*, etc., would certainly be as useful to *Laverna gleditschiæella* in piercing the tough hard cuticle of a *gleditischia* thorn

as they would to a *Lithocolletis* in escaping from its mine through the delicate cuticle of a leaf, or to *Bedellia* which does not have to escape from anything except its pupa skin. In fact, while some pupæ, as, *e. g.*, that of *Prodoxus*, have the armature of the head, but not the lateral armature of the anal segment, and yet are *not known* to have trophi of the first form at any time, yet the fact that these structures of the pupa are better developed in those genera which retain for the longest time the trophi of the first form, suggests that there may be some connection or correllation of growth between the two kinds of structure. That the course of evolution is influenced by variations which have taken place in earlier stages, is stated by Mr. Darwin in the "Origin of Species," chap. 5: "The whole organization is so tied together during its growth and development, that when slight variations in any one part occur, and are accumulated through natural selection, other parts become modified. This is a very important subject most imperfectly understood. The most obvious case is that modifications accumulated solely for the good of the young or larvæ will it may safely be concluded affect the structure of the adult." But, however, if at all, the first form of trophi is related to the particular structures of the pupa which I have mentioned, there can be no doubt that the genera above named have the first form of trophi in the earlier stages of their existence, and afterward change it for the second or ordinary form, without any change whatever in their external surroundings, and it is difficult to see how the change can have been produced by the effect of any external influence such as some naturalists of the mechanical school suppose to be sufficient to account for the initiation of the variations which have resulted in the present condition of the organic world. Many of these larvæ (as all *Lithocolletis* larvæ of the cylindrical group, and some species of *Gracillaria* and *Ornix*) pass the last four stages of their larval existence and the pupa state under precisely the same conditions which characterized the previous stages—living in the same mine, eating the same food, subject to precisely the same influences, and the only change is in the way in which they bite the food; a consequence, not a cause of the changed structure. It is one of the numerous cases of structure in advance of function. Others, as *Lithocolletis ornatella*, *Leucanthiza amphicarpeæfoliella*, cease to feed after the change in the form of the trophi, and pass the remaining two stages of their larval existence still in the mine without eating, although their trophi are more perfect and better developed than they were in their feeding stages; others again, as most

Gracillariæ and *Ornix* leave the mine and continue to feed externally; others, as *Lithocelletis* of the flat group of larvæ pass the remaining two stages of larval life and the pupa state in the mine, with the labrum and mandibles more degraded, but the other organs more perfect, but they do not eat. While *Phyllocnistis* passes its remaining stage in the mine without eating, and with all of its trophi except the spinneret atrophied. Can all this be the result of the influence of external condition ?

I pass now to a consideration of the separate organs. The Antennæ consist always in Lepidopterous larvæ of a short basal joint, a longer cylindrical one which ends in various minute processes and hairs, one, or sometimes in large larvæ two, of which (hairs) are greatly elongated, and are no doubt tactile organs (see figs. 6–12). The number of the terminal processes appears to be normally five, though sometimes I have not been able to detect so many. The only differences that I have been able to detect in these organs is in the number or size of their terminal processes, and in the relative size of the joints. I find nothing in the antennæ of the larvæ that can be of any practical value in classification, and the uniformity of their structure contrast strongly with the variety presented by the same organs in the imago. In the "first form" the antennæ differ from those of the second, as do the trophi (compare figs. 1, 3 and 5 with the others), and are much degraded.

In the Labial palpi there is scarcely any difference throughout the order. They always consist of an elongate basal joint, with a small hair at its apex by the side of the minute second joint which ends in a longer hair (fig. 14).

The Labium is large in the "first form" (figs. 16 and 17). In the ordinary form, that which Burmeister calls the shield of the spinneret, seems to me to be the true labium, whilst the labium of Burmeister is rather the mentum, and that which Burmeister calls the spinneret is only a part of that organ, and may be called its sheath or case. The true spinneret, which is a mere prolongation of the united silk glands, is sometimes seen protruding beyond the lip of this sheath, fig. 15, "*a*" spinneret; "*b*" sheath, which is supported on three arched chitinous rods; "*c*" labium proper, or sheath of Burmeister. This organ (the labium proper) is a simple membrane, elongated and pointed in most of the heterocera, but sometimes shorter, and blunt. or rounded, or emarginate, on its anterior margin, and at its base clasping the sheath and spinneret. The mentum contains a complicated series of mus-

cles, which extend or withdraw the spinneret and sheath, and give them motion in various directions, and when the organ is not in use it is reflexed beneath the head carrying with it the labium and its palpi, and the spinneret and sheath. I have been influenced to take this view of the parts by the position of the labial palpi at the apex of the mentum on each side of the base of the labium.

In one of the papers before refered to, I have stated that the spinneret is absent in the "first form," and in another that it is present in a rudimentary and functionless condition. The contradiction is only apparent, and which statement is literally true depends on what we consider the spinneret. The external organ (fig. 15) is totally wanting, but there is a median wrinkle in the labium, which, with sufficient amplification, presents the appearance shown in fig. 16, and is the functionless representative of the rudimentary spinneret.

Passing now to the MAXILLÆ, we find but little more diversity than in the preceding organs, with the exception of the maxillæ of the genera *Cemiostoma* and *Tischeria*, to which I shall return again. Figs. 20-26 show the general structure, and have been selected from a multitude of dissections to show the extent of the diversity which is found in the structure of this organ. The maxillæ consist of three joints, the basal and second of which are each armed with a single bristle, always arising at the same point. The third joint is tipped with from three to five minute processes; the outer lobe or palpus arises from the top of the second joint, beside the third one. Itc onsists of two joints, the terminal one being tipped with minute hairs and processes, varying in number from four to seven, and sometimes differing in shape. Like the antennæ these organs (except in the genera *Cemiostoma* and *Tischeria*) afford nothing of practical value in classification, though there is some diversity in the number and size of the terminal hairs and processes, and in the relative sizes of the joints.

The MANDIBLES have already been considered; they differ in the number of the teeth, and in hardness, and considerably in shape, notwithstanding which I find nothing of classsificatory value. They work by a ball and socket joint, and have two bristles arising on their upper margin near the base, and which are never wanting in the second form, though never present in the first form of trophi.

The LABRUM is the organ in which we find the greatest diversity (figs. 56–66). There is considerable diversity of *form*, but I have found it of subordinate value only for classification. In the "first form" of trophi it is always ciliated on the inferior surface, and armed with teeth or

around its anterior margin. In the ordinary form it is always, except in the genera *Tischeria*, *Antispila*, *Aspidisca* and *Nepticula*, more or less deeply cleft in the center, dividing it into two lobes, but the size of this notch varies in closely related species of the same genus; thus, *e. g.*, in fig. 58 the labrum of *Gracillaria eupatoriella*, it is small, while in other species of the genus the labrum is scarcely distinguishable from that of some species of *Lithocolletis* (fig. 33). Reaumur long ago alluded to the office of this cleft in the economy of larvæ which feed upon the edges of leaves. The edge passes into the cleft and back between the fore feet, the head being moved forward and backward along it; and Prof. P. Martin Duncan, in his interesting and valuable work upon the *Transformation of Insects*, and other writers seem to consider it a special adaptation of structure to function. But what shall we then say to its presence, equally as well developed in proportion to the size of the larvæ, in many of the little leaf-mining species (*Lithocolletis*, of the cylindrical and *ornatella* groups, *Gracillaria*, etc. (figs. 33 and 59), which never see the edge of a leaf unless it be from the inside of it? In the "ordinary form," the labrum is less ciliated on its lower surface than it is in the first form, but it is always armed on that surface with three teeth, though they are sometimes difficult to detect in some of the more degraded forms of the *Tineina*. It is always armed on its upper surface with certain bristles, and the number of these seem to give us some assistance in classifying the species. In *Phyllocnistis* the trophi of the ordinary form are greatly atrophied, and I have been able to detect but two minute hairs on the labrum. But in all of the other genera and species having the first form of trophi in their earlier stages, the labrum of the ordinary form has ten bristles, and so has that of Mr. Riley's genus *Prodoxus*. Whether this indicates any relationship between *Prodoxus* and the genera having trophi of the first form, remains to be determined when we know the larvæ of *Prodoxus* in its first stage. This larva is certainly a very singular one in many respects, and the pupa is armed with the cephalic tooth as in those species, as is also that of *Pronuba*, though both have the anal hooklets terminal and not lateral. Mr. Riley thinks that these two genera must have been derived from a common ancestor, basing his opinion, however, on the fact that both feed on *Yucca* (in very different ways, however), and on the resemblances of the moths, which, however, are only in ornamentation and size, while the differences in habits of the larvæ, and in the structure of the larvæ, pupæ and imago are very great, and show that if they are

descended from such common ancestor it must have been a very remote one. *Pronuba* has the labrum armed with twelve spines, and they are small, whilst the ten of *Prodoxus* are the largest that I have found among *Lepidoptera*. It is curious that the *Prodoxus* larva, pent up in its little narrow gallery in the hard wood of the *Yucca*, should have its labrum thus armed, since the spines are evidently in its way, and are nearly always found broken. It will not surprise me if the *Prodoxus* larvæ shall prove to have trophi of the first form in its first stage since the labrum has only ten spines.

Gracillaria, *Ornix*, *Coriscium*, *Lithocolletis*, *Leucanthiza*, and *Phyllocnistis* are the only genera that as yet are known to have trophi of the first form in their young stages, and ten spines upon the labrum in the ordinary form. But there are other genera, the mouth parts of which have not been examined in their younger stages, but which, from their resemblance to the foregoing genera in their later larval stages, and as pupæ and imago, no doubt belong to the same group. Thus *Marmara salictella* has probably been observed by no one but Dr. Clemens, yet his account of it leaves no doubt that it is closely allied to *Lithocolletis ornatella*, and *Leucanthiza amphicarpeæfoliella*. Mr. Stainton places the genera *Lyonetia*, *Opostega*, *Phyllocnistis*, *Cemiostoma* and *Bucculatrix* in his family *Lyonetidæ*. Of these we have already considered *Phyllocnistis* and *Opostega*, and my genus *Acanthocnemis*, as are evidently so nearly allied to it in the imago that it is probable they are at least equally so in the larval state, though the larvæ are not at present known. The presence of eye-caps in the imago, and of a tuft on the vertex, circumstances considered of some importance apparently by Mr. Stainton, do not appear to me to have much value in classification; even to the presence or absence of both pairs of palpi, too much importance has I think been generally attached. Thus in both *Opostega* and *Phyllocnistis* the maxillary palpi are obsolete, and the labial palpi are larger in the latter than in the former; their close connection I think is evident at a glance. *Opostega* has the head roughened, and *Phyllocnistis* has it smooth; while *Acanthocnemis* has the maxillary palpi well developed; yet I do not think that any one who inspects it can doubt its near relation to *Phyllocnistis*. I have not examined the larval trophi of *Lyonetia*, but from the characters of the larvæ, pupæ and imago I think it is closely related to *Gracillaria*, and will be found to have trophi of the first form in the first larval stage, and ten spines on the labrum in the later stages. *Cemiostoma* I have already men-

tioned, and shall refer to again. It does not belong to this group. Of *Bucculatrix* the larvæ of only two species are known in this country, and I have not examined the trophi of either of them. The pupa resembles closely that of a *Lithocolletis* of the cylindrical group, and the imago also seems to me to be allied to that genus. The armature of the head and anal segment in the pupæ is identical with that of *Lithocolletis*. Mr. Stainton says (*Ins. Brit.*, v. 3, p. 290): "At a certain age the larvæ quits the mine, and on the underside of the leaf spins a delicate, whitish web or cocoon, within which the larvæ remains motionless, and in a horse-shoe shape, for a considerable time; it then emerges from this coccoon totally different in appearance to what it was as a leaf-miner, and proceeds to eat the epidermis of the leaf which it formerly mined." All of this would suggest forcibly that at this moult in its cocoon it had exchanged the trophi of the first form for those of the ordinary form. But this can not be, for the reason that a larva having the first form of trophi can neither spin, nor crawl, when it is out of its mine, because of the rudimentary condition of its spinneret and feet at that time. If, therefore, the larvæ of *Buccalatrix* ever has trophi of the first form, as I believe it will be found to have in its first stage, it must shed them at its first moult before it leaves the mine, and the moult in its cocoon must be its second or some later moult. Its larval history will be interesting to trace, and it will probably be found that in its early stages it is like that of *Gracillaria stigmatella*, and many other *Gracillaria* which have the first form of trophi in their first stage only, and pass both the first and second stages in the mine. *Bucculatrix* (imago) has no palpi. Both of my American genera, *Eurynome* and *Phyllonome*, are evidently closely allied to *Bucculatrix*, especially the latter, which resembles *Bucculatrix* even in the ornamentation, and may almost be called a *Bucculatrix*, plus both pairs of the palpi. *Eurynome* also has the palpi, and this I think is another instance showing how closely related species may differ in respect to the development of these organs. These are the only American genera that I place in this larval group, though doubtless other exotic genera are known which properly belong here.

The next larval group is characterized by never at any stage having the first form of trophi, and it includes all other Macro and Micro *Lepidoptera* than those above mentioned, and some *Tineid* genera, yet to be discussed, and it may be divided into three such groups, according to the armature of the labrum. The first of these subgroups has the labrum armed with twelve spines, and includes all Macro and

Micro Heterocera, except those above placed in the first group, and the few small *Tineina* yet to be discussed further on, viz., *Cemiostoma*, *Tischeria*, *Antispila*, *Aspidisca* and *Nepticula ;* and we must also exclude from it the large silkworms, and among the *Tineina*, *Plutella cruciferarum.* All the other Heterocera, the larval trophi of which I have examined. comprising species of all of the families to be found in this region, and of a host of genera, whatever may be their other differences as to the form of the labrum, and size of the median notch, or in any other respect, agree in having the labrum armed with twelve spines, even when this forms almost the only bond of union between them, *vide* figs. 60, 61 and 62. The next subgroup comprises, among the Heterocera, *Plutella cruciferarum* (fig. 63) alone, which has the twelve spines as in the last group, and in addition two very large spines rising from the base of the labrum; and, strange to say, we do not meet with this peculiarity again until we reach the *Rhopalocera*, where the skippers have the labrum of a very different form from *Plutella*, it is true, but armed just as in *Plutella* (fig. 64, *Eudamus tityrus*). My examinations of the larval trophi of *Rhopalocera* have been confined to the skippers and *Papalionidæ.* These latter (fig. 65) have the labrum armed like *Plutella* and *Eudamus*, except that the two large spines are placed much further forward than in those genera. *P. cruciferarum* is an interesting species as to its classification. The characters of the imago seem to me to locate it, as Mr. Stainton has done, immediately above the *Gelechidæ* ; yet here we find the structure of the labrum of the larva separating it from all other Heterocera (except the silkworms, of which see post), and allying it to the butterflies and large *Attacidæ.* The mandibles of the larva, too (fig. 44), are of somewhat unusual form, sloping greatly at the upper basal angle, with two spines placed very near the base (the figure 44 does not adequately represent the slope of this part of the organ). The labrum is not only more strongly armed than in other Heterocera, but has the teeth very large, and the anterior angles much produced, and the terminal processes of the maxillæ are of an unusual form (fig. 27).*

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*Its cocoon of open net-work is also remarkable and different from all other cocoons that I have seen, though *Chauliodus chærophylellus*, and, perhaps, a few other European species, are said to make such. Mr. Bates ("Naturalist on the Amazons," p. 413) describes and figures an open net-work cocoon, which, however, is suspended by a thread, and which he attributes to a *Tineid;* and Mr. Howard, while acting as assistant to Prof. Comstock, in the Agricultural Department at Washington, showed me similar cocoons, and a moth bred from them, which I recognized as the same insect that I had before received from Texas, but which I think is hardly referable to the *Tineina*. It is a sordid, sooty brown or blackish moth, with an expanse of wings of near an inch, and I think Mr. Howard informed me that the larva came from Florida.

The *Attacidæ* (fig. 66, labrum of *Platysamia cecropia*) have the spines on the larval labrum, as in *Eudamus* and *Papilio*, except that the two large ones are reduced to the ordinary size, and in addition there is another spine arising near to the center of each lobe, making the number of spines sixteen in this subgroup. The spines in the four groups number respectively 10, 12, 14 and 16. And another group (*Antispila*, etc.) has them obsolete and indefinite.

That these groups exist is a fact easily demonstrated. What the value of the character on which they are founded is, if it has any, must be determined by future observations. Of course I am not proposing to classify the Lepidoptera on the basis of any single character or set of organs; for this purpose each species must be considered in its entirety, so to speak. I simply offer the facts and the groups as I have found them, to be considered *inter alia* by systematists.

There yet remain the *Tineid* genera above alluded to, viz: *Cemiostoma*, *Tischeria*, *Antispila*, *Aspidisca* and *Nepticula*, which will not fit into any of the above groups, but seem to form a separate group. The larva of *Cemiostoma* is, both by its labrum and maxillæ, separated from all other Lepidoptera (figs. 67 and 18). The labrum is densely ciliated on the inferior surface—a character which it has in common with all of the lower *Tineina*, and which, perhaps, simply indicates degradation. I have not been able to detect the presence of any trace of the teeth, and the spines are reduced to two minute hairs. But it is the maxillæ which are most characteristic here; the outer lobe or palpus is reduced to a mere rudiment, although still two jointed; the third joint of the inner lobe is nearly as large as either of the other two, and has an oblique row of minute processes on its side, and it is crowned with a dense tuft of long cilia. To appreciate the differences between it and the usual forms, compare fig. 18 with figs. 20–28.

The genus *Tischeria* is placed by Mr. Stainton among the *Elachistadæ*. Dr. Clemens thought its true location was with *Lithocolletis*. But the larvæ of *Lithocolletis* have in their early stages trophi of the first form, which *Tischeria* never has, and they have only fourteen legs while *Tischeria* has sixteen; and there are other differences sufficient to separate *Tischeria* from the *Lithocolletidæ;* while its larval trophi, I think, separate it also from the *Elachistadæ*. The labrum (figs. 75 and 76), instead of having the median notch trilobed, has the teeth very large, and although it has, I think, ten or twelve spines, the number is difficult to determine, because they are very minute, and differ scarcely, if at all, from the cilia. But the maxillæ are still more

singular (fig. 19), and resemble those of some Coleoptera more than those of any other Lepidoptera; the articulations are almost obliterated; the outer lobe is reduced almost to a rudiment; the terminal joint of the inner lobe is enlarged, almost globular; only two of its terminal processes are present, and it is densely clothed with long hairs (compare fig. 19 with figs. 20–28). The maxillæ separate it from all other Lepidoptera, while the labrum separates it from all of these above discussed, and seems to unite it with *Bedellia*, *Antispila*, *Aspidisca* and *Nepticula*.

Bedellia (fig. 68, labrum of larva) is placed by Mr. Stainton in *Elachistadæ*. The larval labrum is not distinctly trilobed, but the notch is widened into a distinct space, which gives the appearance of trilobation. It has ten spines on its upper surface (as in *Lithocolletis*, etc.), but has ten others around its anterior margin.

Nepticula (figs. 69 and 71) has the notch still more widened, and the trilobation distinct; the teeth are indistinct; I detect no spines, except the ten spines or teeth around the margin. On the whole, in spite of differences, it seems to be about equally related to *Bedellia* and *Tischeria* (it is proper to say, however, that in *N. pteliæella* the labrum (fig. 72) differs from that of all of the other *Nepticula* larvæ that I have examined. Mr. Stainton places *Nepticula* and *Trifurcula* (which I have included in *Nepticula*) in his family *Nepticuladæ*. The maxillæ do not differ in any important respect from those figured at figs. 20–26. The larval labrum, while appearing to be between that of *Bedellia* and *Tischeria*, as above stated, seems to be about equally related to that of *Antispila* (figs. 70 and 73), or *Aspidisca* (fig. 74), in which, although the notch is present, the tendency to trilobation is also distinct; the number of the spines, which are obsolete, varies from four in *Aspidisca* (fig. 74), and in *N. pteliæella* (fig. 72), to eight in *Antispila cornifoiliella* (fig. 70), or only two in *A. ampelopsiella* (fig. 73). *Antispila* has floated around among the *Tineina* as if playing "puss wants a corner." It found a corner for a time among *Elachistadæ*, from which Mr. Stainton removes it, and places it in *Glypipterygidæ*. *Aspidisca* must go with it, and both seem to me to be related by the larval trophi to *Nepticula* and to *Bedellia*, and, so far as the labrum is concerned, to *Tischeria*, which, however, is separated widely enough from them by the maxillæ. I have not seen the larva of *Elachista*. Indeed, the larva of only one of our American species is known at all, and that I think only to Dr. Clemens. But the imago grades through some of our genera of small moths (*Elachista*

concolorella, *Eriphia concolorella*, and other species, *Laverna* (*Perimede erransella*, *Laverna gleditschiæella*, etc.) into the true *Laverna*, so that the close family connection of *Elachista* with *Laverna* can hardly be questioned. But by its larval trophi, *Laverna* is much nearer to *Gelechia* than it is to *Bedellia* or *Tischeria*, which Mr. Stainton places in *Elachistadæ*. From the abundance of species and individuals of *Elachista* in Europe, that genus is probably the most characteristic of the family to which it belongs, and properly give to it the family name. In this country, however, it would, I think, more properly be called the *Lavernadæ*.

Whatever value, if any, attaches to these differences in larval trophi, it is at least curious that of the multitude of larvæ examined all should fall so readily into one or other of these groups. These differences, at least those as to the number of spines on the labrum, do not indicate families, such as *Papilonidæ*, *Tineidæ*, etc., but larger groups. On any theory of the descent of the Lepidoptera from a common ancestral form, and if the larvæ represent a period of development of the order earlier than the pupa and imago, then we must have in their trophi a nearer approach to that of the original form, and the great uniformity which now prevails among the larvæ, as to their trophi, indicates how little variation has taken place in these organs in the long lapse of ages since Lepidoptera first made their appearance on the earth. What, too, are we to think of the "first form" of trophi, destitute, as it is, of spinneret, palpi and maxillæ? Does it represent an earlier form of trophi than the ordinary form in the history of the order, or is it a degraded form? To my mind it is a degraded form — degraded from such trophi as it has after the first form is thrown off, and the labrum is armed with ten spines. Then looking to *Cemiostoma*, *Tischeria*, *Antispila*, etc., which never have the "first form," how are we to account for the curious modification of the maxillæ in the first two, and of the labrum in all of this group? Are they, too, degradations; or do they represent an earlier condition of the "ordinary form?"

The *Lepidoptera* have by some been supposed to have a genetic connection with the *Phryganiidæ*. I have observed the trophi of but few of the larvæ of the latter, but have not found anything in them to indicate any close connection with Lepidoptera. Indeed, the larval trophi of the Lepidoptera seem to have as close a resemblance to those of some *Coleoptera* as to those of any other order, though sufficiently distinct from them, even without taking into consideration the spinneret.

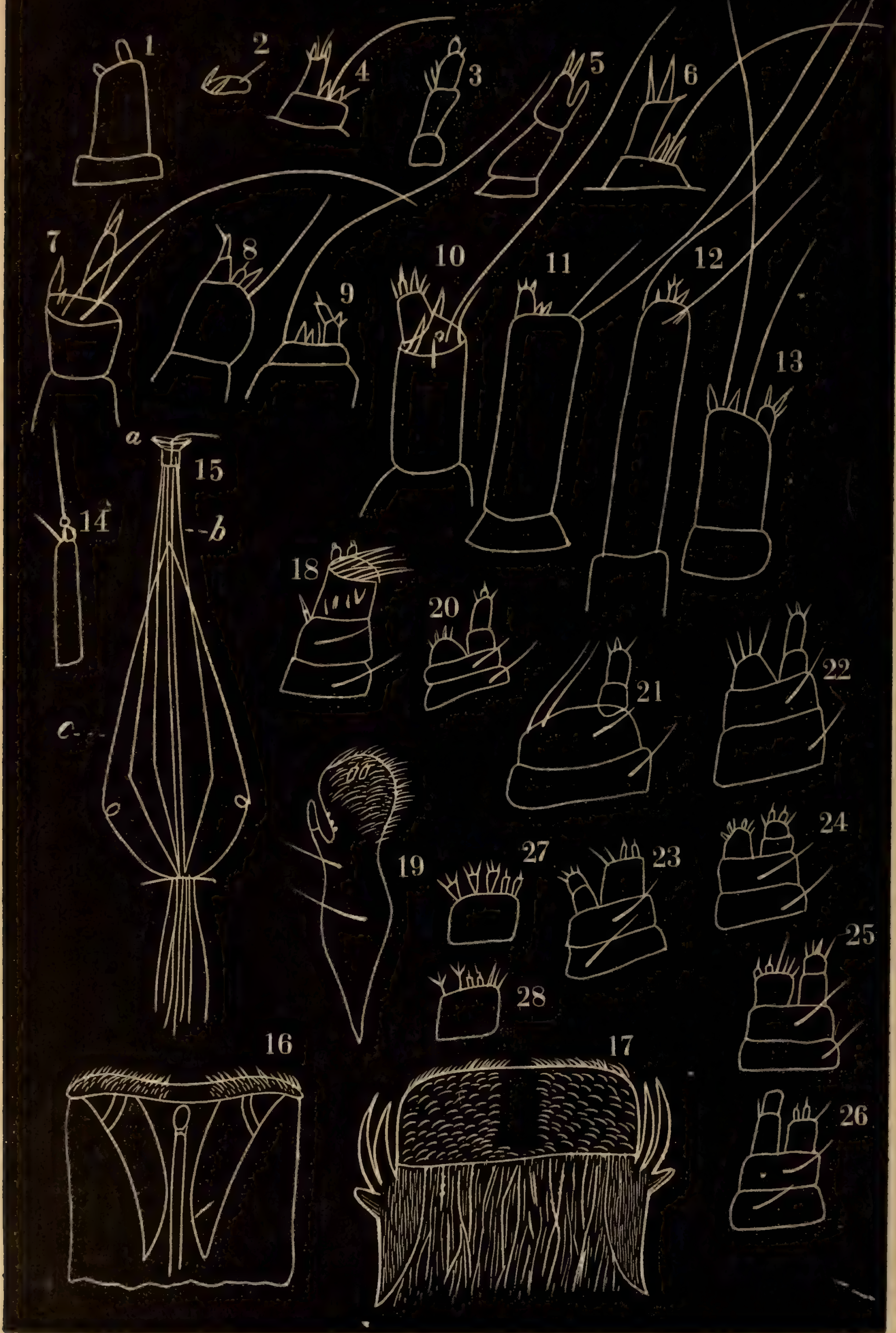
In conclusion, if it be suggested that it is the habit of burrowing in leaves that has produced such modifications as those shown in the "first form," what, I will ask, has produced such different modifications in the leaf-mining *Cemiostoma*, *Tischeria*, *Nepticula*, *Antispila*, etc.? and why has the same habit produced no modification whatever in the leaf-mining *Gelechidæ*, *Coleophora*, *Laverna*, etc.? for there are multitudes of leaf-mining larvæ of these and other genera which show no modification of the trophi whatever. To me it seems rather that a Guiding Intelligence shapes their (anal and cephalic) ends!

EXPLANATION OF THE FIGURES.

Fig. 1. Antenna of *Phyllocnistis vitifoliella*, Cham., 1st form.
2. " " " " 2d form.
3. " *Lithocolletis hamadryadella*, Clem., 1st form.
4. " " " " 2d form.
5. " " *robiniella*, Clem., 1st form.
6. " " " " 2d form.
7. " " *ornatella*, Cham., and *Leucanthiza amphicarpeæfoliella*, Clem., 2d form.
8. " *Ornix inusitatumella*, Cham., 1st form.
9. " " 2d form.
10. " *Gelechia cercerisella*, Cham., and other *Heterocera*.
11. " *Dryopteris* and other *Heterocera*.
12. " *Platysamia cecropia*.
13. " *Sesia*, *Laverna*, *Pieris*.
14. Labial Palpus of Lepidopterous Larvæ.
15. Labium and Spinneret (ordinary form).
16. " of *Lithocolletis hamadryadella*, 1st form.
17. " " *Ornix*, 1st form.
18. Maxilla of *Cemiostoma*.
19. " *Tischeria*.
20. " *Lithocolletis hamadryadella*, ordinary form, it is absent in the first form.
21. " *Lithocolletis ornatella*.
22. " *Leucanthiza amphicarpeæfoliella*.
23. " *Gracillaria eupatoriella*.
24. " *Antispila*.
25. " *Tinea*.
26. " *Platysamia cecropia*.
27. " *Plutella cruciferarum* (terminal joint).
28. " *Eudamus tityrus* (terminal joint).
29. Mandible of *Lithocolletis hamadryadella*, 1st form.
30. " " " 2d form.
31. " *Coriscium* and *Phyllocnistis*, 1st form.
32. " *Lithocolletis* (cylindrical), *Ornix*, and *Gracillaria*, 1st form.
33. " " " " " 2d form.

Fig. 34. Mandible of *Tischeria* and *Nepticula.*
35. " *Prodoxus.*
37. " *Gelechia.*
38. " *Laverna.*
39. " *Tinea.*
40. " *Bedellia.*
41. " *Theridopteryx.*
42. " *Arctia.*
43. " *Euchætes.*
44. " *Plutella.*
45. " *Pieris.*
46. " *Dryopteris.*
47. " *Papilio.*
48. " *Eudryas.*
49. " Unknown Larva found on Oak.
50. " *Eudamus.*
51. " *Notodonta.*
52. Labrum of *Lithocolletis, robiniæella*, 1st form.
53. " " " 2d form.
54. " " *guttifinitella*, 1st form.
55. " " " 2d form.
56. " *Phyllocnistis vitifoliella*, 1st form.
57. " " " 2d form.
58. " *Gracillaria eupatoriella*, 2d form.
59. " *Prodoxus.*
60. " *Pronuba.*
61. " *Coleophora.*
62. " *Sesia.*
63. " *Plutella.*
64. " *Eudamus.*
65. " *Papilio.*
66. " *Platysamia.*
67. " *Cemiostoma.*
68. " *Bedellia.*
69. " *Nepticula saginella.*
70. " *Antispila cornifoliella.*
71. " *Nepticula* (from hickory leaf).
72. " " *pteliæella.*
73. " *Antispila ampelopsiæella.*
74. " *Aspidisca splendoriferella.*
75. " *Tischeria malifoliella.*
76. " " (from oak leaf).

PLATE, A.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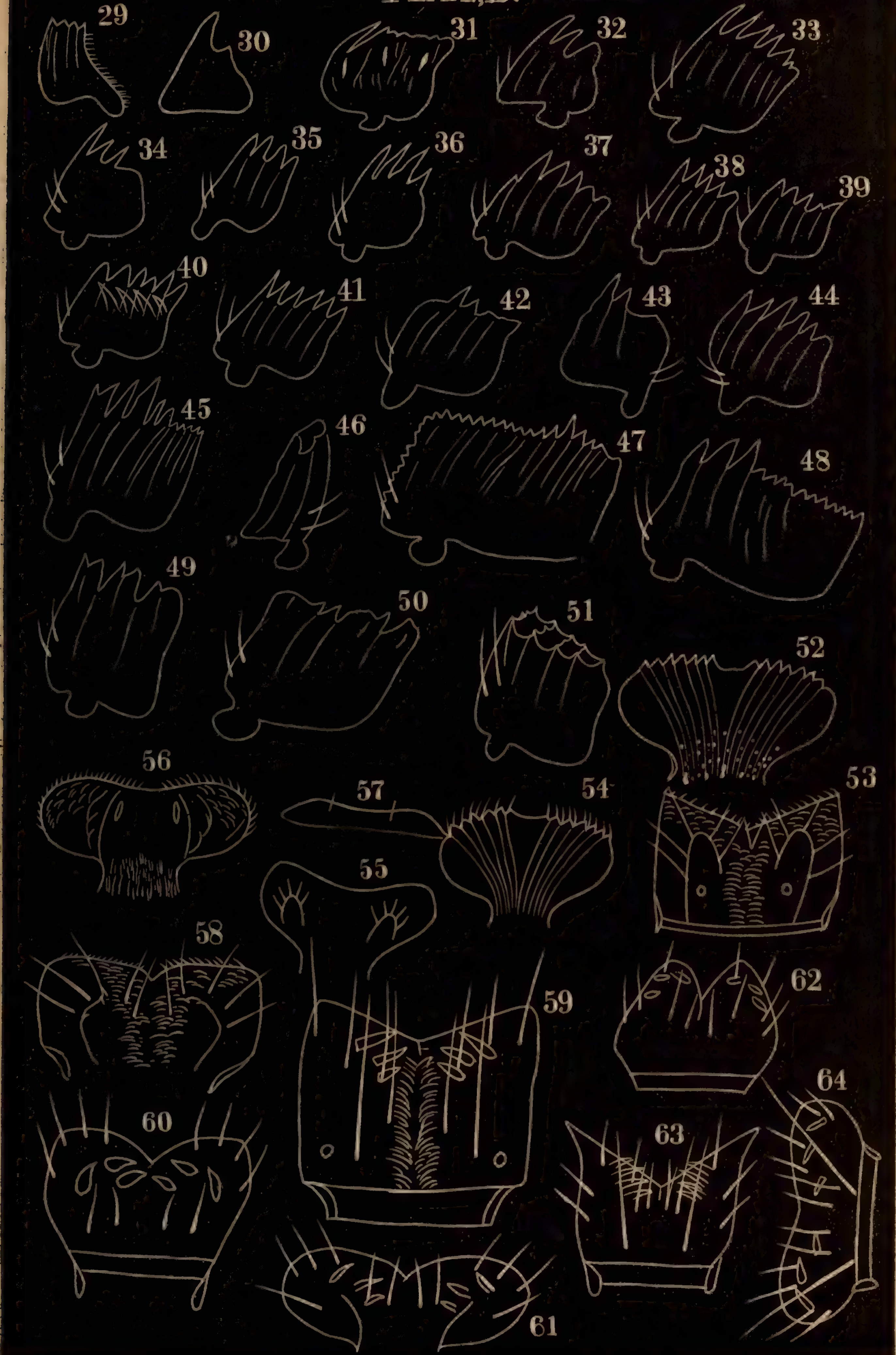
PLATE, B.



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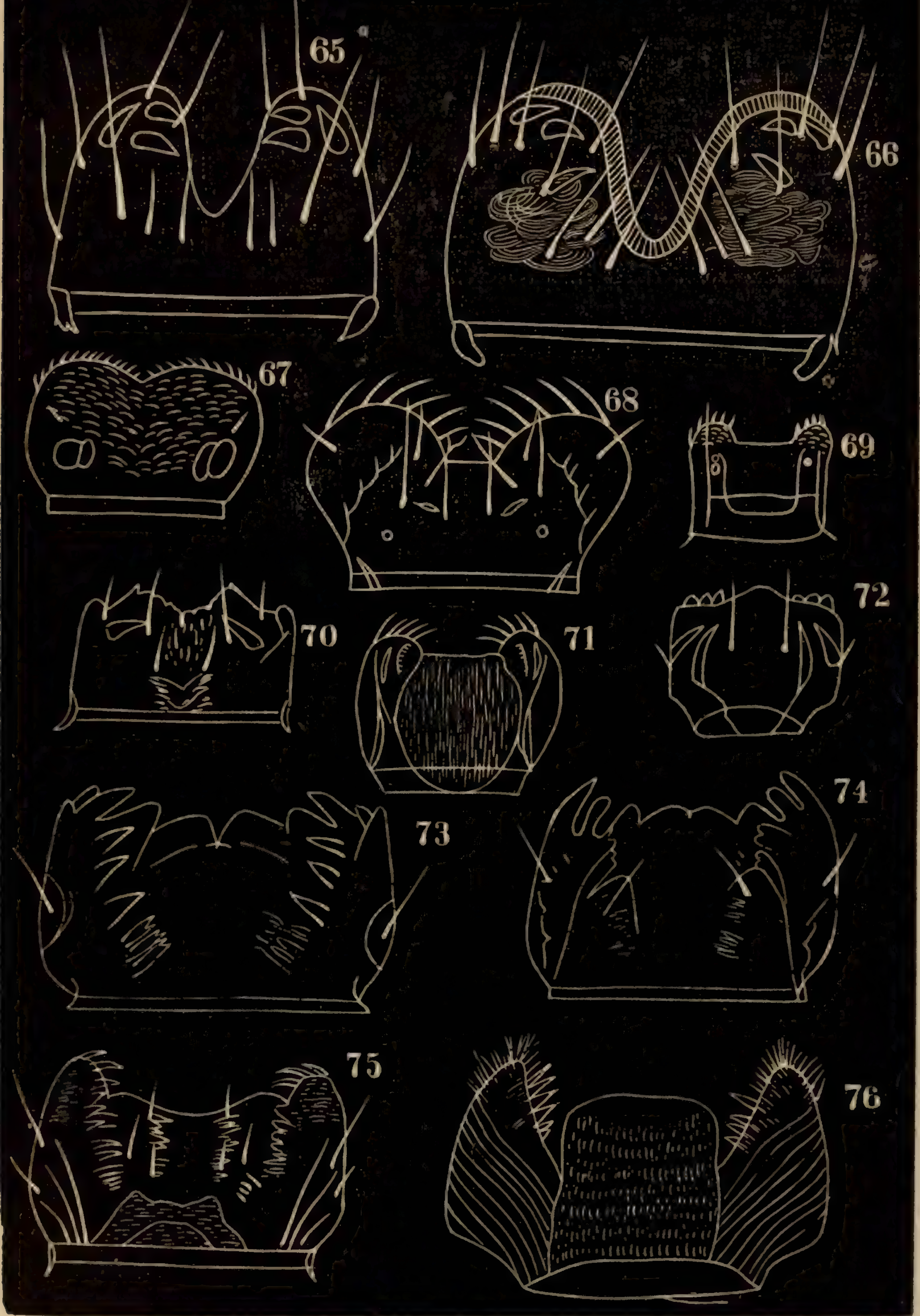
PLATE, C.



NOTICE OF A WORK BY PROF. NICHOLSON ON THE GENUS MONTICULIPORA.

By S. A. Miller, Esq.

In 1874, the writer said, that "after the most careful examination of hundreds of specimens, polished and unpolished, fractured and weather-worn, under the most favorable circumstances, the fact that no coral possessing the generic characters of *Chetetes* was ever found within the Cincinnati Group, seems too clearly established to leave a remnant of doubt upon the subject." That in *Chetetes* "it is a generic characteristic that the walls of the tubes are inseparably connected together, owing to the fissiparous method of reproduction, while the walls of the corals from this locality readily separate."*

Prof. Nicholson found it impossible to separate *Monticulipora* from *Chetetes*,† and consequently referred our corals to the latter genus. This view he continued to entertain until a comparatively recent date, when he changed his mind, and referred them to the former genus, though it can not be said that very much new light had been thrown upon the subject since the work of Edwards & Haime, published nearly twenty years ago. The late work by Prof. Nicholson, "On the Structure and Affinities of the Genus *Monticulipora*, and its subgenera," is almost entirely devoted to the corals of this locality, and hence contains a revision of the work done in the "Ohio Palæontology," which is worthy of an extended notice.

He has subdivided the genus *Monticulipora* into five subgenera, viz.: *Heterotrypa*, *Diplotrypa*, *Monotrypa*, *Prasopora*, and *Peronopora*. The characters are founded upon microscopic observations, and their value, therefore, is not evident to an ordinary observer. I will not undertake to say that this subdivision is wholly without any foundation, but that it is not without serious objections will be apparent in the following review of the work, in contrast with his earlier determinations.

Monticulipora mammulata is left where D'Orbigny placed it in 1850, except that he refers it to the subgenus *Heterotrypa*. A form which has been usually referred to this species, but more densely tuber

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* Cin. Quar. Jour. Sci., vol. i., p. 368.
† Ohio Pal., vol. ii., p. 188.

culated, is called *Monticulipora (Perenopora) molesta*, and another allied form is called *Monticulipora (Heterotrypa) dawsoni.*

His *Chetetes gracilis* is now *Monticulipora (Heterotrypa) gracilis; Chetetes nodulosus, Monticulipora (Heterotrypa) nodulosa ; Chetetes jamesi, Monticulipora (Heterotrypa) jamesi*, and a closely allied form is *Monticulipora (Heterotrypa) implicata.*

The form which he referred to, *Chetetes dalei,* in the Ohio Survey, and which is so well known here as *Monticulipora dalei* of Edwards and Haime, he now refers to *Monticulipora ramosa*, D'Orbigny, 1850, and hence the rugose form of the same species is called *M. ramosa*, var. *rugosa.* I have never seen the work of D'Orbigny, but I can not help expressing my surprise at this identification, at so late a day, though it is probably correct.

The form which he described as *Chetetes approximatus*, in the Ohio Survey, he now says is a synonym for *Monticulipora dalei* of Edwards and Haime, but he regards it as merely a variety of *M. ramosa.* He has certainly been very much misinformed about this species, for he says that it occurs associated in the same beds, at Cincinnati, with *M. ramosa* and *M. ramosa*, var. *rugosa*, and possesses only a slight external difference, with a complete agreement in internal structure, both tangential and longitudinal sections, showing features precisely similar to those exhibited by corresponding sections of typical examples of *M. ramosa.*

In 1875, the writer said, "*Chetetes approximatus* of Nicholson, which should be written *Monticulipora approximata*, is never, so far as my observation has extended, covered with elongated tubercles, as in the rugose variety of the *dalei.* Moreover, the *approximata* is found abundant in the rocks from 300 to 350 feet above low water mark, where it is very rare to see a piece of the *dalei*, while the latter abounds in the rocks from 350 to 400 feet above low water mark, where the former is comparatively quite as rare as the latter is in the rocks first mentioned."* The difference in the range of the two species is, however, greater than I then stated.

The *M. approximata (M. dalei)* may be found in great abundance below the Eden Park reservoir, and about midway of the side hill below the Park, at an elevation of from 200 to 300 feet above low water mark. Clusters may be collected nearly a foot in diameter, and eight inches in height. Specimens too large to go in a peck measure are not uncommon, and yet, throughout this entire range, I have never collected a specimen

* Cin. Quar. Jour. Sci., vol. ii., p. 354.

of what I have heretofore called *M. dalei*, and which is now referred to *M. ramosa.* The latter species abounds on the tops of the hills at Mount Auburn and Corryville, and other places in the city, at an elevation of 350 to 425 feet, where the former is never found. It may be that, between these two ranges, the two species will be found in the same strata, but, at present, I do not recall to mind any instance of finding the two species associated on the same slab. There are no two species in the genus that seem to be more easily distinguished than these. The *approximata* (*dalei* now) is found in clusters as large or larger than the *dalei* (*ramosa* now), but the branches are much smaller, bifurcate at different angles, the monticules are not half as large, nor half as numerous, nor are the interstitial tubuli half so abundant. And if it be true that microscopic sections show no distinguishing differences, we may hesitate before accepting species founded alone upon tangential and longitudinal sections, and with still stronger reason doubt the validity of subgenera established in this manner.

Chetetes pulchellus of the Ohio Palæontology, he now describes as a new species under the name of *Monticulipora* (*Heterotrypa*) *andrewsi.* No one in this country had ever thought of referring this form to the *Monticulipora pulchella* of Edwards and Haime until Prof. Nicholson had so described it in the Ohio Palæontology. And, in 1875, immediately after his identification was in print, I said, "I do not think that *pulchella* is found here at all. Edwards and Haime had before them many corals from this locality, and as the coral now referred by Prof. Nicholson to their species is the most abundant coral in our rocks, it would seem highly probable that they were in possession of it, when they wrote their work on the British corals, in which they frequently referred to localities in America, yet when making the species *pulchella*, the only locality mentioned was England. They described *pulchella* as follows: 'Corallum ramose; its branches often somewhat compressed, and from two to four lines in diameter. Tubercles, broad, not very prominent, and somewhat stellated. Calices rather regularly hexagonal, and very unequal in size; those that occupy the center of the tubercles about one fifth of a line in diameter, and at least twice as large as those placed in the intervals between the groups thus formed.' Our species is usually much larger than this one, and it is very rare to find the branches compressed; the prominences or tubercles are not stellated; the calices are not regularly hexagonal, though as they are crowded together some of them may be hexagonal, while others are pentagonal or heptagonal or approaching a circle, there

being no regularity in their form, and no uniformity in their size. In specimens four lines in diameter, the calices, that occupy the center of the tubercles, are from 1-6th to 1-8th of a line in diameter; the distance from the center of one tubercle to the center of the next, is about one line, and the average number of calices, in that distance, is about twelve. Moreover, Edwards and Haime distinguished *pulchella* from *fletcheri*, by the more acute angle of bifurcation of the branches in the former than in the latter, while no such distinguishing character could be applied to our species, as it bifurcates at all angles. Thus it seems, that our species differs, more or less, in every character from those ascribed to *pulchella* by its authors. For these reasons I do not think that *pulchella* exists in the Cincinnati Group, and it is quite evident that the corals referred to this species by Prof. Nicholson, are the same that were described by Goldfuss in 1826, under the specific name *fibrosa*. If the corals referred to do not belong to the genus *Stenopora*, the name, should be written *Monticulipora fibrosa* instead of *Chetetes pulchellus* and *Chetetes attritus*, and *Monticulipora subpulchella* instead of *Chetetes subpulchellus*."*

In my catalogue of American Palæozoic Fossils, p. 48, published in 1877, I said that I thought *pulchella* is not found in this country, and printed it in the condemned list in italic letters.

These remarks would be incomplete if I did not add that not only did I never adopt Prof. Nicholson's identification of *pulchella*, but that I know of no American palæontologist who did, and that all the credit of the mistaken identification and persistence in it belongs to Prof. Nicholson himself.

The application of these statements will be apparent from the following quotation from his description of the same form under the new name of *Monticulipora* (*Heterotrypa*) *andrewsi*, wherein he makes the observation, that it is the species "which has generally been recognized by American palæontologists as identical with the *M. pulchella*, Edwards and Haime, of the Wenlock Limestone of Britain. So far, in fact, as its external characters are concerned, it is very like *M. pulchella*, resembling it especially in the existence of clusters of thin-walled polygonal corallites, interpersed at short intervals among similarly shaped but slightly smaller tubes. In the absence, therefore, of any accurate microscopic knowledge of the internal structure of the two forms, it was almost inevitable that they should have been grouped

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* Cin. Quar. Jour. Sci., vol. ii., p. 353.

together, though their minute characters, as will appear hereafter, are very different."

For one, who rarely gives credit to American authors for labor performed in this department of science, to charge them with his own mistakes may be regarded as a little cool.

Chetetes fletcheri of the Ohio Palæontology, is now called *Monticulipora (Heterotrypa) ulrichi.* As in the last case of erroneous identification, Prof. Nicholson was the first to call this form the *fletcheri* of Edwards and Haime, and I am unable to find any warrant for his observation in the new definition, in these words. "In common with various American observers, I have formerly identified the present form with the *M. fletcheri*, Edwards and Haime, of the Wenlock Limestone of Britain. I am, however, now satisfied that the examples from the Cincinnati Group certainly can not be properly thus identified with our present knowledge.''

Chetetes subpulchellus is now *Monticulipora (Heterotrypa) subpulchella*, and is said to be rare, at Cincinnati. After the publication of the Ohio Palæontology, I identified, with the description and figures of this species, a common form occurring at an elevation of about 150 feet above low water mark, but with the new definition and limitation the form intended is not so evident.

When the *dalei*, *ramosa*, *mammulata*, and *nodulosa* are associated, under the same generic name, with the *jamesi* and *gracilis*, the remaining polyp corals, in the Hudson River Group, may as well be dumped into the same genus, without attempting a subdivision.

Chetetes petropolitanus is now abandoned as an American species, and the Russian form of Pander is called *Monticulipora (Diplotrypa) petropolitana.* And it is needless to say, that the singular paragraph, which concludes the remarks on this species, in the Ohio Palæontology, is also abandoned, viz: "I am disposed to think that *Lichenalia concentrica*, Hall, has been founded upon the epitheca of *C. petropolitanus*, which is often of sufficient tenuity to allow the bases of corallites to be seen through it."

In 1874, I stated that the "*Chetetes petropolitanus*, found in the Lower Silurian rocks of Russia, in which Lonsdale discovered the divisional laminæ of one tube developed within the area of one which preexisted, does not exist in this locality."* And in 1877, in the Catalogue of the American Palæozoic Fossils, I condemned the applica-

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* Cin. Quar. Jour. Sci., vol. i., p. 368.

tion of the name to American forms by placing it in italics, and said that "it is not evident that this species is found in America."

Monticulipora calyculus is recognized as a species, and placed in his subgenus *Diplotrypa.*

Monticulipora irregularis is placed in his subgenus *Monotrypa.*

His *Chetetes sigillarioides* is classed as a synonym for *Monticulipora onealli.*

His *Chetetes rhombicus* is abandoned as a synonym for *Monticulipora quadrata.* This I did in my Catalogue of Palæozoic Fossils, see p. 48.

Monticulipora clavicoidea is recognized as a species, and referred to his subgenus *Monotrypa.* The same disposition is made of *Monticulipora calceola.*

A form closely related to *Monticulipora lycoperdon* is described as *Monticulipora petasiformis*, and referred to the subgenus *Monotrypa.*

Chetetes discoideus is now called *Monticulipora* (*Monotrypa*) *discoidea.*

Chetetes clathratulus is abandoned as a synonym for *Monticulipora pavonia* of D'Orbigny. He says, "This beautiful form presents a considerable superficial resemblance to *Ptilodictya*, and has been referred to this genus. It wants, however, the definitely circumscribed and peculiarly marked lateral margins of the fronds of this polyzoan type, and what is more important, it is without the peculiarly striated central lamina of the *Ptilodictyæ.* It is true that the bases of the corallites in *M. pavonia*, D'Orb., are so united with one another as to give rise to an irregular calcareous membrane, which separates the two halves of the corallum; but none of the specimens that I have seen exhibit any tendency to split along the line of this membrane, nor can the corallites be forcibly removed from one side of it, exposing the median lamina as a definite structure. In both these respects the *Ptilodictyæ* would show quite different phenomena."

In 1860, Dr. Prout* founded the genus *Cyclopora* for certain Bryozoa, and described the species under consideration as *Cylopora jamesi*, as follows:

"*Polyzoum*, a fragment showing mostly the sole, with chalices superposed upon both faces on certain parts of the specimen; sole formed of more or less concentric ridges, bent or erratic at times, crossed by delicate striæ, or lines, the intervals between which appear like long,

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* Trans. St. Louis Acad. Sci., p. 574.

septate, parallel flattened tubes, the apparent septæ marking the origin of the chalices; intersections of the ridges and striæ mostly at right angles; chalices, or net-work of chalicular apertures, almost regularly quadrangular, somewhat more delicate and condensed where worn than the preceding species, from which it is furthermore distinguished by rythmical swellings upon the surface, or light tuberculations, upon which the chalices are larger and more irregular in form; number of chalices in a space of two lines square, about one hundred. It must have belonged to a specimen from at least four to six inches in length and width, as the concentric ridges upon it are so gently curved as to show a great relative distance from the center."

It is plain, from this description, that Dr. Prout had a specimen that was split, showing the membrane that separates the two halves of the corallum, and notwithstanding Prof. Nicholson has never seen any such, it is a fact that split specimens, showing the concentrically wrinkled calcareous membrane upon either half, are not rare, but, on the contrary, more frequently occur than split specimens of any other bryozoan found in the Hudson River Group. In 1877, in the Catalogue of American Palæozoic Fossils, I followed Dr. Prout in referring this species to the Bryozoa, under the name of *Cyclopora jamesi*. I have no doubt that it is a bryozoan, and, unless the genus *Cyclopora* shall be subdivided, and another species taken as the type, it will remain in that genus. As *pavonia* has priority as a specific name, it should be called *Cyclopora pavonia*, unless it is made to appear that D'Orbigny described another form. I have never seen either D'Orbigny's work, or the *Pol. Foss. des Terr Pal.*, of Edwards and Haime, and hence accept the name *pavonia* on the authority of others. I was not aware, however, that any one had classed the form with the *Ptilodictya* until I learned it from the book under review. The observations upon this species by Prof. Nicholson strongly reminds one of the story of the man who did not believe that water could be frozen into ice, because he had never seen it done, and it may be laid down as a general rule, that where an author ignores the writings and observations of others, and depends upon limited information and experience from which to draw generalizations, we may expect some mistakes; and if he describes new species of fossils, the flood of synonyms will be limited only by his means of publication.

Chetetes briareus is now *Monticulipora* (*Monotrypa*) *briarea*. *Chetetes corticans* is abandoned as a synonym for *Monticulipora tuberculata*, which he refers to his subgenus *Monotrypa*, though

without any reason, while he admits the possibility of its being a bryozoan. *Chetetes newberryi* is now *Monticulipora* (*Prasopora*) *newberryi*. *Monticulipora selwyni*, var. *hospitalis*, is a new encrusting variety. *Chetetes frondosus* is now *Monticulipora* (*Peronopora*) *frondosa*. *Chetetes ortoni* is *Monticulipora* (*Peronopora*) *ortoni*. And *Monticulipora cincinnatensis* is referred to his subgenus *Peronopora*.

The medley of forms under the subgenus *Monotrypa* is quite as objectionable as those arranged under the head of *Heterotrypa*, beside including true Bryozoa with true Polypi, if these classes are found in the Hudson River Group.

He proposes that *Monticulipora lycoperdon* shall be dropped altogether, and that no attempt shall be made to revive it, but that a new name, which he proposes, shall be adopted in its stead. The reasons which he gives for so doing are not laid down in the laws of nomenclature, nor do they address themselves to the mind of an ordinary palæontologist. He seems to be quite innocent of the literature upon the subject, but familiar with some of the mistakes that others have made in identifying other forms with it. His philosophy, applied to other species, would suppress *Monticulipora petropolitana* in Russia, because he had made a mistake in referring an American form to it; it would suppress *Monticulipora pulchella*, in the Wenlock of England, because he had identified *Monticulipora fibrosa*, of America, with it; and so on, indefinitely, specific names would be suppressed on account of the subsequent blunders of others.

The specific name, *lycoperdon*, is attributed by American palæontologists to Say, though he did not describe the species. He was an eminent naturalist, and seems to have called it *Favosites lycoperdon*, by which name it became generally known from its puff-ball shape. In 1842, Prof. Emmons figured it under the name of *Favosites lycopodites*, as characteristic of the Trenton Group, of New York.* He said that he had not discovered it as high as the Utica Slate, and if any fossils are characteristic of the Trenton limestone, this is certainly one (p. 400). In the same year, Prof. Vanuxem figured and described it as characteristic of the Trenton Group, of New York.† He said, in referring to the illustration: "The *Puff-ball favosite* (*Favosites lycopodites*), from its resemblance to that common fungus, is also highly characteristic (of the Trenton limestone), and is in great num-

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* Rep. of the Survey of the Second Geological District, of New York, p. 389.
† Rep. of the Survey of the Third Geo. Dist. N. Y., p. 46.

bers; but it is found also in the lower part of the Utica Slate, where it ends. It is one mass of small, angular cells, arranged side by side. It is equally abundant at Frankfort, Kentucky, where it received the name of *Trianisites cliffordi*." Since that time it has been figured again and again in State surveys and geological publications, and as repeatedly mentioned and described as a characteristic form of the Trenton Group. In 1847, Prof. Hall figured it with transverse and magnified views, and called the branching corals from the Trenton Group *Chetetes lycoperdon*, var. *ramosus*. This variety, *ramosus*, he found in the Hudson River Group, but he says (*Hall's Pal.*, vol. i, p. 276): "This coral acquires its full development in the shaly part of the Trenton limestone, rarely appearing in hemispheric forms in the succeeding shales. In the more calcareous part of the Hudson River Group it occurs in ramose forms, similar to those already described, and assumes some other features in its mode of growth not observed in the limestone." So far as the literature of the subject goes, and my own acquaintance extends, there is no American palæontologist, and has been none since 1842, but who is or was familiar with the true type *lycoperdon* as it characterizes the Trenton Group. Some have supposed that branching corals might be mere varieties of this species, and that therefore the forms from the Hudson River Group might be classed with it, and others have from time to time distinguished and characterized species among the branching forms, but no one seems to have been ignorant of the true type of *lycoperdon*. It has never been a doubtful form. Indeed, there is no American coral where less doubt surrounds the true type of the species. Neither Emmons nor Vanuxem claimed the specific name of *lycopodites*, which is a barbarism, and, by the rules of nomenclature, any one is permitted to spell the name correctly, as Say evidently did, in the first instance, and it makes no difference as to the validity of the name, *lycoperdon*, whether it is followed by Say, as Hall did, in 1847, or by Emmons or Vanuxem, who illustrated and defined it in 1842. It will, no doubt, be used as the specific name of the puff-ball species by all educated palæontologists, as long as the binomial method of nomenclature shall continue to prevail.

Notwithstanding these criticisms, which I have thought are properly demanded, the book contains an amount of information that renders it, on the whole, of some value to science.

DESCRIPTION OF TWO NEW GENERA AND EIGHT NEW SPECIES OF FOSSILS FROM THE HUDSON RIVER GROUP, WITH REMARKS UPON OTHERS.

By S. A. MILLER.

GLYPTOCRINUS MIAMIENSIS, n. sp.

Plate I., fig. 1, side view, natural size.

This species is established, like many others have been, on a single specimen; but, in this case, we have a remarkably fine head, with arms and pinnules preserved, and 2 4-10ths inches of the column attached.

Body, proportionally, long and very gently expanding, so that its diameter at the free arms is only about two thirds of its length; obconoidal, with interradial and intersecondary radial spaces depressed, so as to give it subangular outlines corresponding with the radial series. Surface smooth or slightly granular, but devoid of all sculptured, angular and radiated ornamentation.

Basals.—Basals well developed, forming the lower part of the calyx, with high projecting angles between the under sloping sides of the first primary radials.

First radials.—First radials large, about as high as wide, hexagonal and having long, under sloping sides resting upon the basals, shorter sides in contact with each other and the interradials, and a truncated upper side. The central part of the surface of the upper half rapidly swells, or is contracted into a round ridge, which, in its extension upward, gives a subpentagonal outline to the body.

Second radials.—Second radials a little smaller than the first, about as high as wide, and heptagonal, as three interradials abut upon one side of each, and two on the other. The ridge that commences below becomes semi-cylindrical in its extension upward across this plate, and gives to this part a decided pentagonal outline.

Third radials.—Third radials, about the size of the second, nearly as high as wide, and heptagonal, as two interradials abut upon them upon either side. The secondary radials rest upon the upper, slightly sloping sides. The bifurcation of the ascending radial ridge takes place on the upper third of the plate.

Secondary radials.—In one of the series in our specimen (that upon the right) there is no further division of the radials or arm plates Six or more plates seem to enter into and form part of the calyx in

each series before the two arms become free. The first one has a length equal to that of the third primary radial, but the succeeding plates are shorter, without any determined contraction in width, and graduate up to the cuneiform plates that form the free arms. Were the other radial series like this one, we would have a species with only ten arms, but such is not the case. In the other series, in our specimen (that upon the left) there are three secondary radials, each of which has a length about equal to the third primary radials. Upon the upper sloping sides of the third secondary radials arise tertiary radials, the first of which has a length nearly equal to that of a secondary radial. The succeeding plates are shorter and seem to graduate into the cuneiform plates of the free arms at about the sixth plate. Here are four arms to this radial series or twice as many as there are in the first described series. We are not prepared to call this anomalous arrangement abnormal, for the specimen is well developed, and the arms well preserved and the species quite distinct in other respects from any hitherto described.

Interradial and intersecondary radial areas.—These areas are depressed. The first plate rests between the upper sloping sides of the first primary radials, this is followed by a range of two plates, and these again by a range of two, and these by a third series before passing the top of the third primary radials. Above this, plates continue to fill the narrow interradial space to the top of the calyx, but neither their number nor arrangement has been accurately ascertained. The first plate in the intersecondary area rests between the first secondary radials, this is followed by a single plate between the second secondary radials, and above this the plates have not been determined.

Arms and Pinnulæ.—The number of arms is not known, because we can not say that if two series have six arms, five will have fifteen. Where only two series are known, as in this case, and one has two arms, and the other four, it is evident that the species has more than ten arms, and less than twenty. From the appearance of the parts exposed, on the right of the series first above described, I infer that there are four arms in the adjoining series ; and from the parts exposed on the left of the last described series, we have here the azygous area. If this supposition is correct, then we have four arms in the right anterior series, two in the right posterior series, and four in the posterior series. The free arms rise vertically. They are long and slender, round on the outer side, and are composed of numerous cuneiform plates, the length of four or more of which is only equal to the diameter of

the arm, and each of which supports at its larger end a pinnule. The pinnules are long and very slender, and composed of long-jointed pieces.

Column.—The column is round, and composed of alternately thicker and thinner plates. These project beyond the parts of contact, the thicker plates project beyond the thinner ones, as is usual in other species of this genus. As we recede from the head the larger plates are more distant from each other and project less. The column enlarges a little as it approaches the head. The column, in our specimen, is half embedded in rock, and we have no fragments for examination, hence other peculiarities and distinguishing characters must await some future definition.

The specimen described is from the magnificent collection of I. H. Harris, Esq., of Waynesville, Ohio, and is from the upper part of the Hudson River Group, at that locality.

Remarks.—Messrs. Wachsmuth and Springer seem to have been practically unacquainted with this genus, as their diagnosis requires that the surface of the plates should be "ornamented with radiating striæ in form of elevated ridges which divide into numerous triangular impressed areæ;" that the basals should "scarcely extend to the sides of the body;" that the second radials should be "hexagonal;" that the third radials should be "pentagonal," and as to the succeeding plates the diagnosis would include those of almost any other genus in the family; and having "arms twenty." The above described species would not be included in their diagnosis, and yet I have not the least doubt that it is a true *Glyptocrinus*; it may be that they would refer it to *Reteocrinus*, or propose for it a subgeneric name,—neither course, do I think, would be warranted, with our present knowledge of the structure of crinoids; and this possible reference may justify a few remarks upon Billings' genus.

The genus *Reteocrinus* was described by Billings, as consisting of a reticulated skeleton, composed of rudimentary plates, each consisting of a central nucleus, from which radiate from three to five stout processes. Of such plates there are five in the basal series, five in the sub-radial, and five in the radial series. On the azygous side the sub-radial has five processes; the others have four each. The type species, *R. stellaris*, is well illustrated (plate IX., figs. 4 and 4*a*, *Can. Org. Rem. Decade IV.*), showing these characters. The azygous subradial has five processes, three above and two below. The first primary radial in the right anterior ray has three processes, the upper one of which

supports an arm, while the two lower rest, one of them on one of the upper processes of the azygous subradial, and the other upon a process of the right anterior subradial, and it is probable that the other rays are constructed and situated in nearly the same manner. The right arm divides above the fourth plate. The number of primary radials in the other arms was not certainly ascertained. The spaces between the arms is occupied by numerous small stellate plates.

Prof. Billings was an accurate observer, reliable in his statements, and has not been excelled in his knowledge of the structure of Silurian crinoids by any American palæontologist. The characters that he observed in the genus *Reteocrinus* can not be set aside as erroneous, until some one, from an examination of specimens of *R. stellaris*, shall have pointed out mistakes, and even then, if the genus stands, *R. stellaris* will be the type.

Up to this time, no crinoid possessing the characters ascribed to this genus has been found in the Hudson River Group of this locality. The well-developed basals, large subradials and peculiar azygous subradial, with its elevated ridges extending to the primary radials on either side, and the bifurcation on the fourth primary radial, are important parts of the structure, beside, it is distinguished for its reticulated appearance, owing to the large connecting ridges, extending from the basals to the subradials, and from the latter to the primary and secondary series, and the depressed interradial spaces occupied by small stellate plates.

Messrs. Wachsmuth and Springer have disposed of the genus *Reteocrinus*, of Billings, by saying that it "was described from imperfect material, and altogether misunderstood by its founder," and then proceeding to make *Glyptocrinus onealli* the type of the genus *Reteocrinus*. This is too open a violation of the rules of nomenclature to receive much consideration, beside their separation of the species under this genus, and that of *Glyptocrinus*, shows, to one familiar with the structure, such a cross-mixture of characters as to indicate a want of general acquaintance with the genera and species.

Glyptocrinus sculptus, n. sp.

Plate I, fig, 2, natural size.

Body somewhat urn-shaped, nearly as wide as high, sides rounded below, forming an angular, cup-shaped base. Interradial and intersecondary radial areas flattened and slightly depressed below the radial ridges, giving it a marked angular outline.

Basal plates more fully developed than they are in *G. decadactylus.* The two ridges extending below, from the center of the first radials, and uniting with the ridges on the surface ot the basals, rapidly expand, as they do in *G. angularis.* The first, second, and third radials are much like the same plates in *G. decadactylus*, except the radial ridge is smaller, and the plates are wider in proportion to their length.

There are three secondary radials in each series, which are a little smaller than the primary radials. The upper sloping sides of the third secondary radials support six or eight brachial plates before the arms become free. The free arms are directly continued from the brachial plates without another bifurcation. There are twenty long, round arms, composed of cuneiform plates, and having long, slender pinnules. The column is round, and composed of alternately thicker and thinner plates. The surface of the plates is deeply sculptured. The number of plates in the interradial areas has not been determined.

This species is founded upon two specimens from the collection of I. H. Harris, Esq., of Waynesville, Ohio. They were found in the upper part of the Hudson River Group, in that vicinity.

Anomalocrinus.

Plate I., figs. 3 and 3*a*, roots and lower part of the columns; fig. 3*b*, part of a column longitudinally divided into fifteen parts; 3*c*, part of a column longitudinally divided into twenty parts; fig. 3*d*, interior view of part of a column; fig. 3*e*, transverse section, showing the size of the central opening.

The column of this genus was almost, or quite, unknown to Prof. Meek, and as Wachsmuth and Springer, in their *Revision of the Palæocrinoidæ*, p. 73, have copied only what Prof. Meek said, in *Ohio Pal.*, vol. i., p. 18, where he was evidently describing the base and lower part of the column of a *Heterocrinus*, as I pointed out in the *Quarterly Journal of Science* eight years ago, instead of the *Anomalocrinus*, I have deemed it important to illustrate and describe some of the parts of the column and its roots. If these parts are of special morphological importance, as they seem to be, because constituting so much the larger part of the crinoid, and possessing such complicated and variable structure, then the family affinities of this genus may not be correctly ascertained. Instead of having a flat base as in *Heterocrinus*, it possessed roots that enabled it to cling to several stems of a branching coral. The roots are not numerous, as in *Eucalyptocrinus*, but still there are several springing from each base, that has fallen under my observation. It seems to have grown in clusters, with

bases and roots interlocking and attaching to supports, in such manner, as to indicate that it was, at all periods of life, a stationary crinoid.

Immediately above the roots, the column is round and smooth, next we observe that it is longitudinally divided into five parts, and then longitudinally fifteen partite, with a large, rayed, pentagonal, central opening. The truncated ends of the rays each abut upon one of the longitudinal parts, and two of the longitudinal parts fill each of the interspaces. At another part of the column it is composed of twenty longitudinal rows of plates, three of which occur between the ends of the rays and one at each of the ends. Each longitudinal part or row of plates consists of an alternate arrangement of three, four, or five thin plates, followed by a thick projecting plate. This structure forms a tuberculated column, the tubercles being arranged in longitudinal and transverse order. Near the head the tubercles are less conspicuous than below.

The interior of the column may be described as follows: The spaces between the rays of the opening consists, in each instance, of a smooth angular projection or ridge composed of numerous plates, while the intervening spaces or the rows of plates that abut upon the ends of the rays of the opening are not smooth, but consist of alternately projecting pieces which make each space as rough as the exterior.

The column is the largest known from the Hudson River Group, and much the most complicated in its organization. The specimens illustrated are from my own collection, and I found them near the top of the hills within the city limits.

Stomatopora proutana, n. sp.

Plate I., fig. 4, slightly enlarged; 4*a*, magnified view; 4*b*, magnified many diameters. These views are only approximately correct.

Polyzoary creeping, adhering its whole length to other objects, and branching at irregular distances. Each branch arises as a delicate line in front of and below the preceding swollen cell, and where two branches arise from below the same swollen cell, their angle of bifurcation varies from 10 to 90 degrees. The branches enlarge very little, if any, for the distance of about half a line, when each gradually expands into a subpyriform termination, containing a single cell mouth. The distance between the subpyriform expansions varies from three to six times the length of each, and the greatest diameter of the expansion is only about twice as great as the diameter of the branch below.

The cell-mouths are elongate-oval, and placed on the upper face of the cell or subpyriform expansion.

In our specimens, the branches frequently cross each other and give the whole the appearance of forming distant and irregular reticulating meshes, but no case of anastomosing branches has been observed, hence no network is in fact formed.

The species is distinguished by the long delicate branches, slightly expanding cells, and method of bifurcation. In some instances two or three cells follow each other without a division, and in no instance have I observed more than two branches arising from the same cell.

The specific name is in honor of Dr. H. A. Prout, who did so much to make known the Bryozoa from the palæozoic rocks. The specimen illustrated is from my own collection, and was found adhering to the base of *Anomalocrinns incurvus.*

ORTHIS SCOVILLEI, n. sp.

Plate 1, fig. 5, dorsal view of a specimen, natural size; fig. 5*a*, dorsal view of a smaller specimen; fig. 5*b*, interior of the dorsal valve; fig. 5*c*.. interior of a ventral valve.

Shell sub-circular in outline, somewhat wider than long, cardinal margin shorter than the breadth of the valves, and rounding at the extremities into the lateral margins.

Dorsal valve moderately convex, sinus not defined, beak low, area narrow, surface ornamented with very coarse radiating striæ, which become bifid near the margin, but do not increase by intercalation. About thirty-two cover the dorsal valve. Interior showing the radiating striæ toward the margin; scars of the adductor muscles situated on each side of a strong mesial ridge, which is higher between the posterior than the anterior pair, the former are roughly striated, and extend back as far as the points of the brachial processes ; a well-defined, transverse ridge separates the anterior from the posterior pair; sockets deep; brachial processes strong, and directed laterally forward.

Ventral valve nearly flat, beak low, area a little wider than that of the other valve, and tapering toward the extremities; surface marked by very strong radiating striæ. Interior showing the hinge teeth well developed, prominent, sharp, and transversely trigonal; from the lower and interior sides of these teeth ridges extend forward and curve together, so as to form an elevated margin, to a large and deep oval cavity, extending nearly to the middle of the shell, for the reception of the muscular attachments; a mesial furrow divides this cavity into two equal parts, and makes a notch in the rim at the middle of the front.

This is a very distinct, well-marked species, readily distinguished from all others by the coarseness of the radiating striæ, and their manner of division near the margin.

The specimens were collected by Dr. S. S. Scoville, in whose honor I have proposed the specific name, in the upper part of the Hudson River Group, near Lebanon, in Warren county, Ohio.

Tæniaster elegans, n. sp.

Plate I., fig. 6, natural size, with ends of rays doubled under the specimen; fig. 6*a*, enlarged view of the same specimen, approximately correct; fig. 6*b*, end of ray, natural size: fig. 6*c*, enlarged view of same.

This species is founded upon more than thirty specimens occurring on a single slab, but showing only the ventral side, with the exception of the ends of some of the rays.

The body is deeply stellate, and the rays long, slender and flexible, and margined on either side with a row of spines.

From the length of some of the rays, a complete specimen, properly spread, would probably have a diameter of an inch and a quarter, or more. The rays taper to a sharp point, are rounded on the dorsal side, and margined on the ventral side by a row of spines, one spine arising from each plate. Only two rows of plates seem to form the dorsal side of a ray. The ventral side of each ray is marked by a furrow in the middle, separating two series of plates or ossicles. These plates are a little longer in the direction of the ray than wide, and alternately break joints at the middle, where they are slightly contracted.

This is a delicate species readily distinguished from those hitherto described. It is the first species, in this genus, that has been found in the Hudson River Group of this country, and the specimen is remarkable for the number of individuals that are clustered together on a small slab.

The specimen is from the collection of I. H. Harris, Esq., of Waynesville, and was found in the upper part of the Hudson River Group in that vicinity.

Stromatocerium richmondense, n. sp.

Plate II., fig. 1, piece of a slab, polished and containing specimens, natural size; fig. 1*a*, central part of a specimen showing the ends of the vertical tubes, magnified more than 100 diameters; fig. 1*b*, view of concentric laminæ and longitudinal structure of tubes, magnified more than 100 diameters.

This is a small, globular or spheroidal sponge, consisting of numerous, irregularly concentric, more or less wrinkled, calcareous laminæ,

separated by interlaminar spaces, filled with minute vertical tubes. It is destitute of the larger orifices and canals that usually occur in *Stromatopora*, and I have been unable to ascertain that the concentric laminæ are perforated by canals; they are apparently more dense than the intervening spaces, but it is not supposed that they constituted a barrier to the circulation. The sponge appears to consist of minute tubes radiating from a central point, in all directions; these are cut short by a laminar covering, which forms a basis for the minute radiating tubes to spread in all directions, from its outer surface, until they are likewise arrested by another covering, which, in turn, forms the basis for radiating tubes, and so on to the 10th or 15th covering. These coverings appear in cut and weathered specimens as irregularly concentric laminæ. In magnified sections it shows an apparent vesicular structure, but no spicules have been determined. I have referred the species to *Stromatocerium* because it agrees with that genus in its general texture, and seems to be destitute of the larger canals and superficial openings that characterize the genus *Stromatopora.*

It occurs in great abundance, in some of the rocky strata, in the upper part of the Hudson River Group, at Richmond, Ind. Dr. John T. Plummer, in a communication to the *American Journal of Science*, many years ago, called the specimens "pisolitic balls embedded in the solid rock." He said, these pisolitic strata vary from two to ten feet in depth, and are frequently found blended with the marlite. However, I did not find them in such massive strata, but there are some layers of rock about three or four inches in thickness, largely made up of specimens of this little sponge, that may be found on the high ground immediately above the railroad bridge, in the northern part of the city. It is found at other places, in that locality, and may be regarded as a common species.

DYSTACTOSPONGIA, n. gen.

[Ety.— *Dystaktos*, hard to arrange; *Spongia*, a sponge.]

This is a massive, more or less regularly hemispherical, fixed, calcareous sponge. It possessed a strong frame work that radiated from one or more points of attachment, and bifurcated without any determinable order so as to constitute a great part of the body of the sponge. The entire mass is vesicular, the frame work being more dense than the intervening spaces. Spiculæ not ascertained.

Dystactospongia insolens, n. sp.

Plate II., fig. 2, view of the lower side of a specimen, showing different points of attachment, natural size; fig. 2*a*, the appearance of a prepared slide for the microscope, magnified about three diameters; fig. 2*b*, approximate appearance when magnified 100 diameters.

Sponge, large, irregular, somewhat hemispherical, and varying from two to four or five inches in diameter. The architectural frame work radiates from several different points of attachment, and divides and subdivides without order, and constitutes more than two thirds of the entire mass. As seen under the higher powers of a microscope, the structure is vesicular throughout, and full of amœba-like outlines which may possibly represent spicules. The appearance to the unaided eye is that of a massive coral, having the texture destroyed by mineralization, a thin section, however, even without the assistance of a lens, shows that it is not a coral, and the spongoid character is more and more revealed under the increasing power of a microscope. Under a power of 800 diameters, the vesicles are observed to contain numerous subcircular, subelliptical, and amœba-like bodies, with irregular outlines, but I am not able to say that they are spiculæ, or fragments of such forms, though it is probable that closer study and examination will determine their character.

This species was first collected by Wm J. Patterson, Esq., in the stone quarries, in the Hudson River Group, at Cincinnati. He collected numerous specimens, some of which he presented to the author, and others he preserved for his own collection.

Pattersonia, n. gen.

A solid, amorphous, calcareous sponge, uniform in structure. vesicular, and destitute of larger canals and openings. Spicules (?) The generic name is in honor of Wm. J. Patterson, of Cincinnati, an energetic and discriminating collector, who first discovered the fossil, and subsequently prepared specimens for microscopic examination.

Pattersonia difficilis, n. sp.

Plate II., fig. 3, a large specimen appearing as a cluster, natural size; fig. 3*a*, view magnified about 100 diameters.

Whether the original form of this sponge was globular or not, we are unable to determine, but as we find it now, it consists of a flattened, irregular mass, often appearing as a cluster, but no two specimens having the same form. It is vesicular in structure, and under a magnifying power of 800 diameters, bodies are observed somewhat resembling acicular crystals in the plant *Fuchsia*, and also a few scatter-

ing subcircular or subelliptical forms with irregular outlines, which I have been unable to class as spiculæ.

It occurs in the Hudson River Group, at Cincinnati. Thin, shapeless specimens belonging to this genus are not uncommon, but whether they belong to this species is yet to be ascertained.

DIRECTIONS FOR COLLECTING AND PREPARING LAND AND FRESH WATER SHELLS.

By A. G. Wetherby.

A long experience in the collection and preparation of shells for the cabinet, and the evident want of information on this subject, most important to the student of conchology, as shown by the imperfect and dirty specimens quite usually sent out, are sufficient reasons why I write this article. It may be doubted whether there is really such a thing as a "rare" species. The fable continually disappears in reference to forms once so considered. Hence diligence and good judgment will usually enable a persevering collector to obtain a reasonable number of examples of any object to be fonnd in his region, belonging to recent fauna and flora. The following rules of action are essential:

1. Never rest satisfied until you have found the best examples of a species which your time and opportunities will allow.

2. Never collect imperfect or immature specimens, unless they exhibit some character making such a step desirable.

3. Having found the station which produces the finest specimens, *study it carefully*, that you may the more easily recognize such surroundings again.

4. If specimens are abundant, collect plenty, and the work on that species will be done at once, save as you meet with desirable varieties.

5. Remember that if your specimens are good and clean, it will always give you an advantage in exchanges as soon as correspondents begin to recognize this fact. Never pick up a poor specimen with the remark, "this will do for exchange," if good ones can possibly be had.

LAND SHELLS.

The only apparatus needed in the field is the following:

One or two small bottles, 1 oz. and 2 oz., half filled with a mixture, two thirds best alcohol and one third water, and well corked. If these

bottles are flattened-oval, they may be carried in waistcoat pockets sewed on the outside, and will always be convenient of access.

A pair of dissecting forceps, of the medium size. These will be found useful in picking up loose small shells, in taking them from crevices in bark, old logs, etc. The point of a penknife answers equally well if skillfully handled. This is a "knack" to be acquired by practice.

Two or three flattish boxes, of different sizes, that will readily slip into and out of the coat pockets.

A rake, made as follows: have a "head" made of good oak or hickory, about nine inches long, and one inch by one and one half inch. In the center make an oval hole for the handle, one inch long and one half inch or more wide in the center. Put two blunt teeth, each two and a half inches long, exclusive of the part in the head, on each side of the handle, so spacing the holes bored to receive them as to make the spaces between the teeth equal. Make the teeth of the toughest seasoned hickory. Make, of the same material, a smooth and straight handle, twenty inches long, with one end exactly fitted to the hole in the head. This end should project through the head at least three fourths of an inch. It should be bound by a narrow ferule, so set into the wood as to permit the handle to slip into the head readily. A hole for a small steel spring key should be made between the ferule and the rake head, and so close to each that the key, when in place, shall rest against the ferule on one side, and the rake head on the other. The oval part of the handle fitting the hole in the rake head, should have a shoulder, so that the inside of the rake-head will rest against this, and the outside against the key. When not in use the rake can be taken apart by withdrawing the key, and the whole implement can be carried in the coat pockets. This instrument is indispensable. With it hillsides may be rapidly raked over, or any other grounds inhabited by land shells, and, if the hands are covered with buckskin gloves, briar patches, and other forbidden localities may be explored, and they are often very productive. As much surface can be worked over, with this implement, in half an hour, with perfect comfort and cleanliness, and without injury to the hands, as in half a day using the fingers only, and regions can be examined that it would be impossible to explore without it.

A small tool, made like a hatchet, with a narrow blade at one end, and somewhat hooked and pointed at the other, after the fashion of a geologist's pick, is very convenient for picking and hacking in pieces old logs, cutting away brush, pulling over stones, etc.

No other tools are necessary or even desirable, so far as my experience goes.

Being provided with these implements, you have only to sally forth, and with *perseverance* you will succeed in finding whatever a given locality is likely to produce, if attention is given to the following suggestions :

1. North hillsides are more apt to be productive than southern, unless the latter are specially shaded and moist.

2. Loamy hillsides and ravines will usually be more productive than dry and rocky ridges.

3. Many species inhabit regions of rank undergrowth and high weeds along the borders of streams, just above high water level.

4. Many minute species live in moss, under bark or in its crevices, under stones, etc., and so-called "rare" species are often so because their anomalous station has been the cause of their escaping notice.

5. Search, carefully, with persevering labor, every new station, and make such notes as will be of future assistance, if it is found to be productive.

6. Many of our snails are burrowing species. These can only be collected abundantly and satisfactorily during the breeding season, in early spring. This is the case with many of the larger species.

Having found the specimens, transfer all the smaller ones to the alcohol. Shells of *Stenotrema* can be cleaned by removing the animal, but these, and all shells below them in size, except the *Succineas*, I should drop into the alcohol. The larger species may be dropped, promiscuously, into the collecting boxes mentioned above. When a sufficient number of specimens has been secured, they must be cleaned, and prepared for the cabinet. The following tools are necessary or desirable :

A few hooks of annealed wire, of different sizes and lengths. Take any piece of such wire, put a short, pine handle, of suitable size, on one end, and file the other to a somewhat slender point. These are used for drawing the snails out of the shells. They will hold better if you bend the point into a small hook. Two or three brushes of different sizes. I have a small thumb-brush, and two or three soft tooth-brushes of different sizes.

A test tube, five or six inches long, and half an inch in diameter, and a pint of perfectly clean, fine sand. This can always be had by washing and sifting any sand.

A syringe, I find a rubber one, one inch diameter in the barrel, and six inches long, with small nozzle aperture, to be the best.

A small strainer, such as is used for tea or coffee, and a shallow pan, say two inches deep, and six inches in diameter.

Let us begin with the larger snails, and wash every one clean. Have your pan of hot water on the stove, and your clean shells and implements all handy on a low table near by. Put two or three, or half a dozen if you are tolerably sure of success, into your strainer, to which a wooden handle has been fixed. Set it with the shells into the hot water, and allow it to remain for a minute or less. Lift it out, and taking one of the specimens in your left hand, between the thumb and fore fingers, hook one of your wire implements into the animal, making a gentle effort to withdraw it. If it comes out readily, draw out the others, and throw them into a dish of clean, tepid water. If the animal can not be withdrawn readily, scald them again for a short time. They will usually come out readily enough, but certain species can not be withdrawn at all if scalded too much. These are matters of experience, and will be learned by perseverance. Shells that you can not at first succeed with, on account of irregularities in the aperture, small size, etc., will all be mastered after a while. Having withdrawn the animals, wash the shells again thoroughly on the outside, and syringe them out thoroughly inside, shake out the water, and lay them on a newspaper to dry, mouth downward.

The specimens thus prepared will be perfect, clean, and a delight either for study or exchange. The small shells remain to be looked after. If they are clean, leave them in the alcohol for a day or two, then take them out, dry and assort them, and put them in their proper receptacles. But *Pupas*, *Vertigos*, and the small *Helices* are generally dirty. They may be perfectly cleaned in the following simple manner.

Put all you have of one species into the test-tube. Put in with them a small quantity of the clean sand, say one-fourth or one-fifth what the tube will contain. Fill it with water, and shake very gently. As the sand removes the dirt, turn out the dirty water and fill with clean. In a few moments judicious care will clean such shells perfectly, and not damage them in the least. When clean, turn water, sand and all into a saucer, put in a little more water, shake all gently, and the sand will go to the bottom while the little concentric wavelets will gather all the shells into a small space in the center, whence they may be removed with a spoon or any convenient instrument. Turn off the water, dry your sand, and put it away for future use. *Never use any acids or oils about land shells*, unless the tiniest amount of the latter on the too often eroded

apices of burrowing species. Remember this caution, and always act upon it. Each species, when cleaned and thoroughly dried should be accurately labeled with name, author, locality, and date of capture if the locality is one seldom visited. The little boxes or tubes containing the smaller species should be kept in a larger box, the *Pupas* together, *Vertigos* together, etc. This will reduce the labor of selecting exchanges more than one half.

FRESH WATER SHELLS.

The following implements are needed: Brushes, as before, but one or two larger and stiffer ones for the *Unionidæ.*

A scoop made of wire gauze, fine enough to hold the smallest shells, with a socket for the handle. This scoop should be hemispherical, eight inches in diameter, with the rim made of good, tough hoop-iron, to which the socket is attached.

The handle may be used for a walking stick, and the scoop can be carried in your basket. Both socket and handle must have a hole for the spring key. A quart or two of saturate solution of oxalic acid. A small quantity of nitric acid. A bottle of boiled linseed oil. Bottles of alcohol, diluted somewhat, say one-fourth water. A few tin boxes of various sizes. These are all the necessary tools, according to my experience.

Having reached your locality, your best method of procedure will depend upon what you are looking for. If the bottom is muddy, or sandy, and you are seeking for *Sphærium*, *Pisidium*, the *Amnicolidæ*, etc., usually found in such stations, put your handle into the scoop, slip the spring key into its place, and scoop up mud, sand, and shells by a dragging motion along the surface. When the scoop is sufficiently filled, shake it in the water, washing out the mud and finer sand. Pick out the sticks and leaves, and continue this operation until your shells are easily removed. Put the little univalves into alcohol. The smaller *Pisidiums* and *Sphæriums* may also go there. The larger *Sphæriums* may be treated as hereafter described.

By this means, if you do not hesitate to wade in the mud once in-a-while, you can very rapidly collect all that you will need of such species from a given locality. The same implement can be used for skimming *Planorbis*, *Physa* and *Limnæa* from the surface, or for collecting them from the bottom, when crawling there. These shells should be taken home in the tin boxes. If you are collecting in Southern

streams, where the various genera of the *Strepomatidæ* abound, no plan is so expeditious as a judicious use of the scoop. In some cases hand-picking must be resorted to, as these creatures live on the under side of stones, in rock crevices, and among the gravel and pebbles at the bottom of streams, where they can not otherwise be reached.

Gather these all into alcohol. It is not necessary to extract the animals, and if they are taken out, dried and cleaned, as I shall here describe, they will be in prime condition. If to the alcohol a quantity of arsenic is added, the larvæ of *Dermestes* and *Anthrenus* will not afterward infest them. In hunting for fresh-water univalves every kind of station should be explored. In mountain regions springs, creeks, rivulets, small ponds and larger streams will all have their characteristic genera, species and varieties, and all need to be thoroughly worked up.

For the *Unionidæ* no place is equal to wading into the water, and taking out the specimens alive from their normal stations. Species inhabit all kinds of bottom, pebbly, sandy, muddy and gravelly. I have even found species to prefer narrow crevices in the rocky bottom of streams, as the *U. punctatus*, in Cumberland river, and *U. fascinanes*, in Powell river. The collector who is unwilling, through fear of snakes, rheumatism, or colds, to don an old suit and "wade in," or to strip and dive if necessary, will do well to quit talking about collecting *Unionidæ.* In many cases they will be found packed so closely in rocky or gravelly bottoms, as to enable one to soon take out bushels of them. I have so found them in the Ohio, Clinch, Holston, and Tennessee.

In such cases a potato-hook, or some implement of the kind, gently crowded in among them, will rake out a half-dozen at a pull. The flowing water will wash away the mud, and you can select such as you need. These should be carried out on to the river bank, and cleaned before going home; but if this is not practicable, the operation may be deferred until afterward. As in the case of the land shells, wash them clean, and then drop them into a kettle or pan of boiling water. When the shells gape, and the muscles are loosened, scrape out the soft parts, thoroughly wash out the inside of the shell, and again rinse off the outside. Let the shell dry until all mosture is dried off the outside, and then wrap them close in an old newspaper. Smaller ones may sometimes be nested in the larger ones, on long journeys, where space is desirable and must be economized. But I never do so if I can avoid t. It frequently occurs that the shells of *Unionidæ*, *Strepomatidæ*, and

Limnæidæ are stained with ferruginous and other matters that no amount of washing will remove. If such shells are immersed for a few moments in the oxalic acid solution, these stains will readily wash off, and a judicious use of the acid does not harm the shell in the least. If it is desirable to remove these stains from *Unionidæ*, I should drop thêm into the acid immediately after washing, and before scalding out the animal, the presence of which prevents the acid from coming in contact with the nacre of the shell, which it will slightly dim if the shells remain in it for too great a length of time. It is often the case among the southern shells that these stains have so obscured the real characteristic markings of the shells as to have made it one of the chief causes of so much synonomy. If dead shells must be taken, or musk-rat shell-heaps explored, which is sometimes the case, a judicious use of the acetic acid will remove stains, and in many cases fairly well restore the original appearance of the nacre.

The black and dirty univalves which we generally receive in exchange, and the dirty *Unionidæ*, may be perfectly cleaned by judicious use of these acids. But while they are to the careful student collector an inestimable boon, a careless or injudicious use of them will ruin every shell so treated. I consider a dirty shell as useless and worthless for cabinet purposes. I have many such, and am obliged to receive them or none, and while shells so received may often be cleaned so as to be made presentable, the proper time to do it is when the shells are collected.

I have to add, that where the *Strepomatidæ* are collected in alcohol or any preservative solution in quantity, they may be subjected to the cleaning process *whenever opportunity offers.* It will generally only be necessary to immerse those having the worst stains in the acid for a few moments, and then wash and rinse them thoroughly. Many *Uniones* and univalves are much improved, and given the appearance they have when in the water, or when wet, by rubbing them with a clean sponge, on which are a few drops of boiled linseed oil. "Woolly" shells, or those with a soft epidermis, may be excluded from this list.

Many of the *Unionidæ* also have a very highly polished epidermis, and when clean look as well dry as wet. The use of the oil is a great improvement to some species, and it preserves all fresh water shells; but as before stated, it must be kept off of land species. *Physa*, *Limnæa*, and *Planorbis* must be scalded, and the animals removed with the land shell hooks, and they should afterward be treated in the same way. If stained, treat them with the oxalic acid, using it judiciously, and you

can clean the worst of them perfectly. *Amnicola*, *Bythinella*, *Gillia*, *Somatogyrus*, etc., small univalves, almost universally stained, should be put into the test-tube with the sand, and a small amount of the oxalic acid solution, and shaken as before described for the small land shells. They can thus be rendered perfectly clean, all stains will be removed, and, instead of having your collection of these shells as much dirt as shell, unless, as I have known to be the case, you wash them one by one, you will have a clean and beautiful series, that it will be a delight to study. I should not undertake to remove the animals from such small shells, as if collected in the alcohol, as before described, the animals will be much shrunken, and, when dried, will not disfigure the shell particularly.

Pisidium and all the smaller *Sphærium* are often stained, and should be put into the test-tube and treated in precisely the same way. The larger species may be scalded, and the animal removed as above described for the *Uniones*.

In conclusion, I wish to impress upon all collectors the advantage of having good, clean, perfect specimens of whatever objects of natural history they undertake to study. If the characters are obscured by dirt, or obliterated by decay and erosion, you have no right to complain if those of better tastes in these matters, and of more industry, reject, as worthless, these evidences of your want either of one or both of these requisites; but if you faithfully follow the suggestions here made, there will be no complaint that you lack either.

ZOOLOGICAL MISCELLANY.*

In our last issue we announced the establishment of a new department of the JOURNAL, under the above title, with a view to furnishing a place of permanent record for the original observations of Ohio Valley Zoologists.

We again invite attention to the fact that these pages are open to contributions in any and all branches of Zoology, and trust that our working naturalists will avail themselves of the opportunity thus offered for an interchange of views and personal experiences, which will tend toward the advancement of Zoological science.

We print in this issue an interesting account of a raid by an army of red ants on a colony of the black species, observed by Mr. C. G.

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* Edited by Dr. F. W. LANGDON.

Siewers, the well-known entomologist. We shall hope for frequent contributions from his pen. Mr. Charles Dury furnishes some valuable notes on local *Coleoptera;* and the article on far-western birds, by Colonel J. W. Abert, the original discoverer of Abert's Finch (Pipilo aberti, Bd.), will be found to possess features of especial interest to ornithologists.

MAMMALOGY.

Lynx rufus, Rafinesque.—*American Wild Cat.*—One of these animals was shot by Mr. David Williams, while hunting about three miles back of Hanging Rock, Lawrence county, Ohio, during the month of January, 1882. It was closely pursued by hounds. When about thirty-five yards distant, he fired twice with a double-barreled shot gun containing No. 2 shot. The animal was so disabled that it was soon overtaken by the hounds, which were completely out-generaled by the wounded stranger, until Mr. Williams arrived upon the scene.

It measures twenty-nine inches from nose to end of tail; tail very short. Teeth are all perfect. No signs of previous injuries. This is perhaps the third one killed in this county during the last ten years.

It was sent to Prof. Dury, of Cincinnati, for preparation, and is now to be seen mounted in the window of A. Winter's drug store, Ironton, Ohio.—B. M. Ricketts, M.D., Ironton, Ohio.

Arvicola riparius, Ord.—*Meadow Mouse.*—Measurements of four specimens taken at Brookville, Indiana, in January, 1878:

Date.	Sex.	Nose to root of tail.	Length of tail vertebra.	Length of tail to end of hairs.	Fore foot.	Hind foot.
January 14, 1878.	Female.	3 1-16	1 1-10	1 3-16	22-50	7-10
January, 1878.	Female.	3 3-16	1 1-10	1 1-2	25-50	3-4
January, 1878.	Male.	4 6-16	1 1-2	1 3-4	26-50	13-16
January 22, 1878.	Female.*	4 7-16	1 5-16	1 9-16	3-4	3-8

* Contained four embryos.

—E. R. Quick, Brookville, Indiana.

ORNITHOLOGY.

Dichromatism in the Screech Owl—(Scops asio, Bp.)—The question of the relative frequency of the two phases of plumage in this and other dichromic species, being one of considerable interest to ornitho-

logists, the following table has been compiled with a view to attracting the attention of our local collectors to the matter, and of eliciting from them further facts and statistics bearing on the subject.

Table showing coloration of fifty-six specimens *Scops asio*, from Ohio and adjacent portions of Kentucky and Indiana.

Red Phase.	Gray Phase.	Locality.	Collector.
11	8	Hamilton County, Ohio.	J. W. Shorten.
3	....	" " "	W. H. Fisher.
....	1	" " "	George Keck.
4	2	" " "	F. W. Langdon.
8	3	Various Ohio localities.	C. Dury.
2	5	Celina, Ohio.	C. Dury.
2	2	Latonia Springs, Kentucky.	C. Dury.
1	......	Darke County, Ohio.	J. W. Shorten.
....	1	Brookville, Indiana.	E. R. Quick.
....	1	" "	Brookville Soc. Nat. His.
1	1	" "	J. Rheme.
32	24		

According to Mr. Ridgway,* the proportion of erythemic specimens bears a decided relation to the humidity of the atmosphere, Red Screech Owls preponderating in the Mississippi Valley, while east of the Alleghenies the gray phase is the rule. In support of this opinion he asserts that in the Wabash Valley fully 95 per cent. of the Screech Owls are red. As will be seen by the foregoing table there is a decided reduction of this percentage of red owls in this vicinity, which fact so far as it goes, tends to corroborate Mr. Ridgway's opinion as to the influence of humidity.—(Ed.)

Albinism—Buteo borealis, Vieillot.—*Red-tailed Buzzard.*—This beautiful specimen was taken near Wilmington, Clinton county, O., Nov. 15, 1881, and was sent to me alive. The entire plumage is white as snow, and absolutely immaculate; the irides, dark brown; the sex, male; and the specimen evidently a mature bird. It has been a conspicuous object in the above neighborhood for more than a year, and managed to elude every effort for its capture until the time above mentioned, when it was taken with the aid of a steel-trap. The specimen is now undergoing the process of preservation, and will soon grace the ornithological cabinet of one of our prominent educational institutions.†—John W. Shorten, Cincinnati, O.

* Proc. U. S. National Museum, 1878.

† This specimen is now in the collection of the Cuvier Club.

I have some interesting visitors to my school-room windows at times. At one window, which is a favorite place with the children for cracking nuts, the following species are often seen:

SITTA CAROLINENSIS, Gmelin.—*White-bellied Nuthatch.*

LOPHOPHANES BICOLOR, Bp.—*Tufted Titmouse.*

CENTURUS CAROLINUS, Bp.—*Red-bellied Woodpecker.*

PICUS PUBESCENS, Linn.—*Downy Woodpecker.*

And on one occasion—

PICUS VILLOSUS, L.—*Hairy Woodpecker*—Which is somewhat surprising, as he is the shyest Woodpecker we have.

On one occasion a smart specimen of the Tufted Titmouse was seen hanging head downward from a crossbar of the window-sash with half a walnut in his bill. Such acrobatic exhibitions are not uncommon at my windows. I have this to say, to the credit of our boys, that at this school I have yet to see the first stone thrown at a bird.—E. R. QUICK, School District No. 12, Brookville, Indiana.

The winter of 1880-81 will long be a memorable one in this section, both for its severity and its length; and the following list of birds observed during that season by Mr. E. R. Quick, is therefore of exceptional interest. In the words of the author, "It proves that migration is not governed so much by severity of the weather as by presence (or absence) of the food of many species, and disproves the general supposition that in severe winters there is a paucity of birds."

"The notes were all taken within a few miles of Brookville, Indiana.

"The time comprised in the term winter is from the 15th of Dec., 1880, until the 5th of February, 1881, when the Robins and Blackbirds began to return."

The nomenclature has been revised to correspond with Mr. Ridgway's National Museum list of 1881.—(ED.)

Winter Birds of 1880 *and* 1881 *on the Whitewater.**

SIALIA SIALIS, Haldeman.—*Bluebird.*—Common all winter.

REGULUS SATRAPA, Lichtenstein.—*Golden-crowned Kinglet.*—Noticed at intervals throughout the winter.

LOPHOPHANES BICOLOR.—Bonaparte.—*Tufted Titmouse.*—Common. Frequenting the door yard for crumbs and nuts placed out for this and other species.

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* Read before the Brookville Society of Natural History, March, 1881.

Parus carolinensis, Aud.—*Tom-tit; Carolina Chickadee.*—Very common, constantly associated with the last.

Certhia familiaris rufa, Ridgway.—*Brown Creeper.*—More common than usual.

Thryothorus ludovicianus, Bp.—*Carolina Wren.*—Common. A pair which seemed to winter in a wood house, were several times noticed eating some lard which was in an open vessel in the building.

Lanius borealis, Vieill.—*Butcher Bird; Great Northern Shrike.*—One specimen.

Ampelis cedrorum, Baird.—*Cedar Bird.*—Small flocks noticed during the colder weather.

Chrysomitris pinus, Bp.—*Pine Linnet.*—One identified January 29.

Pyrgita domestica, Cuvier.—*European House Sparrow.*—Small flocks feeding where stock had been fed; also seen eating sunflower seed which had been placed out for better birds.

Spizella montana, Ridgway.—*Tree Sparrow.*—Common.

Junco hyemalis, Sclater.—*Black Snowbird.*—Common.

Melospiza fasciata, Scott.—*Song Sparrow.*—Common.

Cardinalis virginianus, Bp.—*Redbird.*—More common than usual.

Corvus frugivorus, Bartram.—*Common Crow.*—Contrary to what I have usually noticed during severe winters, the Crows have been present during all the colder part of the winter.

Cyanocitta cristata, Strickl.—*Blue Jay.*

Eremophila alpestris, Boie.—*Shore Lark.*—Very common, frequenting stock feeding ground.

Ceryle alcyon, Boie.—*Kingfisher.*—Very rare during the coldest weather.

Picus villosus, Linn.—*Hairy Woodpecker.*—This and the three following, common.

Picus pubescens, Linn.—*Downy Woodpecker.*

Sphyrapicus varius, Baird.—*Yellow-bellied Woodpecker.*

Centurus carolinus, Bp.—*Red-bellied Woodpecker.*

Colaptes auratus, Sw.—*Yellow Hammer; Flicker.*—Very rare. Only one seen in December and January.

Scops asio.—*Screech Owl.*—Very common. Of four specimens taken only one in the red plumage.

Bubo virginianus, Bp.—*Great Horned Owl.*—Common.

Tinnunculus sparverius, Vieillot.—*Sparrow Hawk.*—Several noticed about January 1st.

Pandion haliaetus carolinensis, Ridg.—*American Fish Hawk; Osprey.*—Seen several times during the winter.

Circus hudsonicus, Vieillot.—*Marsh Hawk.*—Identified once in December.

Accipiter fuscus, Bp.—*Sharp-shinned Hawk.*—Seen several times during December.

Accipiter cooperi, Bp.—*Cooper's Hawk.*—Common throughout the winter.

? Astur atricapillus, Bp.—*Goshawk.*—A single large Hawk, which I can ascribe to no other species, was several times noted.

Buteo lineatus, Jard.—*Red-shouldered Hawk.*—Very rare. One specimen.

Buteo borealis, Vieillot.—*Red-tailed Hawk.*—Common.

Aquila chrysaetus canadensis, Ridgway. — *Golden Eagle.*—One often seen until January 29, when it was killed by Wm. Greg. It had been feeding on the putrid carcass of a hog, and when taken contained a quantity of the flesh. Another was seen on Feb. 3d, when the writer drove within thirty or forty yards of it which did not frighten it from its perch.

Haliaetus leucocephalus, Savig.—*Bald Eagle.*—Present throughout the winter.

Cathartes aura, Illig.—*Turkey Buzzard.*—After an absence of about thirty days, several of these birds returned during a few warm days near the 20th of December.

Zenadura carolinensis, Bp.—*Turtle Dove.*—Common all winter.

Bonasa umbellus, Stephens.—*Ruffed Grouse; Pheasant.*—Several specimens taken during December.

Ortyx virginiana, Bp.—*American Quail.*—Has never been common since the winter of 1878-9. Comparatively rare this winter.

Merqus merganser americanus, Ridgway.—*American Sheldrake.*—Common all winter, feeding in the deepest parts of the river, wherever there is current enough to keep the ice from forming. The presence of this species and the Fish-hawk and Bald Eagle is ascribed to the fact that the deep swift portions of the Whitewater never freeze entirely over, always leaving good fishing for these species.

Larus argentatus smithsonianus, Coues.—*American Herring Gull.*—But one seen. That taken by the writer, January 20th.—Edgar R. Quick, Brookville, Franklin county, Indiana.

Mimus polyglottus, Boie.—*Mocking Bird.*—Mr. C. W. Beckham, of Bardstown, Nelson Co., Kentucky (about 100 miles southwest of Cincinnati), writes that he took a specimen of the Mocking Bird at that place, about January 25, 1882.—(Ed.)

ALUCO FLAMMEUS AMERICANUS, Ridgway.—*Barn Owl.*—A fine specimen taken at Hartwell, Hamilton Co., O. (about 10 miles from Cincinnati), by G. V. Stevenson, Esq., March 3, 1882. This is, I believe, the first Barn Owl recorded from this immediate vicinity.—JOHN W. SHORTEN, Cincinnati, O.

I herewith furnish some memoranda in regard to the various kinds of birds which I took note of, in a march across the prairies from Ft. Leavenworth, Mo., to Santa Fe, New Mexico, and back again *via* Santa Fe trail, in the years 1846 and 1847.

Along Santa Fe Road, through State of Kansas.

BUBO VIRGINIANUS, Bp.—Great Horned Owl.—June 29, 1846.
CERYLE ALCYON, Boie.—Kingfisher.—June 29, 1846.
CONURUS CAROLINENSIS, Kuhl.—Carolina Parakeet.—June 29, 1846.
ZENÆDURA CAROLINENSIS, Bp.—Turtle Dove.—June 29, 1846.
COLAPTES AURATUS, Sw.—Flicker.—June 29, 1846.
SIALIA SIALIS, Haldeman.—Bluebird.—June 29, 1846.
PIPILO ERYTHROPHTHALMUS, Vieill.—Towhee Bunting.—June 29, 1846.
CORVUS FRUGIVORUS, Bartr.—Common Crow.—June 29, 1846.
MOLOTHRUS ATER, Gray.—Cowbird.—June 29, 1846.
GALEOSCOPTES CAROLINENSIS, Cab.—Catbird.—June 29, 1846.
CHARADRIUS DOMINICUS, Mull.—American Golden Plover.—July 1, 1846.
ELANOIDIS FORFICATUS, Ridg.—Swallow-tailed Hawk.—July 2, 1846.
MELEAGRIS GALLOPAVO AMERICANA, Coues.—Wild Turkey.—July 2, 1846.
NUMENIUS LONGROSTRIS, Wils.—Long-billed Curlew.—July 2, 1846.
NETTION CAROLINENSIS, Bd.—Green-winged Teal.—July 2, 1846.
TYRANNUS CAROLINENSIS, Tennu.—Kingbird.—July 4, 1846.
HARPORHYNCHUS RUFUS, Cab.—Brown Thrush.—July 4, 1846.
ORTYX VIRGINIANA, Bp.—Quail.—July 4, 1846.
CUPIDONIA CUPIDO,Bd.—Prairie Chicken.—July 4, 1846.
OXYECHUS VOCIFERUS, Reich.—Killdeer Plover.—July 4, 1846.
TACHYCINETA BICOLOR.—White bellied Swallow.—July 4, 1846.
CYANOCITTA CRISTATA, Strickl.—Blue Jay.—July 10, 1846.
CERYLE ALCYON, Boie.—Belted King-fisher.—July 10, 1846.

Colorado, along Arkansas River to Bent's Fort.

XANTHOCEPHALUS ICTEROCEPHALUS, Bd.—Yellow-headed Blackbird.—July 13, 1846.
ICTERUS GALBULA, Coues.— Baltimore Oriole.—July 13, 1846.
SCOLECOPHAGUS FERRUGINEUS, Sw.—Rusty Blackbird.—July 13, 1846.
GRUS AMERICANA, Temm.—Whooping Crane.—July 14, 1846.
EREMOPHILA ALPESTRIS, Boie.— Shore Lark.—July 16, 1846.
RECURVIROSTRA AMERICANA, Gm.—American Avocet.—July 18, 1846.

Porzana carolina, Bd.—Sora Rail.—July 21, 1846.

Melanerpes erythrocephalus, Sw.—Red-headed Woodpecker.—July 21, 1846.

Chordeiles popetue, Bd.—Night Hawk.—July 21, 1846.

Buteo borealis, Vieill.—Red-tailed Hawk.—July 21, 1846.

Oxyechus vociferus, Reich.—Killdeer Plover.—August 26, 1846.

Zenædura carolinensis, Bp.—Turtle Dove.—August 26, 1846.

Bent's Fort, Colorado.

Eremophila alpestris, Boie.—Shore Lark.—September 12, 1846.

Sturnella neglecta, Aud.—Western Meadow Lark.—September 12, 1846.

Colaptes auratus mexicanus, Ridg.—Red-shafted Flicker.—September 12, 1846.

Xanthocephalus icterocephalus, Bd. — Yellow-headed Blackbird.—September 14, 1846.

Meleagris gallopavo americana, Coues.—Wild Turkey.—September 14, 1846.

Spanish Peaks, Colorado.

Molothrus ater, Gray.—Cowbird.—September 15, 1846.

Sialia sialis, Hald.—Bluebird.—September 15, 1846.

Merula migratoria, Sw. and Rich.—Robin.—September 15, 1846.

New Mexico.

Cathartes aura, Illig.—Turkey Buzzard.—September 20, 1846.

Corvus corax carnivorus, Ridg.—American Raven.—September 20, 1846.

Sturnella neglecta, Aud. — Western Meadow Lark.—September 20, 1846.

Fulica americana, Gmel.—Coot.—September 23, 1846.

Santa Fe, New Mexico.

Cyanocitta stelleri, Cab.—Stellar's Jay.—September 26, 1846.

Grus canadensis, Temm.—Sand-hill Crane.—October 9, 1846.

Along Rio Grande del Norte, from Santa Fe to Val Verde, New Mexico.

Merula migratoria, Sw. and Reich.—Robin.—October 9, 1846.

Chen hyperboreus, Boie.—Snow Goose.—October 31, 1846.

Anas boscas, Linn.—Mallard Duck.—November 6, 1846.

Grus canadensis, Temm.—Sand-hill Crane.—November 6, 1846.

Olor americanus, Bp.—Whistling Swan.—November 6, 1846.

From Val Verde, New Mexico, north to Bent's Fort, Colorado.

CALLIPELA SQUAMATA, Gray. — Scaled Quail. —November 10, 1846. Stomachs full of grass seed and green hemiptera.

SITTA CAROLINENSIS, Gmel.—White-bellied Nuthatch.—November 11, 1846.

OLOR AMERICANUS, Bp.—Whistling Swan.—November 14, 1846.

LANIUS BOREALIS, Vieill.—Great Northern Shrike, Butcher Bird.--November 14, 1846.

COLYMBUS TORQUATUS, Brunn.--Loon.—November 14, 1846.

LOPHODYTES CUCULLATUS, Reich.—Hooded Merganser.--November 14, 1846.

TINNUNCULUS SPARVERIUS, Vieill.--Sparrow Hawk.--November 14, 1846.

MELEAGRIS GALLOPAVO AMERICANA, Coues.--Wild Turkey.--December 5, 1846.

SIALIA ARCTICA, Sw.--Rocky Mountain Blue Bird.--December 5, 1846. Stomach full of mistletoe berries.

COLAPTES AURATUS MEXICANUS, Ridg.—Red-shafted Flicker.--December 7, 1846. Stomachs filled with ants.

CALLIPEPLA SQUAMATA, Gray.--Scaled Quail.—December 7, 1846.

CORVUS CORAX CARNIVORUS, Ridg.—American Raven.—December 20, 1846.

PICA RUSTICA HUDSONICA, Bd.—Black-billed Magpie.-December 20, 1846.

PLECTROPHANES NIVALIS, Meyer.--Snow Bunting.--December 20, 1846.

Colorado—East along Arkansas River.

GEOCOCCYX CALIFORNIANUS, Bd.--Road-runner.--January 10, 1846.

HALIAETUS LEUCOCEPHALUS, Savigny.--White-headed Eagle.—Arkansas River, January 24.

CONURUS CAROLINENSIS, Kuhl.--Carolina Parakeet.—I met flocks of Parakeets at Council Grove, Kansas, on the 24th of February, 1847, and again on the 1st of March, 1847. That month there was much snow on the ground, and the Kansas river was blocked with ice.

EREMOPHILA ALPESTRIS, Boie.—Shorelark.—On the 6th of Jan., 1847, I found very large flocks of "Sky-larks" in the Rocky Mountains. The birds were so numerous that I killed 25 at a single discharge of my fowling-piece. Great numbers of half starved ravens were flying around, and they pounced upon the crippled "sky larks" with all the predacious voracity of hawks, and would fight furiously with each other for possession of the crippled birds.

PICA RUSTICA HUDSONICA, Baird.--Black-billed Magpie.--Magpies were quite numerous along the road through Nebraska and Colorado, feeding on the dead animals which the army had left scattered along the route.

--JAMES W. ABERT, Colonel U. S. A., Newport, Ky., March, 1882.

ICHTHYOLOGY.

Haploidonotus grunnieus, Raf.—*Sheepshead; Grunting Perch.*—I have noticed two specimen of the Grunting Perch, a species before unknown here, taken in the Whitewater in the summer of 1881. They bit freely and persistently on a hook baited with a small minnow under a float.—E. R. Quick, Brookville, Franklin county, Indiana.

ENTOMOLOGY.

Hymenoptera.—*A Slave Foray.*

Formica ruber and Formica niger.—Driving some pigs out of a corn patch one day at a run, I was startled by what appeared to be a long red snake, so much so that I sprang over it, and after disposing of the marauders, returned to see what this thing might be. It proved to be an army of red ants returning from the plunder of a black ant settlement. It was then about one hundred yards long, marching well closed up, three or four abreast, and about half an inch wide in column. About every tenth ant carried a black ball in its mandibles, which proved to be an ant. On touching *Ruber* the burden was dropped, which then scurried to one side and hid. They were carried into an ant hill behind my barn, and made to dig underground, but not allowed to come out, their captors carrying out large quantities of clay pellets.

These forays are made in the fall, when the young brood is nearly full grown. The *Nigers* fight bravely for their young, but are overpowered by numbers. The young only are taken, as the weight and resistance of the old ones makes them undesirable.

I met a similar army in a wood, when a boy, but it was much longer, and had just struggled up a hill, and many were dead when dropped. Excavations have resulted in some curious discoveries. On reaching the queen's chamber, she was found surrounded by a body guard, who refused to budge, and she and they were removed to a glass case, when her guard at once surrounded her. Food was put in one corner, but it remained untouched a whole day, though the guard was very uneasy, vibrating their antennæ violently, but always facing the queen. As they refused to feed, starvation was imminent. A few black ants from the hill were now introduced, who, taking in the situation at once, rushed to the food, and after feeding the queen, also fed the guard.

Here we have an insect, without speech, communicating the discovery of a black settlement,* the rallying of a host, the regular march

* They wait till fall.

in line, crossing, in my case, a small run on a board, fighting a battle, making numerous prisoners, carrying them away in triumph, and setting them to work in mines which they never again are able to leave. And all this planning carried on in a brain that would not fill an empty pinhead. Do our boasted generals do more ?—C. G. SIEWERS, Newport, Kentucky.

COLEOPTERA.

OMOPHRON ROBUSTUM, Horn. — The locality for this species (on Mill creek, near the C., H. & D. R. R. bridge), seems to be completely obliterated, the high water washing away the sandy banks completely. The geographical distribution of the species is very remarkable. It was described by Dr. Horn (*Trans. Am. Ent. Soc. III.*, 1874), from a single specimen taken by Mr. Schwarz on Lake Superior. It remained unique until Mr. H. B. Wilson and myself found it in company with *Omophron tessellatum* and *O. americanum*, at the above mentioned locality. By pouring water on the banks, the *Omophron*, thinking the creek was swelling, came up out of the sand in which they were concealed, and ran up for higher ground. On my first visit to this locality, I secured 147 *O. robustum*, from which I have supplied nearly every collection in the U. S., and several in Europe.

MEGALODACUE ULKEI, Crotch.—This pretty little *Erotylid* was described by Mr. Crotch from a single specimen in Mr. Ulke's great collection—its locality was Kentucky. While hunting insects in some heavy woods on the reservoir road back of Newport, I took from a single beech log about 200 of this species, then unknown to me. They were feeding on a brown fungus (*Polyporus*) which was growing thickly over the log. Since then hundreds have been taken from this woods, and though we have hunted the other favorable localities for miles around, not a single specimen has been observed out of it; it seems to be confined to this woods.

EUDESMA UNDULATA, Mels.—Melsheimer's type has been for years the sole representative of this species, and is in Dr. LeConte's collection in Philadelphia—its locality was "Penn." Mr. C. G. Siewers re-discovered the species (one specimen) under the bark of a sycamore tree, July 1879. In August, 1880, while hunting in the crevices of a decaying buckeye log for minute insects, I took several more of this very rare insect.

DRYOBIUS SEXFASCIATUS, Say.—This beautiful longicorn was more abundant last July than I have ever before observed it. By nailing slabs

of bark loosely to dead trees, the insects go under to secrete themselves; by lifting the bark many were taken. Specimens were also taken in the act of eating their way out of dead beech.

Clylanthus albofasciatus, Lap.—This species was taken by holding an inverted umbrella under dead wild grape vines and beating them.

Lacconotus punctatus, LeC.—Mr. Siewers took a single specimen of this extremly rare *Mycteria* near Newport, Ky., June, 1880.

Rymbus minor, Cr.—Since *R. ulkei* was taken, a more careful search in the same locality produced this smaller species. Like *R. ulkei*, it was found on partly decayed logs of beech.

Liodes blanchardi, Horn.—In company with *L. discolor*, near Newport, I took this species. The type was from Lowell, Mass.—Charles Dury, Avondale, Hamilton county, Ohio.

Macrosila cingulata, Fabr.—A fine and very perfect specimen of this handsome Moth was caught in September, 1881, in the conservatory of the Cincinnati Floral Company, this city, and is now in my collection. This species differs from *M. quinque maculata*, Haw., principally in the coloration of the hind wings and abdominal spots, which are in *cingulata* of a beautiful and brilliant pink. I am not aware that the species has been recorded heretofore as occuring in this locality.—John W. Shorten, Cincinnati, O.

THE JOURNAL

OF THE

CINCINNATI SOCIETY OF NATURAL HISTORY.

VOL. V. CINCINNATI, JULY, 1832. No. 2.

PROCEEDINGS OF THE SOCIETY.

TUESDAY EVENING, *April* 4, 1882.

Dr. R. M. Byrnes, President, in the chair. Present, 40 members.

Dr. A. E. Jones, Charles Rule, Thos. H. Orr, and Miss Sarah C. Stubbs were elected members.

The following officers of the Society were elected for the ensuing year: President, Dr. R. M. Byrnes; First Vice-President, Dr. J. H. Hunt; Second Vice-President, Dr. F. W. Langdon; Secretary, D. L. James; Treasurer, S. E. Wright; Librarian, S. A. Miller. Members at large to the Executive Board: G. W. Harper, C. F. Low, L. S. Cotton, J. Mickleborough; Trustee for two years, Julius Dexter; Curators—Mineralogy, J. W. Hall, Jr.; Palæontology, J. Mickleborough; Conchology, E. M. Cooper; Entomology, J. H. Hunt; Botany, Dr. O. D. Norton; Ornithology, J. W. Shorten; Ichthyology, Dr. D. S. Young; Archæology, Dr. H. H. Hill; Comparative Anatomy, Dr. A. J. Howe; Herpetology, A. E. Heighway, Jr.

Donations were announced as follows: Colonel J. W. Abert, mineral specimens; Chas. F. Low, 700 specimens of insects, in twenty boxes; John Schimmel, five minerals; P. T. Abert, Washington, D. C., lot of Indian antiquities from Virginia; Dr. Walter A. Dun, bones from Madisonville cemetery; E. M. Cooper, one volume; A. H. Bugher, specimen of snake in alcohol; W. J. Patterson, two fossils; C. D. Walcott, New York, two pamphlets; Department of Interior, three volumes; Smithsonian Institution, four pamphlets; Department of Agriculture,

Washington, twenty-five species pine cones and seeds; O. M. Meyncke, Brookville, Ind., forty sections of native wood; S. C. Ferguson, a *Belostoma grandis;* a large lot of relics and bones from the Madisonville cemetery were also received as the society's share of the objects excavated there during the preceding month.

The custodian, Jos. F. James, made a report showing the additions to the museum during the year. In the department of palæontology there were added—

By donation, 400 species, 3,000 specimens; by exchange, 37 species, 65 specimens; by purchase, 77 species, 192 specimens; total, 514 species, 3,257 specimens.

In the department of mineralogy, Mr. J. W. Hall, Jr., the curator, had done a great deal of work, and under his direction the collection had assumed good shape. The additions during the year had been almost entirely from Mr. Cranch and Mr. Gest, these numbering about a thousand specimens. Beside these donations there had been received from various sources 150 specimens.

In the botanical department, the entire collection had been gone over, the duplicates picked out, and the herbarium specimens labeled and arranged according to the natural orders. The additions during the year had been as follows:

Herbarium specimens—By donation, 157 species, 190 specimens; by exchange, 50 species, 70 specimens. Seeds, pine cones, etc.—By donation, 75 species, 150 specimens. Sections of wood—By donation, 40 species, 47 specimens. Total, 322 species, 457 specimens.

In ichthyology, the curator, Dr. D. S. Young, had arranged the species in glass bottles, labeled and catalogued them.

The curator of herpetology commenced the arrangement of the collection in his charge, but the work was stopped for want of the necessary alcohol. The additions had been as follows:

By donation, 8 species, 9 specimens.

The ornithological department had been increased as follows:

By donation (mounted specimens), 1 species, 2 specimens; by donation (skins), 6 species, 7 specimens; by purchase (mounted), 49 species, 50 specimens; total, 56 species, 59 specimens.

The collection of birds' eggs and nests had been arranged, labeled and catalogued, and the additions had been as follows:

By donation (eggs), 71 species, 175 specimens; by purchase (eggs), 42 species, 326 specimens; by donation (nests), 2 species, 2 specimens; total, 115 species, 503 specimens.

To the mammals had been added as follows:

By donation, 2 species, 2 specimens.

In entomology the collection had been examined, and partly arranged in boxes. These are pasted up, and seem to be free from pests. The additions had been as follows:

By donation, 325 species, 1,000 specimens.

In the conchological department the additions had been as follows:

By donation, 185 species, 800 specimens; by exchange, 189 species, 346 specimens; total, 374 species, 1146 specimens.

For the purposes of comparative anatomy, the additions had been as follows:

By donation, 3 specimens; by purchase, 8 specimens.

In archæology a large amount of material had been received from the Madisonville ancient cemetery, which is packed away, waiting for time and case room to display it. Beside this, 36 specimens of diseased bones from the same locality, and about 75 miscellaneous articles from various localities had been donated, and 36 plaster casts of crania added by purchase. Taking all the departments together, there had been added to the collection about 7,000 specimens, many of them of course duplicates.

A register of visitors to the rooms had been kept during the year, and though many had come and gone without registering, the record showed 980 visitors.

The value of the collection as an educational factor had been shown in the use made of it by the teachers of the kindergarten school, as well as by the teachers and pupils of the various high schools of this city and Covington.

The valuable addition of a microscope had been made to the collection for the use of the members of the society.

Dr. J. A. Warder furnished the following list of plants in bloom in the open air, April 4, 1882.*

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* The plants followed by the letter J in parenthesis, thus (J), were added by Davis L. James. Fifty-one species were observed in bloom on April 9th, all growing within a very limited locality. The frosts of the nights of April 10th and 11th were severe, the thermometer registering 28° in exposed situations. This checked the growth of vegetation, and destroyed the bloom of many hardy shrubs, beside doing an incalculable amount of injury to the fruit crop.

Native Plants—62 *Species.*

Anemone acutiloba, Lawson (Hepatica acutiloba, DC.)
Thalictrum anemonoides, Michx. Rue anemone.
Ranunculus abortivus, L. Small flowered Crowfoot.
R. repens, L. Creeping Crowfoot, Buttercups.
Isopyrum biternatum, Torr & Gray. Often mistaken for T. anemonoides, but easily distinguished by its fibrous roots and several seeded follicles. (J.)
Caltha palustris, L. Marsh Marigold. (J.)
Delphinium tricorne, Michx. Larkspur.
Jeffersonia diphylla, Pers. Twinleaf.
Stylophorum diphyllum, Nutt. Celandine Poppy.
Sanguinaria canadensis, L. Bloodroot.
Diclytra (Dicentra) canadensis, DC. cucullaria, DC. Dutchman's Breeches.
Corydalis flavula, Raf.
Dentaria laciniata, Muhl. Cut-leaved Toothwort.
Cardamine rhomboidea, DC. Spring Cress.
Arabis lævigata, DC. (J.)
Draba verna, L. Whitlow Grass.
Brassica alba. White Mustard.
Capsella bursa-pastoris, Mœnch. Shepherd's Purse.
Viola cucullata, Ait. Common Blue Violet.
V. striata, Ait. White Violet.
V. canadensis, L. Canada Violet.
V. pubescens, Ait. Yellow Violet. (J.)
V. tri-color, var. arvensis, Gray. Pansey.
Stellaria media, Smith. Common Chickweed.
S. pubera, Michx. Great Chickweed.
Claytonia virginica, L. Spring Beauty.
Acer saccharinum, Wang. Sugar or Black Maple.
A. dasycarpum, Ehrh. White or Silver Maple.
A. rubrum. Red Maple.
Negundo aceroides, Mœnch. Box-Elder.
Cercis canadensis, L. Red bud.
Cratægus cordata, Ait. Washington Thorn.
Saxifraga virginiensis, Michx.
Chærophyllum procumbens, Crantz. Chervil.
Erigenia bulbosa, Nutt. Harbinger-of-spring, almost gone out of flower.
Senecio aureus, L. Golden Ragwort.
Taraxacum dens-leonis, Desf. Dandelion.
Collinsia verna, Nutt. Blue-eyed Mary, Innocence.
Veronica peregrina, L. Purslane speedwell.
Nepeta Glechoma, Benth. Ground Ivy.
Lamium amplexicaule, L. Dead Nettle.
Lithospermum arvense, L. Corn Gromwell.
Mertensia virginica, DC. Virginian Cowslip or Lungwort.
Phacelia purshii, Buckley. Miami Mist. This plant has been known to blossom during the entire winter. Dr. Warder gathered specimens in Jan. 1880. (J.)
Polemonium reptans, Tourn. Jacob's Ladder, Greek Valerian.
Phlox divaricata, L. Common Phlox.
Lindera benzoin, Thunberg. Spice Bush.
Ulmus fulva, Michx. Slippery or Red Elm. In fruit.
U. americana, L. White Elm. In fruit.
Celtis occidentalis, L. Hackberry.
Populus alba, L. Passed out—White Poplar.
P. grandidentata, Michx.
P. angulata, Ait. Catkins fallen.
Symplocarpus fœtidus, Salisb. Skunk Cabbage, fading.
Trillium sessile, L.
Erythronium americanum, Smith. Yellow Adder's Tongue.
E. albidum, Nutt. White Dog's Tooth Violet. The common name misleading — Adder's Tongue much better. (J.)
Luzula campestris, DC. Wood Rusk. (J.)
Poa annua, L.
Cystopteris fragilis, Bernh. Fronds expanding. (J.)

Cultivated Plants.

Calycanthus floridus, L.
Akebia quinata.
Dicentra spectablis.
Viola adorata, L.
Berberis aquifolium.
Prunus americana. Marsh.
P. maritima.
P. chicasa.
P. spinosa.
P. armeniaca.
Amygdalus persica, Mar. 20.
Spirea prunifolia.
S. thunbergii.
Fragaria vesca.
Amelanchier canadensis.
A. var. botryapium.
A. var. alnifolia.
Pyrus malus.
P. communis.
Cydonia japonica.
Exocharda grandifolia.
Rhodotypus kerriana.
Lonicera tartarica.
L. odorata.
Halesia tetraptera.
Vinca minor.
Cercis japonica.
Forsythia viridissima.
Syringa vulgaris. Blue and White varieties.
Betula alba.
Tsuga canadensis.
Larix europæa.
Juniperus virginiana.
J. communis.
Thuja occidentalis.
Biotia elegantissima.
Chætocyperus obtusa.
Narcissus pseudo-narcissus.
N. poeticus.
N. jonquilla.
Galanthus nivalis. Passing out.
Iris pumila.
Tulipa. Varieties.
Scilla siberica.
Hyacinthus. Varieties passing out.

Tuesday Evening, *May* 2, 1882.

Dr. R. M. Byrnes, President, in the chair. Present, 30 members.

General F. D'Utassy and John M. Nickles were elected members.

A microscopical soiree was announced for Wednesday evening, May 10.

The following donations were announced: From Otis T. Mason, five pamphlets ; from Smithsonian Institution, five pamphlets ; from Signal Service Bureau, Monthly Weather Review ; from Department of the Interior, Bulletin of Entomological Commission ; from H. S. Bosworth, specimens of Leptogorgia stenobranchis, Coquina, Serpula and shells from Florida ; from F. A. Sampson, Sedalia, Mo., ten species of shells and fossils ; from James N. Davison, two insects ; from Colonel J. W. Abert, twelve specimens ores ; from M. Parr, Omaha, Neb., seventeen specimens minerals and fossils; from F. L. Eaton, one insect; from H. S. Clark, one Helianthus annuus (sunflower); from Dr. J. H. Hunt, fifty microscopical slides of diatoms, etc.; from Dr. Robert Fletcher, Washington, D. C., one pamphlet; from Mrs. John Chapman, per Judge Force, a large collection of minerals, shells, fossils, wood specimens, whale's teeth, etc.; from Dr. O. D. Norton, skull of badger.

Mr. John W. Shorten read the following paper :

I desire to call attention to a few facts concerning the relation of our rapacious birds to agriculture.

The prevailing popular belief regarding the food of hawks and owls is, that they subsist chiefly on insectivorous, song and game birds, and on barn-yard fowl, and therefore should be considered and treated as pests. On this hypothesis our county commissioners are acting, and advertise to pay a *per capita* for hawks' scalps.

Investigation into the habits of the birds of prey will not justify this extreme measure; on the contrary it will show conclusively, I think, that instead of being detrimental to agricultural pursuits, they are positively beneficial, both to the farmer and to those interested in the preservation of game and song birds. And my object in bringing this matter before you is to show, from the evidence of those who have made the habits of birds a life study, that even the despised hawks have their duties to perform in the order of nature, and that in the main their destructive propensities are in the interests of the farmer.

Permit me to quote from vol. ix., page 47, "Pacific Survey," speaking of the family *Strigidæ*, the owls, this recognized authority states: "The larger species subsist on small quadrupeds and birds, but much the majority almost exclusively prey on insects."

Dr. Coues, in his "Birds of the Northwest," page 365, in speaking of one of the larger species of hawks, says: "They pick up their prey as they pass by, dipping obliquely, and it requires no great agility to elude their clutch. Most small birds evade capture, so that the hawks chiefly confine themselves to less active quarry."

Again, from the same author, page 366: "In the stomachs of those examined I found the remains of burrowing pouched rats, the western wood-mouse, kangaroo mice, and some arvicolæ, and would remark in passing, how often small mammals, reptiles, and insects, which might long remain undetected owing to their rarity or insignificance, are found in the stomachs of rapacious birds."

I might mention here that our only record of the Carolina-rice field mouse in Ohio, rested for several years on a portion of a specimen found in the stomach of a red-tailed hawk taken in this vicinity. Skulls and teeth of this interesting mammal have since, however, been found amongst the ashes in the Madisonville cemetery.

In speaking of the habits of the beautiful and well known sparrow-hawk, Dr. Coues says: "Subsisting on small insectivorous birds, it is true, but also destroying countless field mice and noxious insects, he is to be held a benefactor to the agriculturist."

Again, the same author describing the habits of Swainson's buzzard, or hawk, says: "I scarcely think they are smart enough to catch

birds very often. I saw one make the attempt on a lark bunting; the hawk poised in the air at a height of about twenty yards for fully a minute, fell heavily, with an awkward thrust of the talons, and missed. Those I shot after midsummer all had their craws stuffed with grasshoppers."

Audubon says of the American barn owl: "After long observation, I am satisfied that our bird feeds entirely on the smaller species of quadrupeds, for I have never found any portions of birds about their nests, not even the remains of a single feather in the pellets which they regurgitate, and which are always formed of the bones and hair of quadrupeds."

In "Land Birds and Game Birds of New England," Minot says: The food of the well known great horned owls consists of "rabbits, squirrels, skunks, partridges, poultry and the like;" and of the Cooper's hawk, commonly known as chicken hawk, they feed on "rabbits, squirrels, water fowl, and other birds, but not often on the smaller kinds, as I have seen those near them, or about their nests, disregarded." The same author, page 364, describing the habits of our abundant red-shouldered hawk, says: "they do not often catch our so called partridges, owing to the latter's rapid flight, and rather persistent occupation of the woods, and it is not uncommon to find these game birds in groves where the hen hawks have their nests."

Dr. A. J. Howe, of this city, informs me "that he found in the stomach of a bald eagle the remains of several Norway rats;" think of it, the proud emblem of our country dining on the common house rat.

I have received the following letters on this subject from Prof. Spencer F. Baird, of the Smithsonian Institution, Washington, D. C., and from Dr. Elliott Coues, the well-known ornithologist. The world-wide reputation of these gentlemen as authority on zoological questions will certainly demand, for their opinions, your greatest consideration.

WASHINGTON, April 10, 1882.

DEAR SIR:—The destruction of hawks will save an occasional fowl, but will cause a great increase in the abundance of field-mice, rabbits, squirrels, snakes, frogs, etc., upon which the hawks feed.

It has now been conclusively shown, I think, that hawks perform an important function in maintaining in good condition the stock of game-birds, by capturing the weak and sickly, and thus preventing reproduction from unhealthy parents. One of the most plausible hpyotheses, explanatory of the occasional outbreaks of disease among the grouse of Scotland, has been the extermination of these correctives, the disease being most virulent where the gamekeepers were most

active in destroying what they considered vermin. It is my firm conviction that in the average of well-settled countries, the hawks and owls are a benefit, rather than the reverse, to the community in general, and to the farmer in particular.

Yours respectfully,

SPENCER F. BAIRD.

WASHINGTON, D. C., April 18, 1882.

DEAR SIR:—In reply to your questions of the 8th inst., I beg to say that I do not consider rapacious birds as pests, in the main, or in particular; and that I do not think that laws enacted for their extermination would be founded upon an intelligent knowledge of their habits. They have their duties, as well as their rights, in the order of nature, interference with which can never be right nor wise.

Very truly yours,

ELLIOTT COUES.

It should be noted in conclusion, that the destruction, or keeping in check the smaller mammals, such as mice, rats, ground squirrels, weasels, etc., directly favors the protection and increase of all the ground-building birds.

TUESDAY, *June* 6, 1882.

Dr. R. M. Byrnes, President, in the chair. Present, 20 members.

Mr. Davis L. James read a paper on "Palms and their representatives in the United States."

A. P. Morgan was elected a regular member.

Dr. F. W. Langdon proposed an amendment to the constitution of the society, by which any resident member for ten years, not in arrears for dues, may become a life-member by payment of twenty-five dollars, and any member not in arrears for twenty years may become a life-member without further payment. Also an amendment to the by-laws proposing a change in the name of curator of archæology to that of anthropology.

Donations were announced as follows: from Smithsonian Institution, one volume and eight pamphlets; from Isaac Hart, tooth of fossil horse; from Miss Louisa Johnson, through Dr. W. H. Mussey, section of basalt from Giant's Causeway; from Bureau of Ethnology, one volume; from Signal Service Bureau, one pamphlet; from Jos. F. James, two species of acorns; from R. E. C. Stearns, four pamphlets; from S. T. Carley, six species shells and fossils; from J. Robinson, Jr., one specimen Boa Constrictor; from Chief of Engineers, Washington, one volume on Geology; from J. Prell, a moth; from Jacob Hoffner, through A. E. Heighway, M. D., a fossil shark's tooth; from Mrs. Stanley, one rock specimen; from Dr. L. B. Welch, a green snake; from Dr. O. D. Norton, twelve specimens dried plants; from Dr. C. U. Aydelott, one specimen quartz.

*CHARLES ROBERT DARWIN.**

By Joseph F. James.

There has passed away, within the last few weeks, one of the most eminent, and one of the greatest men which our century has so far produced. A man who is perhaps better known, at least by name, than any other. A man whose influence in science and upon scientific thought has been most profound. And a man who should be admired as a teacher, an experimenter, and an investigator. We as cultivators and students in the wide domain of Natural History, should lay a tribute of respect upon the grave, and honor the name of Charles Robert Darwin.

He was born at Shrewsbury, England, on February 12, 1809, and was, therefore, at the time of his death, in his 74th year, having exceeded by a little the three score years and ten alloted to the life of man. He was the worthy grandson of the justly celebrated Erasmus Darwin, in whose writings, the "Botanic Garden" and "Zoonomia," were shadowed forth the theories which the eminent and talented descendant was destined to bring so prominently before the eyes of the scientific world.

Mr. Darwin began his investigations into natural science at an early age, and after completing his college course at Cambridge, volunteered his services as naturalist to H. M. Ship "Beagle," then about to sail on a voyage round the world. This was in 1831, and it was while upon this voyage that Mr. Darwin made observations which brought him prominently before the notice of the world. His observations upon the "Structure and Distribution of Coral Reefs," was the first of a long series of works of permanent value. In this book he first propounded the theory that the Coral islands of the South seas were the result of the subsidence of the land, thus enabling the zoophytes to build up the reefs, as the land sank, to the surface of the water, and forming those beautiful "atolls," or coral-encircled lakes, which are one of the beauties of the Pacific ocean. His observations upon general natural history were embodied in that most charming of all works of travel, "A Naturalist's Voyage Round the World." This book has been read and enjoyed by thousands who know but little of his other writings, and is certainly one of the most fascinating narratives, and at the same time one of the most instructive ones which has ever been written. Its immense popularity has been shown by the

* Read May 2d, 1882.

many editions it has gone through, and by its having been adopted as a book for children, by putting the narrative into simple language.

In 1846 was published his "Geological Observations upon South America," a volume of 268 pages, which was one of the results of his voyage in the Beagle. His monograph of the sessile and pedunculate Cirripedia, with figures of all the species, was published in two parts in 1851 and 1854, and is replete with interesting and valuable notes upon their life history. Another monograph, on the Fossil Lepadidæ of Great Britain, was published by the Palæontological Society of England in 1851, and these works show Mr. Darwin to have been as great an authority in special branches as he has since been recognized to be in the wide field of Biology.

It was while upon his voyage round the world, that Mr. Darwin first had suggested to him the ideas afterward embodied in his "Origin of Species," and from the time of his return from his first and only long journey, in 1836, until his death, he was engaged in work which tended to confirm and establish his first ideas. It was the reading of the celebrated treatise of Malthus on "The Principles of Population," which originally directed his ideas toward the matter of the "Struggle for Existence," which forms so prominent a part of his great theory. When the "Vestiges of Creation" first appeared, in 1844, an epoch began which will be long remembered in the history of science. Although about 1830 the great Cuvier had ridiculed and vanquished his opponent Geoffroy St. Hiliare, before the Paris Academy of Sciences, the theories of Lamarck and of St. Hiliare had their influence upon thinking men. Though many of the ideas were crude and improbable, they contained germs of truths which were afterward fully elaborated.

For twenty years previous to the publication of Mr. Darwin's "Origin of Species," the work by which he is most widely known, he was engaged in collecting facts and making observations into the natural history of the animal kingdom. His friends, Sir Charles Lyell, and Sir Joseph Hooker, names which will descend to posterity with no small amount of fame attached to them, were cognizant of his labors in this field, and repeatedly urged him to make an abstract of his observations for the benefit of science. This he had as often refused to do, not being satisfied with the materials at his command. But in 1858, Mr. Alfred Wallace, then traveling in the Malay archipelago, sent home an article "On the Tendency of Varieties to depart indefinitely from the Original Type," with the request that if thought worthy it be read before the Linnean Society. Then Mr. Darwin was induced

to prepare a short paper giving a digest of his views on the subject. Both of these papers were read at a meeting of the Linnean Society, and appear in a volume of the Transactions. They created no stir except among scientists, for people at large did not know of their full significance. This paper was the prelude to the publication of the "Origin of Species," the first edition of which is dated Nov. 24, 1859.

It was a fire-brand thrown into a mass of inflammable material. It ran through an edition of thousands in a few months. A second (in March, 1860) and a third appeared, and the world was taken by storm. Advocates and opponents appeared on all sides. Invectives and praises were showered upon the author from all quarters. Nearly the entire body of the clergy rose against him, and from pulpit and sanctum, at home and abroad, he was ridiculed and abused. But his advocates took up the gauntlet, and the battle has raged ever since. One of his earliest and most ardent admirers was Prof. Huxley, who joined issue with the detractors, and threw his weight into the scale of Darwin. In a review of the book, Prof. Huxley, after referring to the hostility always shown by the clergy to every advance made in science, said: "Extinguished theologians lie about the cradle of every science, like strangled snakes beside that of Hercules; and history records that whenever science and orthodoxy have been fairly opposed, the latter has been forced to retire from the lists, bleeding and crushed if not annihilated, scotched if not slain." And the result has been the same in this conflict as in all the others; and now, when the theory of Mr. Darwin has been all but proved, many of those who were originally its opponents have become its staunch advocates.

It is needless to go into an account of the theory of the "Origin of Species." It is well enough known to science, though, perhaps, imperfectly so to its opponents generally. There can be but little doubt but that the publication of this book marks an epoch in the history of the human intellect. It came at a time when the world was ripe for it, and when the slightest impetus drove it onward and upward with a force which is gathering strength day by day. Now, but twenty-three years after the first public announcement of the theory, it receives the avowed sanction of nearly every scientific man in the world, and of thousands who know of science but by hearsay. It has been translated into the French, German, Dutch, Italian, Russian and Japanese languages. It is a triumph which has been achieved by no other book which has appeared in this century. It has effected such a change in thought, it has given such an impetus to scientific investigation, that

its effects must be felt for all time to come. Its influence in directing research toward the natural sciences, and its effect upon the whole world has been such, that when the descendants of this generation, as the poetical Tyndall puts it, "shall have melted into the infinite azure of the past," the decade in which Charles Darwin's "Origin of Species" appeared, will form as bright an epoch in natural science as the age of Shakespeare in Dramatic Literature, as the discovery of America in History, or the advent of Christ in theology. And though the subject of this notice has received most of the honor gained by the publication of the theory, his co-discoverer and worker, Mr. Wallace, is entitled to a full share of the honor. With a generosity unhappily seldom known in science, he urged Mr. Darwin to bring the theory before the public in a worthy manner, while he himself stood in the background.

The "Origin of Species" was the first of a long series of books and papers upon matters intimately connected with the theories of natural selection and the struggle for existence. In 1862 appeared a volume "On the Various Contrivances by which British and Fore gnOrchids are fertilized by Insects, and on the good effects of Intercrossing"—a second edition, with many additions, being issued in 1877. This is a book full of interesting facts, told in a fascinating manner, and showing the benefits derived from occasional crossing. It is but one instance of the wonderful power of Mr. Darwin in observing, recording and commenting upon things which to other eyes would be unseen or inexplicable. In the hands of Mr. Darwin order is brought out of chaos, and what would under other circumstances be a mere jumble, is through the medium of his pen a work of lasting value.

He contributed various articles relating to the fertilization of plants, and the forms of flowers to different periodicals, but especially to the Transactions of the Linnean Society. These were afterwards republished with much additional matter in separate volumes. But in 1868 appeared the "Variation ot Animals and Plants under Domestication," two volumes of over 800 pages, which contain innumerable facts, and the details of many experiments. A glance at the table of contents of these volumes gives a slight idea of the amount of labor necessary to prepare the work. Over one hundred pages are devoted to pigeons alone, and such marvelous changes are noted in the plumage, and in the structure of all parts of the skeleton, that the reader is astonished when told that all the 150 breeds of our domestic pigeons are descended from a single species, and is nearly ready to believe from facts there given, in the theory of the origin of one species from another.

This book was followed by another in 1871, in two volumes, on the "Descent of Man." Though Mr. Darwin, in his "Origin of Species," drew no direct conclusions as to the relation in which man stood to the rest of the animal kingdom, still the relationship was implied and well known. But now he applied the facts he had collected in relation to animals to the human race, and the "Descent of Man" was the result. He brought forward in the second part, the subject of Sexual Selection, a matter which had not until then been treated in any way completely. Another uproar was created by this book, for while many naturalists were willing to allow the descent of animals with modifications, they stopped at man, and contended that his origin was on a higher plane.

Then followed in 1872, as a sequel to this book, one on the "Expression of the Emotions in Man and Animals." Mr. Darwin had found that in order to satisfy himself and the public in regard to the close relationship of man and the higher classes of animals, that he must study the expression of the emotions, and in this volume he gives the facts he collected. He was indefatigable in his work. He studied in infants, in the insane, in paintings and sculptures, and in animals, the expressions and actions when under the influence of various feelings and passions. Further, in order to find whether the same gestures and expressions prevailed among savage races as were to be seen in civilized man, he had printed a set of sixteen or more questions which were sent for answers to various parts of the world. From all these sources Mr. Darwin gathered his information, and incorporated it in a work which takes as high a rank as the celebrated treatise of Sir Charles Bell on "Expression," for the contradiction of which it was, in fact, intended.

His next work was on "Insectivorous Plants," a volume of 450 pages, filled with details of experiments on various species of Drosera, on Dionæa, and other plants. This book is a marvelous production, not only because of the nature of the facts given, but from the methods by which they were ascertained, and it stands as a lasting monument to the patience of the man. As an example of the delicacy of the investigation, and of the accuracy of his methods, it is stated that a particle of cotton thread only $\frac{8}{1000}$ of an inch in length, and weighing $\frac{1}{78740}$ of a grain, was experimented with; and that the absorption of a particle of carbonate of ammonia weighing only $\frac{1}{134400}$ of a grain caused the tentacles of a leaf of Drosera to become inflected. Think of the patience of a man who could measure and weigh and experiment

with particles of matter so minute. And still it is only a sample of the pains-taking qualities of Mr. Darwin, and an example of his accuracy in research.

This book was followed at close intervals by six others, all on Botany, and treating of "Climbing Plants" (1875); "The Effects of Cross and Self Fertilization in the Vegetable Kingdom" (1876); "The Different Forms of Flowers on Plants of the same Species" (1877); A second edition of the "Fertilization of Orchids" (1877); "The Power of Movement in Plants" (1880); and lastly, during the past winter, by one on "The Formation of Vegetable Mould through the Action of Worms." All of these are full of new and interesting facts, and of new experiments, bringing to light things before unthought of, and creating in the minds of readers a thirst for more, and a desire to study and see for themselves the matters there treated.

In summing up an estimate of Mr. Darwin's work in science, we are profoundly impressed with his versatility. He was a geologist, as his "Observations on South America Geology," and upon "Volcanoes," will testify. He was a palæontologist. He was a biologist without a peer. His works upon the Cirripedia, and on Coral Islands, show a profound knowledge and wonderful observing power. His volumes on Botany, on Orchids, on Insectivorous Plants, Various forms of Flowers, Variation of Animals and Plants, show him to have been an observer of nature, and an experimenter without a rival. One who with an eye for everything, found nothing too insignificant to notice; and one who saw the meaning of matters which to another were meaningless. He was patient in his observations, never giving prominence to anything but what was worthy. He never allowed his judgment to be warped. He was fearless in stating facts, no matter what might be the conclusions drawn from them, honest in acknowledging his errors, and courteous in noticing the remarks of others. And as Prof. Gray says: "Mr. Darwin's evident delight at discovering that some one else has 'said his good things before him,' or has been on the verge of uttering them, seemingly equals that of making the discovery himself. It reminds one of Gœthe's insisting that his views in Morphology must have been held before him, and must be somewhere on record, so obviously just and natural did they appear to him."* His "Origin of Species," putting aside all theoretical deductions, is a perfect encyclopædia of facts; it is a condensed manual of observations made during

* Nature X., p. 80, June 4, 1874.

twenty years of study and investigation. It is a book to be read and re-read, and in which something new will be found at each perusal. His "Descent of Man," taken in connection with his "Expression of the Emotions," proves beyond a doubt, that between the bodily features and mental powers of animals and man, there exists only a difference of degree.

Mr. Darwin never was a man of robust health, and many of his recorded observations were made while confined to the house. Fortunately he leaves behind him sons, who have already done much toward the increase of human knowledge, and upon whom it is hoped, but can hardly be expected, the mantle of the father has fallen. Taking Mr. Darwin's work as a whole, it constitutes a contribution to science, and a monument to himself, which will be a lasting one. And even if the Darwinian theories of natural selection, and the struggle for existence should fall to the ground, his work will be remembered. It will make him live in the memory of mankind as long as science holds a place upon earth. Charles Robert Darwin is dead, but his spirit, and the life which he has infused in the whole scientific and material world survives him, and will continue to animate students for all time to come.

NOTICE OF THE WORK OF PROF. J. D. WHITNEY ON "THE CLIMATIC CHANGES OF LATER GEOLOGICAL TIMES."

By S. A. Miller.

The second part of the very excellent work by Prof. J. D. Whitney on climatic changes, has appeared in the memoirs of the museum of comparative zoology, at Harvard College. It is no doubt the best considered work that has been published in America upon this subject, and withal is very readable. In view of the statements so repeatedly made at the late Forestry Convention held in our city, that the destruction of forests produces important changes in the climate, a dessication of the earth, and the ruin of the people, it will not be uninteresting to some of our readers to know that this whole subject has been treated by an eminent scientist, who has shown that the cutting away of the forests has no such effect, that man has not been able to effect a noticeable change in the climate of any region, and that the

human race is in no way responsible for the changes which have brought ruin upon some countries that were once prosperous and in a comparatively high state of cultivation.

He says, that an excellent opportunity has been offered, in New England, for throwing light on the question whether disforesting a country does really change the character of its climate, or materially diminish its rain-fall. There is no doubt that New England was, not long since, a country well covered with a forest growth. That it was such when its settlement by the whites began, 250 years ago, is a generally admitted fact. The aboriginal inhabitants had not in any perceptible degree taken from it, during their occupancy, its character as a great forest. Take the States of Massachusetts, Rhode Island, Connecticut, and the Southern half of Vermont and New Hampshire, where as respects the abundance of timber, the territory has been reduced from the highest to the lowest condition since the settlement of the country by the whites; and mainly within the last fifty years. Here is where the observations upon rain-fall have been taken more fully and for a longer period than elsewhere upon the continent, and if disforesting a country is followed by a decrease of the precipitation, in the region cleared of its trees, we ought to find some evidence of the fact in the case of Southern New England. The statistics, however, do not, in the least, indicate any diminution of the rain-fall, but on the contrary, an increase of rain, on the average, since 1835, is distinctly indicated, for the Atlantic sea-board, from Maine to Virginia, including a considerable part of New York where extensive clearings have been made in the last fifty years.

All about the Bay of San Francisco the removal of the timber has gone on, within the past few years, with the greatest rapidity, but there is no statistical proof that the rain-fall in that region has been diminished since the occupation of it by an English-speaking people. Under no circumstances does our country, in any part of its vast area, furnish any support to the theory that removing the forests brings about any change in the climate or tendency to barrenness and desolation.

The earliest travelers deseribed the prairies of the great west just as we see them now. Geologists tell us they have existed for thousands of years, but no one has heard any complaint about the want of the precipitation of rain in the State of Illinois, which is almost wholly a prairie country, nor that less rain falls in the prairie regions of Minnesota than on the timber lands of Wisconsin.

It would be difficult for any one to assign a single reason why clearing away a forest would interfere with the precipitation of rain, and we are not aware that any one has undertaken the task, and it is as well probably to ascertain the fact before hunting up the theory. The Mississippi valley is supplied with rain from the Gulf of Mexico, and if forests controlled the precipitation, then we would expect to see the clouds wrecked in crossing Arkansas and Tennessee, and light smooth sailing over Illinois with rarely or never a shower. But as the forests have nothing to do with the quantity of rain fall, and there is no falling off in the precipitation in the eastern or central part of the continent, we need not borrow trouble for this locality.

In the Cordilleras where lakes have been drained and important orographic changes have taken place in the later Tertiary period, coming down to a very recent date, we find abundant evidence of a change in the climate, and just such a change as geological causes are expected to produce. But it would require too extended an article to fully review our author upon this region, and the interested reader is therefore referred to the book itself. The changes of climate that have taken place in Europe and Asia during and preceding the historical period, are dwelt upon at great length, and shown to be the result of causes over which man has had no control. When great lakes are dried up, or drained or diminished in area, there is less surface for evaporation, and consequently less rain falls in the vicinity; the elevation of a mountain range may change the course of the winds so as to materially interfere with the precipitation of rain over a great extent of country, and this seems to have occurred in South America; and other geological and cosmical changes may materially interfere with the climate of a country; but it is not within the power of man to effect the temperature a fraction of a degree, or the annual rain-fall a fraction of an inch, by cutting down or planting trees.

DESCRIPTION OF TEN NEW SPECIES OF FOSSILS.

By S. A. Miller, Esq.

Cyathocrinus crawfordsvillensis, n. sp.

Plate III., fig. 1, natural size.

Calyx cup-shaped, about as wide as high, plates slightly convex, and sutures well defined.

Basal plates of moderate size, and regularly pentagonal. Subradials a little more than twice the size of the basals, and those on the posterior side hexagonal. First radials about the size of the subradials, pentagonal, prominent, and arcuate on the upper face for the reception of the succeeding plates of the free arms. The free arms bifurcate on the third plate from the first radial, and again on the third or fourth succeeding plate, and again at about the same distance, above this, more plates intervene between the bifurcations, but the divisions continue until, as shown in our specimen, there are three hundred and twenty arms. The arms are long, round, slender, and diminish only slightly in size following each division. The ventral sac or proboscis is very long, extending quite to the extremity of the arms, and composed of hexagonal plates pierced by numerous fissures in the sutures.

This is a very beautiful species from the Keokuk Group, at Crawfordsville, Indiana, and belongs to the magnificent collection of I. H. Harris, Esq., of Waynesville, Ohio.

Glyptocrinus pattersoni, n. sp.

Plate III., figs. 2, and 2*a*, natural size, both specimens are injured in the interradial areas, but the plates of the radial series are not correctly represented in either figure.

Calyx small, height and width subequal, with interradial areas depressed, so as to give it strong, angular outlines corresponding with the radial series. Surface finely sculptured.

Basals small, but projecting up between the under sloping sides of the first primary radials. The first radials are the larger plates of the body, hexagonal, and about as long as wide. The strong radial ridge in its extension below, divides at the centre of this plate. The second radials are much smaller than the first, about as high as wide, and hexagonal or heptagonal. The third radials are about the same size as the second.

The secondary radials arise upon the upper sloping sides of the latter, and become free arms at the third plate without another bifurcation.

Arms only ten, and after they become free, at the third plate above the first radial series, consist of strong cuneiform plates, each of which bears a coarse pinnule. They are long, and with their coarse and numerous pinnules form a large, brushy head, with a small calyx.

The column is round, of medium size, and composed near the head of alternately thicker and thinner plates.

This species is distinguished by the depressed interradial areas by

the long strong arms and coarse pinnules, and more especially, from all others heretofore described, by the fact that it has only ten arms. It is a true *Glyptocrinus*, however, and as four specimens have been collected, we can safely conclude, from all the appearances, that they are mature, and that the species never possessed more then ten arms.

It was collected by Wm. J. Patterson Esq., in rocks of the age of the Utica Slate, in the banks of the Ohio river, opposite to the city of Cincinnati.

SACCOCRINUS PYRIFORMIS, n. sp.

Plate III., fig. 3, side view of a slightly compressed specimen, but showing the vault too much elevated; fig. 3*a*, summit view.

Body usually rather large, sometimes having a length of $2\frac{1}{4}$ inches, and a breadth, at the summit, of $1\frac{3}{4}$ inches. It gradually expands from a subacute base to the arms, vault very moderately convex.

Basal plates wider than high, hexagonal, and about half the size of the first primary radials.

Primary radials.—Three of the first radials rest upon the wider sides of the basals, and two in the angles formed at the junction of the basals. Three are hexagonal, and two heptagonal. Height and width subequal. Second radials smaller than the first, hexagonal, and a little higher than wide. Third radials smaller than the second, and very regularly heptagonal.

Secondary radials.—The first secondary radials are heptagonal, and from half to two thirds as large as the third primary radials. The second secondary radials are heptagonal, and smaller than the first.

Tertiary radials or brachial series.—There are three tertiary radials or brachial plates in each series.

Interradials.—The first regular interradials are hexagonal, a little smaller than the first radials, and about as high as wide. These are succeeded by five pairs or ten plates before reaching the interbrachial spaces, and these are followed by three pairs of small plates in the interbrachial spaces before reaching the top of the vault. There are five intersecondary radials, succeeded by interbrachials. Vault moderately convex, with a convex ridge extending from the central part over the azygous side. Arms twenty.

Remarks.—This species is distinguished from *S. urniformis* with which it seems to be most nearly related, by the more gradual expansion of the body from the base upward, and more regularity in the size of the plates, by the absence of a third plate intervening between

the pairs in the interradial spaces, at the height of the first secondary radials, by having a few more plates in the interbrachial spaces, by the less convexity of its vault, and by the flattened instead of concave depressions between the ambulacral ridges.

Collected by W. C. Egan, in the Niagara Group, at Chicago, Ill.

Eucalyptocrinus rotundus, n. sp.

Plate III., fig. 4, the interbrachials are not contracted toward the top as shown in the figure ; fig. 4*a*, may be erased, as it teaches nothing ; fig. 4*b*, is a small specimen, but the vault is made to appear too high.

Body round or globular, calyx very shallow, saucer-shaped, height of the cast of the dome a little more than the depth of the calyx, and the height of the two rather more than the length of the canal leading from the dome to the top of the interbrachials.

First radials wider than long, and larger than the succeeding ones. Second radials, quadrangular, wider than long. Third radials, wider than long, lower lateral and upper sides very short.

Large interradial, ten sided, and a little longer than wide, the others small and narrow.

Canal leading from the dome to the top of the interbrachials rather large, but not extending beyond the interbrachials,

Collected by W. C. Egan Esq., in the Niagara limestone, at Chicago, Illinois.

Remarks.—This species is distinguished by the almost perfectly globular form of the body including the brachials and interbrachials, by the short saucer-shaped calyx, and comparatively large canal leading to the top of the interbrachials.

Eucalyptocrinus turbinatus, n. sp.

Plate III., fig. 5, for the purpose of showing the form and height of the cast of the vault; fig. 5*a*, is very imperfectly drawn, and makes the calyx appear too high, and does not show the constriction, the plates indicated on 5*a*, if drawn upon fig. 5, would give a more correct idea of the species.

Body rather large, the base distinctly pentagonal, the angles being at the junction of the plates. Calyx very rapidly expanding, though obscurely constricted in the middle part. Width at the arm bases nearly twice as great as the height of the cup. Cast of the dome rather low, so that the entire height of the cast from the base to the top of the vault is less than the diameter at the arm bases.

The first radial plates are hexagonal, wider than long, and in the cast, show the pentagonal outline and prolongation at the sutures below the point of junction with the column. It is more marked in this

particular than *E. tuberculatus.* The second radials are quadrangular, very little wider than high, and about two thirds as large as the first radials. The third radials are hexagonal, sides very unequal, the two upper sloping sides and the base being the longer, and the other three the shorter ones. The first secondary radials are very large, and rest upon steep sloping sides of the third radials, which gives breadth to this part of the body. The second secondary radials, and the inter-secondary radials, are wider in proportion to their length than is usual with the plates in this genus. The interradial is a large, ten-sided plate, a little longer than wide, that supports upon its two upper sides a pair of interradials, which support the interbrachials.

This species is readily distinguished from *E. cœlatus*, by the angular extension of the plates below the point of attachment with the column, and from all other described species by its general form.

It was collected by W. C. Egan, of Chicago, Illinois, in the Niagara Group, at Bridgeport, within the corporate limits of the city.

Lyriocrinus sculptilis, n. sp.

Plate III., fig. 6, basal view, not indicating all the plates ; fig. 6*a*, lateral view from the azygous side ; fig. 6*b*, summit view, but not showing half the plates that are on the specimen. All from the same specimen.

Calyx, below the arms, saucer-shaped, vault depressed between the arm bases, possessed of very slight convexity, except as to a swelling upon the azygous side that terminates in a sub-central proboscis. The plates are convex, those below the arm bases are sculptured, and the sutures are well defined.

Basals.—There are five small basal plates situated within the small columnar cavity, and covered by the column. These are beautifully shown by the specimen, but are not indicated in the figure.

Subradials.—There are five heptagonal subradials. These are the larger plates of the body, with the exception of the first interradials, and being longer than wide, they form a star-shaped outline, with truncated rays. The two shorter sides abut upon the basals, and the two longer sides support the radial series.

Primary radials.—There are three primary radials in each series. The first is pentagonal, wider than long, a little smaller than the sub-radials, rests between the sloping sides of the latter, and has the longer side uppermost. The second is hexagonal, wider than long, and wider than the first radial; the lateral sides are the shorter, and the upper and lower sides the longer. The third radial is pentagonal,

much the smaller of the three, and supports upon the upper sloping sides a pair of secondary radials.

The secondary radials are small, and support the arm-plates, which are not preserved in our specimen.

Interradials.—Regular interradials, three. The first is heptagonal, about the size of the basals, and wider than long. It supports the other two, which are much smaller, and are followed by two interbrachials that connect with the plates that cover the vault. The first azygous interradial is a large octagonal plate. It is succeeded by three interradials, instead of by two, as in the other interradial areas. These are followed by polygonal plates of unequal size, that are continued to the proboscis.

The vault is covered by numerous polygonal convex plates of unequal size. The arms are arranged in five pairs, each pair being much closer together than they are in the other species of this genus. The column is unknown.

In *Lyriocrinus melissa* (*Rhodocrinus melissa*), from Waldron, Indiana, the third radial is hexagonal, being truncate at the top, and supports an intersecondary plate, which is not the case in this species.

This species I received from Tennessee, labeled from the Niagara Group, though it may possibly be from the Lower Helderberg. It is such a marked species, that it will be readily distinguished without the special locality from whence it came.

ENDOCERAS EGANI, n. sp.

Plate IV., fig. 1, ventral view of the siphuncle and the interior tube a short distance below its apex, where it nearly fills the cavity of the siphuncle: the dotted line shows the swelling of the siphuncle at the commencement of the internal tube: fig. 1*a* shows the point of the internal tube and its rapid wedge-shaped expansion: fig. 1*b* is the other part of the same specimen, as the two pieces are broken, and shows the swelling of the siphuncle within the chamber at the place where the internal tube arises.

This species is founded upon the siphuncle and the internal tube, the external appearance of the outer shell being unknown. The siphuncle is long and very slightly tapering. The marks of the septa are distant, and cross the siphuncle diagonally, inclining toward the apex on the ventral side, at an angle of from 20 to 30 degrees. The diameter of the siphuncle, at the place at which the internal tube arises, is a little less than an inch, and the septa are distant nearly one half an inch.

The internal tube arises near the ventral side, and rapidly enlarges into a half wedge-shape, or a tube convex on one side and flattened on

the other. The convex side of the tube hugs, closely, the interior of the ventral side of the siphuncle, and, as it enlarges, the flattened side approaches the dorsal side of the siphuncle until it well nigh fills the internal area, as shown by the figures. It arises between the lines that mark the septa, and, at this point, there is a slight expansion of the siphuncle, marked by a convex swelling extending quite around the siphuncle, but greatest upon the ventral side.

It was collected by W. C. Egan, Esq., of Chicago, Illinois, in whose honor I have proposed the specific name, in rocks of the age of the Hudson River Group, at Bristol, in that State.

Remarks.—The internal tubes of the *Endoceras*, as known to Prof. Hall, at the time he founded the genus, were conical, and it seems, from the "Observations on the purposes of the embryonic sheaths of *Endoceras*, and their bearing on the origin of the siphon in the *Orthocerata*," by R. P. Whitfield (Bull. No. 1, Am. Mus. Nat. Hist., 1881), that only conical sheaths or tubes have, heretofore, been described in America. In this species, it might be described as somewhat half conical, or more nearly half wedge-shaped. In the two specimens illustrated, the siphuncles are crystalline, and the internal tubes are perfectly smooth and without any indications of attachment to the surrounding siphuncle. If, therefore, the internal tube was constructed for the purpose of the protection of the animal, after the apex of the shell had been injured or worn away, we have a secondary tube constructed in a wholly different form from the primary one; but, as it soon expands so as to nearly fill the original siphuncle, the appearance, on the whole, gives countenance to this view of its purpose, as advanced, by Prof. Whitfield, in the paper above alluded to, if we except, possibly, the expansion of the siphuncle at the point of the commencement of the tube.

ENDOCERAS BRISTOLENSE, n. sp.

Plate IV., fig. 2, showing the rapid expansion of the internal tube of the siphuncle; fig. 2*a* shows the marks of the septa on the siphuncle before the commencement of the internal tube.

This species is founded upon the siphuncle and the internal tube, the external appearance of the outer shell being unknown. The siphuncle is rather rapidly tapering, at least, much more so than it is in *E. egani.* The marks of the septa are moderately close together, and cross the siphuncle diagonally, inclining toward the apex on the ventral side, at an angle of about 40 degrees. The diameter of the siphuncle, at the place at which the internal tube arises is about an inch, and the septa are distant about 22-100ths of an inch.

The internal tube arises centrally or subcentrally, and very rapidly expands in a conical shape, until it fills, or nearly fills, the interior space of the siphuncle. The specimens examined are crystalline, and the internal tubes are perfectly smooth, without any indications of attachment to the surrounding siphuncle, in the upper part; but from the rapid expansion, and the nearness to the shell of the siphuncle, at the points observed, we may fairly infer that it unites with the siphuncle, at no great anterior distance, thus forming a protection to the animal from injuries to the apex of the shell, or cutting off its means of attachment or its habitation from the older part of the shell, when it was no longer needed or desired.

It was collected by W. C. Egan, Esq., in rocks of the age of the Hudson River Group, at Bristol, Illinois.

ENDOCERAS INÆQUABILE, n. sp.

Plate IV., fig. 3 and 3*a*, natural size.

This species is founded upon the siphuncle, all other parts being unknown. The siphuncle is straight upon one side. It commences at a point and somewhat rapidly swells upon one side for the distance of about an inch, and then slowly contracts itself upon that side until it forms a true cylinder, forward of which, as far as our specimen is preserved, which is more than an inch, there is neither expansion nor contraction. The marks of the septa, upon the cylindrical part, are distant about half the diameter of the siphuncle, cross it diagonally, and inclining forward, upon the straight side, at an angle of about 30 degrees. If we judge by the inclination of the septa, in comparison with other species, the straight side will be the dorsal, and the distended side, the ventral. Having three specimens of this peculiar siphuncle, I have no doubt that it is a normal form and represents a particular species, though it would have been more gratifying, if the specimens had shown other characters in addition to those defined.

It was collected by W. C. Egan, of Chicago, in rocks of the age of the Hudson River Group, at Bristol, Illinois. These three species of *Endoceras* present characters so distinct from any known to the author, from rocks of the same age in this vicinity, that they have been to him of special interest.

CANCELLARIA LIVINGSTONENSIS, n. sp.

Plate IV, fig. 4, an aperture view; 4*a*, dorsal view, both very poorly executed, but bearing such resemblance as to be of some service in identification.

Shell obliquely subovate, spire depressed, and rising but little above

the body volution; volutions three, very rapidly increasing in size, the last one forming nine tenths of the entire bulk of the shell. Suture deep. Shell very thick and deeply cancellated. About twelve coarse revolving lines commence at the aperture, but not more than three reach the second volution, and I am inclined to think that only two are prolonged so far as that. These are crossed by strong oblique furrows that give the surface a deeply-pitted or cancellated appearance. The aperture is somewhat half-elliptical, or forming rather more than half an ellipse. (Fig. 4*a* shows the aperture much too circular, it is not as wide above, and is more prolonged below than is shown by the illustration). It is full two thirds of the length of the shell. The shell is not perfect at the base, and is destroyed at several other places on the specimen, but enough is preserved to show its general character.

I collected this species in rocks of the age of the Ripley Group, near Livingston, Alabama.

Last season I had occasion to visit the towns of Macon and Meridian, Mississippi, and Livingston, Alabama. By the railroad, Macon is situated about 60 miles north, and Livingston about 40 miles northeast of Meridian. I traveled in a buggy south from Macon about 12 miles, and northeast from Livingston to the Black Warrior, which is about the same distance. In addition to this, I ascended to the top of the hills at Meridian, and had a general view of the surrounding country, beside the observations I was enabled to make along the lines of railroad travel. I am thus particular in mentioning the opportunities for observation, because I saw no evidence throughout the whole region mentioned, of the northern drift. The contour of the country and the character of the strata evidence the local wear and tear of the seasons since the elevation of the land, without the aid of any foreign eroding force. It is, therefore, as I am very fully convinced, a driftless area.

The fossils collected in the various exposures, from Macon south for a distance of fifteen miles, and from the Black Warrior to Livingston, Alabama, were mixed together, but the formations exposed are the same on the two lines of travel. The rotten limestone is exposed at Macon, and on the Black Warrior, while the Ripley Group caps the highest part of the hills farther south, from either place. The two groups shade into each other, and during the limited time of my observations, I did not discover the line of separation; indeed, I was not expecting to see any exposures of the Ripley Group, and it was not until I examined the fossils, at home, that it occurred to me that the

sandy limestone, on the ridges crossed, belong to this age. The following list of fossils, which I collected, indicates the presence of rocks lower than the Ripley Group, as well as of that age; but under the circumstances, it being probable that this is the first published list from these localities, I prefer not to attempt to separate them:

Baculites asper, *B. labyrinthicus*, *B. ovatus*, *Nautilus perlatus*, *Heteroceras conradi*, *Exogyra costata*, *E. interrupta*, *Ostrea confragosa*, *O. congesta*, *O. denticulifera*, *O. littlei*, *O. mesenterica*, *O. panda*, *O. peculiaris*, *O. plumosa*, *O. pusilla*, *Placunanomia saffordi*, *Panopæa tuomeyi*, *Idonearca vulgaris*, *Cardium alabamense*, *C. hemicyclicum*, *Trigonia thoracica*, *Gryphæa mutabilis*, *G. vomer*, *Inoceramus barabini*, *Axinæa hamula*, *Anomia argentaria*, *A. tellinoides*, *Plagiarca carolinensis*, *Cucullæa ungula*, *Legumen ellipticus*, *Veniella conradi*, *V. trapezoidea*, *Leiopistha protexta*, *Clavagella armata*, *Plicatula urticosa*, *Turritella fastigata*, *T. vertebroides*, *Chemnitzia meekana*, *Gyrodes alveatus*, *G. petrosus*, *Scalaria sillimani*, *Voluta spillmani*, *V. subjugosa*, *V. tuomeyana*, *Rostellites nasutus*, *Leioderma canalis*, *Pyropsis richardsoni*, *Angaria lapidosa*, *Anchura arenarum*, *Radiolites lamellosus*, *Spatangus parastatus*, *Serpula barbata*, *Hamulus onyx*, *Stomatopora regularis*, *Dentalina pulcher*, *Cancellaria livingstonensis*, here described as a new species, and a few microscopic forms, and the fragment of a crinoid.

Archæological researches in the Madisonville Pre-historic Cemetery are still being prosecuted by this Society, in connection with the Peabody Museum of American Archæology and Ethnology.

Professor Maxime Kovalevsky, of the University of Moscow, was in the city for a few days in the latter part of June. The professor is investigating the subject of American Ethnology, and devoted considerable time to the Anthropological Department of the Society's Museum, manifesting especial interest in the large series of objects from the Madisonville Ancient Cemetery.

The Society has recently added to its attractions, by purchase, a microscope, of first-class working model, and a cabinet in which is arranged a beautiful series of coral sections, representing this vicinity; fossil diatoms from every known locality, and a good series of histological slides.

Attention is called to the fact that the instrument is intended for the use of members of the Society.

ZOOLOGICAL MISCELLANY.*

A DAY IN A LOUISIANA SWAMP.

Words fail to express the sensations experienced by a northern naturalist, on entering for the first time, the Sugar District of Louisiana. While the monotonous landscape of this section, with its never-varying fringe of moss-hung cypress limiting the view in all directions, is but slightly attractive from an artistic standpoint, to the naturalist even the very monotony is unique in character ; while he can not fail to be impressed by the peculiarities of climate, the sub-tropical character of the fauna and flora, and the evidences existing on every side of that long continued conflict between land and water, to which is due such vast accessions to our southern border in ages past; a conflict still waging as persistently and silently as ever, and gradually converting the Mexican Gulf into an inland sea.

Strolling quietly along on a clear April morning, through the highly cultivated grounds of a sugar plantation in the Parish of West Baton Rouge, our ears are saluted by the full, clear notes of the Cardinal Grosbeak, whose brilliant plumage glows like a live coal in the dark recesses of a hedge of Cherokee Rose ; from the top of a tall weed swaying in the breeze, the rainbow-hued Nonpariel Finch sings a pleasing ditty to his plainly-colored mate in the brier-patch below ; whilst the many-tongued Mocker pours out his matchless wealth of song from the topmost bough of a China-berry tree.

A startled Crow peers up at us over the edge of a neighboring ditch bank, where he is seeking the crayfish which form a considerable portion of his diet in this region, and uttering harsh protests against our intrusion at his breakfast table, betakes himself to more distant poaching grounds.

High overhead a pair of Red-tailed Hawks are passing in interlocking circles, making the ambient air resound with piercing screams; while afar off in the azure distance a circling band of Turkey Vultures and Carrion Crows mark the course of that artery of a continent—the Mississippi.

These are only a few of the sights and sounds which divert our atten-

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* Edited by Dr. F. W. Langdon

Communications intended for this department should be addressed to the Editor. Contributors will please write legibly, and on one side only of the paper, leaving an inch of margin on the left.

tion as we pass through a mile or two of newly plowed canefield, toward the dark wall of verdure which marks the outline of the adjoining "swamp," as the woodland, dry or wet, is here called, for it is all wet at some season of the year.

Leaving the border of the plantation, our course lies along the banks of a small bayou, or creek, as we would call it in Ohio; the appearance of a ripple on its surface apprizes us of the presence of a Mink, cleaving the inky waters like an arrow,—a flash, a report, and the smoke rolls up from the water disclosing the struggling form of another candidate for scientific immortality. Passing onward through scattering thorny locusts, sycamores and sweet gums, with an abundant undergrowth of blackberry vines, our eyes are delighted with the sight of a pair of beautiful Swallow-tailed Kites, floating over the tree tops or skirting the edge of the woodland in graceful, undulating curves, as they pursue their insect prey; a startled hare, bouncing from her covert, disappears within the friendly labyrinth of briers. A few steps farther and we reach the moist black soil and deep shades of the swamp proper, where the umbrageous evergreen oaks and stately sweet gums, heavily festooned with Spanish moss, vie with each other in shutting out the light of day. Immense gnarled vines struggle upward through the gloom like giant serpents enfolding the monarchs of the forest in their embrace; on every side a maze of lesser climbers creep, stretch and hang from tree to tree; the fan-like palmetto spreads its serrate leaves to catch the faintest zephyrs that reach these sylvan depths; while high above all the towering cypress lifts its moss-crowned head, with arms outstretched as if to guard the precincts below from desecration. A solitary sunbeam, piercing an opening in the canopy of foliage, stretches through the sombre depths like a golden shaft, and tipping the palmetto spines with yellow light, is shattered into a thousand splinters on the surface of the pool below.

A Blacksnake, snugly ensconced in a mass of tangled vines, eyes us lazily as he basks in its welcome rays; scurrying Lizards of varied hues seek a place of safety from whence to view our movements; and an Opossum, with half a dozen young clinging to tail and back, looks up in surprise for an instant before seeking the friendly shelter of a convenient hollow log.

In a neighboring thicket, the unique notes of the White-eyed Vireo, and the metallic lisp of the Blue Yellow-backed Warbler are heard, while the varied song of the Mocking Bird reaches our ears from the now distant border of the plantation. From a thickety knoll a Chuck-

wills-widow flickers noiselessly into view for an instant, giving us a long-wished for opportunity for a hasty shot at the place in the dense foliage, where it disappeared.

Securing our bird, we turn our course toward an open glade, whence the tapping of the shy Pileated Woodpecker on some blasted trunk, greets our ears; a pair of Wood Ducks are disporting themselves in the pool below; a Snowy Egret poises gracefully in bold relief against its inky surface, while the rattling note of the Kingfisher on an over-hanging limb, announces our intrusion. The Alligators have not yet awakened from their winter's sleep, and even at the most favorable times are not nearly so common as us unsophisticated Northerners are apt to think them.

The hour of noon arrives: the palmettos quiver in the embrace of the last dying zephyr; all forest sounds are hushed, save the monotonous hum of myriad insects; and, after due attention to the material wants of the inner man, we take our siesta on the prostrate trunk of a patriarchal cypress.

Rested and refreshed, we shape our course to reach the edge of a clearing, where our wishful gaze is rewarded by the sight of an approaching flock of Little Blue Herons. They number among their ranks a goodly number of the white (generally considered immature), birds, and after circling about for a few moments, set their wings and glide downward into the center of an overflowed meadow, far out of gunshot from the nearest cover, where, with craning necks and stately, measured steps, they proceed to regale themselves to satiety on the ever-abundant Crayfish.

This last-mentioned animal is an exceedingly important element of the fauna, as well from an economic as from a zoologic standpoint; for not only does it form a staple article on the bill of fare of many birds and mammals, but at the tables of the native population supplies the place occupied by the Shrimp in many seaboard districts; and the writer can testify, from abundant personal experience, to its gustative attractions. It is a very common sight to see half a dozen or more Creole women and children grouped along a ditch-bank in the warm afternoon sun, catching the Crayfish for their evening meal. Their tackle is exceedingly simple, consisting merely of a stick three or four feet long and a line of equal length, to which is attached a "chunk" of bacon; with this primitive apparatus you may take a peck or more of Crayfish in a few hours. As the city of Paris consumes annually five or six millions of Crayfish, at a cost of about eighty thousand

dollars,* it is not surprising that the natives of this section, who are mostly of French descent, should appreciate their dietetic importance.

Again, the innumerable burrows of these crustaceans, honeycombing the soil everywhere, and all leading toward the nearest ditch or bayou, greatly facilitate the rapid carrying away of the surface drainage—an exceedingly important matter in this almost perfectly level country. On the whole, therefore, their extermination would doubtless prove a serious loss, even though they do sometimes occasion trouble by perforating the levees.

Turning our attention to the swamp again, our reflections on Crayfish and Correlation are brought to a sudden termination by the appearance, through an opening in the foliage, of a Great Blue Heron, winging his way heavily toward a blasted Cypress top, whence, after glancing warily about, he sets his broad pinions, and with dangling legs sails languidly down to the margin of the bayou below.

So the time passes, almost like a dream, until at last the thickening gloom and hootings of numerous Barred Owls admonish us of the approaching sunset. The swallows are skimming homeward o'er the newly plowed ground; the frogs begin their evening pipe along the bayous, while from his resting place in some hollow trunk the Red Bat flickers forth and with vacillating flight marks out his zig-zag course against the sky.

We look in vain for our accustomed Northern twilight—the crimson sun drops behind the Cypress wall that borders the horizon, and night reigns supreme.—(Ed.)

MAMMALOGY.

Sciuropterus volucella, Goeffroy.—*Common Flying Squirrel.*

Felis domesticus, L.—*Common House Cat.*

Coming home one Saturday evening, after a week's absence in town, I found the juveniles of the family in great tribulation. They had planted a pea patch by the side of the wood on some idle ground, and the paths were all littered with pea shells. I went up next morning with dog and gun, but saw nothing. Dog did not seem to know the scent. Sent for the cat. She scented the shells and trotted home. Looked bad for the peas; next Saturday evening came home; all was lovely; peas safe; tails of three flying squirrels were produced—found

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**Vide* Huxley, "The Crayfish," p. 10.

on sweeping under the bureau. Though owning the wood for twenty years, had never seen one in it. They are easily taken when their nest is known, as they sleep all day and are abroad only at night, unless disturbed. The cat was all that saved the crop.—C. G. Siewers, Newport, Ky.

Blarina brevicauda, Baird.—(See Ornithology—*Buteo borealis*, p. 95).

ORNITHOLOGY.

Spring arrivals at Bardstown, Ky.—Almost all of our common migrants are considerably ahead of time this spring. I have noted the following early arrivals:

Harporhynchus rufus (Linn.), Cabanis.—*Brown Thrasher.*—March 3d.

Polioptila cærulea (Linn.), Scl.—*Blue-gray Gnatcatcher.*—March 28th.

Siurus motocilla (Vieill.), Coues.—*Large-billed Water Thrush.*—March 30th.

Mniotilta varia (Linn.), Vieillot.—*Black and White Creeper.*—April 1st.

Dendrœca dominica albilora, Baird.—*White-browed Yellow-throated Warbler.*—April 3d.

Dendrœca blackburniæ (Gm.), Baird.—*Blackburnian Warbler.*—April 3d.

Helminthophila pinus (Linn.), Ridgway.—*Blue-winged Yellow Warbler.*—April 10th.

Parula americana (Linn.), Bp.—*Blue Yellow-backed Warbler.*—April 10th.

Dendrœca cærulea (Wilson), Bd.—*Cerulean Warbler.*—April 10th.

Dendrœca virens (Gm.), Baird.—*Black-throated Green Warbler.*—April 10th.

Vireosylvia olivacea (Linn.), Bp.—*Red-eyed Vireo.*—April 10th.

Lanivireo solitarius (Vieill.), Bd.—*Blue-headed Vireo.*—April 10th.

All of these birds are from two to three weeks in advance of their usual time of appearance here.—C. W. Beckham, Bardstown, Nelson county, Ky.,* April 30th, 1882.

Brookville (Indiana) Notes.

Thryomanes bewicki (Aud.) Baird.—*Bewick's Wren.*—Early in March, 1882, two or three Bewick's Wrens were noted. About the 15th

* About 100 miles southwest of Cincinnati.—(Ed.)

of the same month, I discovered in the hollow of a log of an old building, a nest of the same species, which from some cause was abandoned when completed. On April 25th, being told of another Wren's nest, about forty rods distant from the first, I found it in a hollow fence-rail, and on rapping the rail a few times, I was much pleased to see a Bewick's Wren come out and alight a few feet from me. Supposing incubation was far advanced, I did not disturb the nest or eggs.

Helminthotherus vermivorus, Salv. & Godm.—*Worm-eating Warbler.*—While squirrel hunting, five miles south of Brookville, yesterday, I found the nest of the Worm-eating Warbler (*Helminthotherus vermivorus*). It was situated on a densely-wooded hillside, on the almost perpendicular bank of a gully, and was overhung by the base of a small shrub. It was composed of dried leaves, and lined with fine shreds of bark of the grapevine. When driven from the nest, the bird refused to leave the vicinity, but with distended tail and fluttering wings, moved round me at a distance of a few feet, until I called a companion, on whose appearance she flew away. The nest contained two addled eggs and one half-fledged young. The eggs are about the size of those of the Summer Yellow bird (*D. æstiva*), with diameter proportionately greater. They are pure white, dotted everywhere with light reddish brown, most thickly at the larger end. On my first acquaintance with this species, it was supposed to be rare, but on becoming familiar with its habits and note (which exactly resembles that of the Chipping Sparrow), I find it to be quite common; indeed, I think that among our woodland species it will rank next in number to the Oven Bird (*S. auricapillus*), which is one of the most common.

Chondestes grammica (Say), Bp.—*Lark Finch.*—On April 18th, I saw a *flock* of this species, eight in number, keeping close together on the ground. I flushed them several times, and they always took wing and alighted again in a compact flock.

Sphyrapicus varius (L.), Baird.—*Yellow-bellied Woodpecker.*—This species was very common from the beginning of March until April 15th. Three or four seen every day. None seen after the middle of April.

Bubo virginianus (Gm.), Bp.—*Great Horned Owl.*—On April 16th, I visited a nest of this species, situated in the hollow of a large white oak, about thirty feet from the ground; it contained two young, in the downy stage of plumage, one much larger than the other. I kept them several days, and they were good Owls when they were not hungry.

Pandion haliaetus carolinensis, (Gm.) Ridgway.—*Fish Hawk,*

American Osprey.—Common spring and fall migrant. Invariably present for several weeks in the spring, when I have known it to remain as late as the middle of May.

ECTOPISTES MIGRATORIA (Linn.), Swainson.—*Wild Pigeon.*—I have seen the female sitting on the nest within two miles of Brookville, Ind.

MELEAGRIS GALLOPAVO AMERICANA (Bartr.) Coues.—*Wild Turkey.*—Specimen taken in Franklin County, Indiana, in December, 1878.—E. R. QUICK, Brookville, Franklin county, Indiana.

HERODIAS ALBA EGRETTA (Gm.). Ridgway.—*American Egret.*—I have to report the capture, at Maysville, Ky., April 22, 1882, of a female example of the Great White Egret, in full breeding plumage. The specimen is handsomely decorated with the elegant plumes for which the genus is noted. I do not know of any previously recorded instance of the occurrence of the species, in this vicinity, in spring plumage.—JOHN W. SHORTEN, Cincinnati, Ohio, May 13, 1882.*

SPIZA AMERICANA (Gm.) Bonap.—*Black-throated Bunting.*—An anomalous specimen of this species taken at Madisonville, July 4, 1877, presents the following peculiarities of plumage: the black, shield-like patch characteristic of the jugulum of the male bird, is tolerably well defined in a bright yellow ground; while the sides are streaked like those of the normal female. On dissection, the specimen proved to be an adult female.—(ED.)

BUTEO BOREALIS (Gm.) Vieillot.—*Red-tailed Hawk.*—The stomach of a specimen taken at Valley Junction, Ohio, March 24, 1877, contained three Garter-snakes (*Eutœnia sirtalis*), one nearly whole, and about eighteen inches long, the other two smaller and partially digested; also the head and fore-legs of a Mole Shrew (*Blarina brevicauda*).—J. W. SHORTEN, Cincinnati, Ohio.

CUPIDONIA CUPIDO (Linn.) Baird.—*Prairie Hen.*—Two adult specimens of this species were kept in confinement by the writer from January to June, 1875. They seemed to bear their captivity well, but lost little or none of their native wildness, and the only evidence manifested of an inclination to breed was the loud cooing of the male heard during the month of May, which sounded very much like the highly-exaggerated voice of a Turtle Dove. The male finally injured himself fatally by flying against the roof of the apartment in which they were confined.—(ED.)

RALLUS ELEGANS, Audubon.—*Great Red-breasted Rail.*—A specimen taken at Madisonville, April 30th, 1876, had sticking in its œsophagus a large water beetle (*Hydrophilus triangularis*), the sharp spine on

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* This specimen is now in the Museum of this Society.

the ventral surface of the beetle having penetrated the wall of the viscus.—(Ed.)

HERPETOLOGY.

Eutænia sirtalis (L.), B. & G.—*Common Garter Snake.*—(See Ornithology, *Buteo borealis*, p. 95).

Diemyctylus viridescens, Raf.—*Spotted Triton ; Newt.*—Early in March, I found this species in ponds, and with it were many young batrachians with external branchiæ. As they increased in size, the branchiæ diminished. On the first of May they were almost as large as the adult, and had developed white spots corresponding to the vermillion spots in the adult; the external branchiæ having almost disappeared. The species seems to be very common.

Spelerpes longicaudus (Green), Baird.—*Cave Salamander.*—Two specimens of this Salamander were taken in a "spring house" near Brookville, and brought to me. They both escaped from a bottle in which I thought to keep them over night.—E. R. Quick, Brookville, Franklin County, Ind., May 11th, 1882.

ENTOMOLOGY.

Coleoptera.

On looking back over last season, the finds of entomologists in this section seem to have been rather meagre. In Lepidoptera little was done except in *Catocala* by sugaring. Some good Coleoptera were taken. In Silphidæ, *Necrophilus subterraneus*, Dahl., after three seasons' hopeless search, turned up again last fall. Mr. Charles Dury had taken three and I one, there being at the time but one known specimen, credited to Pennsylvania. Last fall Mr. Dury found another, and I, by replacing fungus, took three. On a trip out the Louisville Short Line to Bank Lick Station, some good captures were made, among the rest that handsomest of Elaters, *Lymonius aurifer*. In Tenebrionidæ, *Strongylium crenatum*, very rare and new; also, in Lagriidæ, a fine bronze variety of *Arthromacra ænea*, not known to Dr. Le Conte. This season is very late like the last, but it is now high time to begin beating bush and limb.—C. G. Siewers, Newport, Ky., June 8th, 1882.

Hydrophilus triangularis, Say.—(See Ornithology—*Rallus elegans*, p. 95.

THE JOURNAL

OF THE

CINCINNATI SOCIETY OF NATURAL HISTORY.

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PROCEEDINGS OF THE SOCIETY.

WEDNESDAY EVENING, *July* 5, 1882.

Dr. F. W. Langdon, Vice-President, in the chair. Present, 13 members.

Dr. Robt. Sattler, Dr. S. C. Ayres, Dr. G. M. Allen, J. B. Patterson, and Patterson A. Reece, were elected members.

Section 6, of Article II., of the By-laws of the Society, was amended by striking out the word "Archæology," and inserting in its stead "Anthropology."

The amendment to the constitution proposed at the June meeting, was passed by the necessary vote, and laid over to the August meeting for final action.

Dr. O. D. Norton read a paper on the Yellowstone country of Montana.

Donations were announced as follows:

Smithsonian Institution, ten pamphlets; O. N. Collett, two pamphlets; B. W. Chidlaw, larvæ of *Leucania unipunctata*; J. & S. Bosworth, fruit of the Mangrove and Agave of Florida; Signal Service Bureau, Weather Review; State Mineralogist of California, six pamphlets; Ralph Colvin, four bottles of insects in alcohol; Dr. L. B. Welch, a Night Heron, mounted by J. W. Shorten; Otis Mason, three pamphlets; W. H. Stanage, skin of Night Heron; W. F. Fiedeldey, seven slugs (*Limax maximus*); Chas. Dury, 26 beetles; Miss Stickney, five shells; A. E. Heighway, Jr., dusky bat, mounted by Chas. Dury; and from

Dr. A. E. Heighway and A. E. Heighway, Jr., a lot of lignite and fossil leaves from Montana.

TUESDAY EVENING, *August* 1, 1882.

Dr. R. M. Byrnes, President, in the chair. Present, 40 members.

Dr. F. W. Langdon and Dr. J. H. Hunt exhibited specimens of *Bacillus tuberculosis* of Koch. There were three microscopes on the table. The specimens were from one ten-thousandth to one twenty-thousandth of an inch in diameter.

Article three of the Constitution was finally amended so as to add to it the following: "Any resident member who shall not have been in arrears for dues for a period of ten consecutive years, may become a life member upon the payment of twenty-five dollars. Any resident member who shall not have been in arrears for a period of twenty consecutive years, shall become a life member without further payment.

The President announced the death of Dr. W. H. Mussey, an ex-president of the society, and on motion of R. B. Moore, a committee was appointed to draft suitable resolutions expressing the appreciation of the deceased by the members, viz: R. B. Moore, Dr. A. E. Heighway, Dr. J. H. Hunt, Dr. O. D. Norton and Dr. F. W. Langdon.

Donations were announced as follows:

From Smithsonian Institution, nine pamphlets; Signal Service Bureau, one pamphlet; Ed. M. Cooper, two volumes Ohio Survey; from Stephen and Walter Coles, fossils; E. L. Sherwood, two fossils; Alin Ross, a *Cyrtoceras*; from Dr. J. H. Hunt, a microscopic slide; from Truxton Swift, two bird skins; from Dr. F. W. Langdon, an insect; from Col. Crary, of Texas, two specimens of Indian pottery, from that State; and from L. S. Cotton, a specimen of coral.

TUESDAY EVENING, *September* 5, 1882.

Dr. R. M. Byrnes, President, in the chair. Present, twenty-five members and a number of visitors.

Davis L. James exhibited specimens of *Nelumbium speciosum*, the sacred lily of the ancient Egyptians. He referred to the history of the lotus, and to the various species of the order to which it belongs, the *Nymphaceæ*. The order is quite a large one, and is distributed over the world. The lotus is a native of Asia and Australia, and though not now found in Egypt, there is no doubt that at one time it was abundant in the Nile. Many representations of it are given on the Egyptian monuments. It was considered by them to be a sacred

flower, as was the case with the Hindoos, who said that Brahma floated on the surface of the water, buoyed up by a lotus leaf, and there created the flower. Since then it has been symbolized as the type of the creation. He showed the strength and elasticity of the spiral ducts in the interior of the petiole of the leaf, drawing them out twelve or eighteen inches. The cells in the interior of the petiole are very large and covered on the inside with curious stellate hairs. The large cells contain air sufficient to buoy up the peltate leaf. The blossoms were very large, and of a deep rose color, while the leaves were circular and of a deep velvety green.

Dr. A. J. Howe spoke upon some anatomical points of the brain, showing its development from the lowest to the highest forms, and gave some remarkable illustrations of recovery or partial recovery from injuries to this vital organ.

The Committee on the memory of Dr. W. H. Mussey, reported as follows :

William Hebberden Mussey was born at Hanover, N. H., September 30, 1818, and died in this city, August 1, 1882, after a long and honorable career of personal and professional usefulness. He was one of the earliest and most liberal friends of this Society, of which he became a member at its organization, January 19, 1870. He manifested a special interest in the cultivation of the natural sciences, and supplemented his works and good will by the donation of an extensive and valuable collection in Comparative Osteology to the Society's museum, which was, to use his own words, "To be increased by future donations and called the Mussey Collection of Comparative Anatomy, in honor of the donor's illustrious father." Often a worker in the Society himself, and at one time its President, he lost no opportunity of furthering its interests and usefulness; his frank and zealous habits, his upright walk and conversation, candor and thoroughness, gave him at once a commanding position as colleague in the upbuilding of any good work.

In scientific research, he was broad, liberal and comprehensive; a diligent worker and a faithful friend, with sympathies always for the right and for progress. As an evidence of his energy and promptness, as well as regard for the welfare of this Society, the following may be educed:

In a conversation relating to the interests of the Society, deep regret had been expressed at the loss to our city of the great collection of fossil mammalian remains from Big Bone Springs, Kentucky,

formerly exhibited at the Cincinnati Western Museum, and afterward sent to Europe. Dr. Mussey replied, "This Society must and will have a suitable representation of those remarkable remains, if we have to take steam machinery and dredge the whole morass." He also suggested at the same time another locality to which these animals probably resorted, perished and became entombed.

Of his professional career it is almost superfluous to speak here. Occupying as he did a high position in the medical profession, both as a teacher and practitioner, his work needs no further comment. In addition to the chair of Surgery in the Miami Medical College, which he occupied at the time of his decease, he was also Surgeon to the Cincinnati Hospital, member of the School Board, and of the Board of Members of the Cincinnati Public Library. He also occupied important and responsible positions, as Military Surgeon during the late war, and was one of the first organizers of the Cincinnati Sanitary Commission.

Physician, patriot and philanthropist, reaper and gleaner in the domain of scientific research, he was at the same time an earnest Christian, and most truly, it may be said of him, "a great man is gone"—"the world is better for his having lived." With profound regrets for his decease, respect to his memory and sympathy for his family in its bereavement, we hope and trust that the mantle of a worthy father may again fall upon a worthy son.

R. B. Moore,
A. E. Heighway, M.D.,
J. H. Hunt, M.D.,
O. D. Norton, M.D.,
F. W. Langdon, M.D.

A. P. Morgan exhibited some oil paintings of Fungi made by Mrs. Morgan.

Donations were announced as follows: Smithsonian Institute, eleven pamphlets and a volume on Ethnology; Joseph F. James, two barn swallow-nests and some botanical specimens; I. W. Spurlock, herbarium specimens of plants; Mechanics' Institute, a pamphlet; D. L. James, pods and seeds of the trumpet vine; H. S. Clark, humming bird's nest; Signal Service Bureau, a pamphlet, and Dr. F. W. Langdon, microscopic slide of *Bacillus tuberculosis.*

BRIEF MENTION OF SOME OF THE MEN WHO AIDED IN DEVELOPING THE SCIENCE OF GEOLOGY IN AMERICA, BUT WHO ARE KNOWN NO LONGER, EXCEPT BY THEIR WORKS.

By S. A. Miller.

I am conscious of the incompleteness of this biographical list of names, but, in addition to accidental omissions, there are serious obstacles in the way of making it complete, without extraordinary investigation, as some of the geologists have not received obituary notices in the scientific journals, and not being members of scientific socities they have passed away from their field of labor without proper public notice. It is but just that their names should be commemorated, and this article, even in its incompleteness, will no doubt possess some value for reference, and as a basis for a more thorough biography.

Thomas Jefferson was born in Albemarle county, Virginia, April 2d, 1743, and died on the 4th day of July, 1826, in the 84th year of his age. He was the author of the Declaration of Independence, President of the United States, and eminent as a statesman and author. His geological work consists principally in an essay on the fossil bones of the Mastodon and Megalonyx, published in 1818, in the Transactions of the American Philosophical Society.

Mr. Thomas Say died on the 10th day of October, 1834, in the 47th year of his age, at New Harmony, Indiana. He was born in Philadelphia, where he lived until 1825. He then changed his residence to New Harmony. He described more than 1,500 species of insects, a great many land and fresh water shells, and thus, probably, did more than any other individual had done to make known the Zoology of the United States. His contributions to geology were not numerous. He will be remembered as one who enlarged the boundaries of science, and reflected honor upon his country, and the age in which he lived.

Stephen Van Rensselaer, of New York, died on the 26th day of January, 1839, in his 75th year. He laid no claim to being a geologist himself, but evinced the highest opinion of the value of the science by establishing schools where it might be taught, and frequently bestowing bounties upon those in its pursuit. He maintained Prof. Eaton engaged in geological studies, for many years, and paid the expenses of several publications, and the preparation of many plates.

His name is to be commemorated as a munificent and untiring patron of the science, who projected plans for investigation, and brought the discoveries when made before the public. He, therefore, not only stimulated its cultivation, but furnished material aid, and performed an essential part in the labor of discovery and advancement.

Mr. Wm. Maclure died at San Angel, in Mexico, on the 23d day of March, 1840, in the 77th year of his age. He was born at Ayr, in Scotland, in 1763, and for a time was engaged in commercial enterprises in London, where he made a fortune. He crossed the ocean several times, and finally concluding to make America his future home, he proposed to make a geological survey of the United States, and as early as 1809 produced his observations on the Geology of the United States, explanatory of a geological map which was the first thing of the kind done in America. In 1817, a corrected edition was issued. He wrote a number of geological papers for the American Journal of Science and Arts, and also for other journals. He was elected President of the Academy of Natural Sciences, of Philadelphia, on the 30th day of December, 1817, and was annually re-elected up to the time of his death, thus filling the position for more than twenty-two years. He contributed to that Academy a large library, a large collection of specimens of Natural History, and many thousand dollars. He contributed toward the establishment of museums in nearly every State of the Union, one of which was in our city, and did more to create an interest in geological matters and diffuse a knowledge of the subject than any other man of his day.

Constantine S. Rafinesque-Schmaltz, a Sicilian by birth, came to America in 1802, and remained for three years. He returned again in 1815, and remained until his death, in September, 1840. His favorite pursuit was botany, though nothing in natural history escaped his observation that came within his reach. He was remarkably gifted, indefatigable in his labors, eccentric, and in literature a prodigy. His geological work, however, did not extend beyond the brief definition of a few species.

Jacob Green was born at Philadelphia, July 26, 1799, and died there February 1, 1841. He was a chemist and an author. He wrote a Monograph of the Trilobites of North America, in 1832, and afterward contributed upon the same subject to the Transactions of the Geological Society of Pennsylvania, Journal of the Acadamy of Natural Sciences of Phila., and to the American Journal of Science and Arts.

AMOS EATON died on the 10th day of May, 1842, in the 66th year of his age. He made a geological survey of the country adjacent to the Great Western canal, from 1820 to 1824, under the patronage of Van Rensselaer. His index to the Northern States was published in 1818, and the 2d edition in 1820. When the Rensselaer school was established he was appointed a professor, and remained there during the remainder of his life.

JEAN N. NICOLLET was born July 24, 1786, and died on the 11th day of September, 1843, at Washington, D. C. He had been in this country about ten years, a large part of which time was devoted to a geographical, topographical, astronomical and geological survey of the Territories west of the Mississippi. He prepared a geological map of the Western Territories, which was exhibited to the Association of American geologists and naturalists for the year 1843; but we know little of his geological work, save from the proceedings of the Association, where he frequently spoke in off-hand debate, and from the valuable collection of fossils which he secured, part of which were described by Dr. S. G. Morton.

RICHARD HARLAN was born at Philadelphia, September 19, 1796, and died at New Orleans, in October, 1843. He was a physician by profession, and a prominent naturalist. His book on the Fauna Americana is the leading work of his life, relating to palæontological subjects.

ADOLPHE THEOPHILE BRONGNIART was born in Paris, in 1770. He was a botanist of great learning, and described numerous plants from the Coal Measures of America, in his Histoire des Vegetaux Fossiles —published from 1828 to 1838.

DOUGLASS HOUGHTON was born September 21, 1809, and on the night of October 13, 1845, perished in a storm that capsized a small boat in which he had embarked to go from Keweenaw Point to Eagle river, on Lake Superior. He was an active and energetic geologist, and at the time of his death was State Geologist of Michigan, and also engaged in surveying the public lands of that State.

On the 25th day of January, 1848, LARDNER VANUXEM died, at his farm, near Bristol, Pennsylvania. His father was a Philadelphia merchant, and gave his son the advantage of three years in Paris, at the school of Mines, where he became the associate of Brongniart and other distinguished scientific men. After his return home he wsa

engaged in the College at Columbia, South Carolina, as Prof. of Chemistry. In 1826 he went to the city of Mexico and took charge for a time of a gold mine in that vicinity. He returned and purchased a farm at Bristol, Penn., where he married and remained until the time of his death. He was distinguished for his work on the Geological Survey of the State of New York.

George August Golfuss was born at Baireuth, in 1782, and died in 1848. He published several American fossils in his *Petrefacta Germaniæ.*

Julius T. Ducatel was born at Baltimore, June 6, 1796, and died April 23, 1849, at the age of nearly fifty-three years. He was Professor of Chemistry and Geology in the University of Maryland for several years, and also filled the chair of Chemistry, Mineralogy and Geology in St. John's College, Annapolis. In 1832 he was appointed, with J. H. Alexander, to make a new map of the State of Maryland, which appeared in 1834, with a report on a projected geological and topographical survey of the State. He was then appointed to make a geological survey, which position he held until 1841. His geological work consists of seven annual reports upon that State—from 1834 to 1840.

Gerard Troost was born at Bois le Duc, Holland, March 15, 1776 and died on the 14th day of August, 1850, at Nashville, Tennessee. He was professor in the University of Nashville for twenty-two years, and State Geologist of Tennessee for nearly twenty years. He wrote nine reports. The first two were not published; the other seven were published from 1835 to 1848.

Samuel George Morton was born at Philadelphia on the 26th day of January, 1799, and died on the 15th day of May, 1851, in his fifty-third year. He became a member of the Academy of Natural Sciences of Philadelphia, in 1820, and was President of the same at the time of his decease. His principal contribution to Geology and Palæontology was his "Synopsis of the Organic Remains of the Cretaceous Group of the United States." His work entitled "Crania Americana," published in 1839, and his "Crania Egyptiaca," published in 1845, placed him in the highest rank as an ethnologist. He was distinguished also as a medical author, while he labored industriously in the practice of medicine.

James E. DeKay died at his residence on Long Island, on the 21st

day of November, 1851, at the age of fifty-nine. He contributed to Geology and Palæontology, but is best known for his work upon the Zoology of New York.

Dr. DANIEL DRAKE died at his residence, in Cincinnati, on the 7th day of November, 1852, at the age of sixty-seven years. He was best known as a medical author and successful practitioner of medicine. He was the first writer who called attention to the drift scattered over the Southern part of Ohio, and especially in the vicinity of Cincinnati.

CHARLES B. ADAMS was born in Dorchester, Massachusetts, January 11, 1814, and died at St. Thomas, in the West Indies, on the 18th day January, 1853. He was a professor in Amherst College in 1836; in 1837 he was at Marion College, Missouri; and in 1838 at Middleburg College, Vermont. He was State Geologist of Vermont from 1845 to 1848, and made four annual reports. In 1852, in connection with Professor Alonzo Gray, he published a school book under the name "Elements of Geology." He was an original investigator in zoology and geography, and a special student of the mollusca. His "Contributions to Conchology" and "Catalogue of Shells collected at Panama, with notes on their synonomy, station and geographical distribution," are his best scientific publications.

JOHN C. WARREN was born August 1, 1778, and died May 4, 1856. In 1806 he was appointed Adjunct Professor of Anatomy and Surgery at Harvard College, and in 1815 he was made Hersey Professor of Anatomy and Surgery, from which position he retired in 1847. After his retirement he prepared and published his celebrated work on the "Mastodon giganteus."

JAMES G. PERCIVAL was born in Berlin, near Hartford, Connecticut, September 15, 1795, and died at Hazel Green, Wisconsin, on the 2d of May, 1856. He was eminent as a poet and a scholar. In 1835, he was appointed, in conjunction with Prof. C. U. Shepard, to make a survey of the geology and mineralogy of the State of Connecticut. A report of 495 pages octavo was issued from New Haven in 1842, accompanied by a geological map. In 1854 he was appointed State Geologist of Wisconsin, and issued his first annual report in January, 1855. He died before completing the 2d annual report.

ZADOC THOMPSON was born at Bridgewater, Vermont, May 23, 1796, and died on the 19th day of January, 1856, at Burlington, in the same

State. He was the author of an elementary work on the geology and geography of Vermont, and assistant under Prof. Charles B. Adams, State Geologist. At the time of his death he was Professor of Natural History in the University of Vermont, and had recently been appointed and entered upon the duties of State naturalist, which included a geological survey of the State.

John Locke died at Cincinnati, on the 10th day of July, 1856, at the age of 65. He had long been distinguished for his zeal and successful labors in many departments of science. He was an assistant on the geological survey of Ohio in 1838, and afterward explored the great northwest. His reports are characterized throughout by original investigation, sound learning and good judgment.

William C. Redfield was born at Middletown, Connecticut, on the 26th of March, 1789, and died in New York, February 12, 1857. He was distinguished as a meteorologist and naval engineer. His geological publications consisted of a Notice of Fossil Fishes in Virginia in 1838; Short notices of American Fossil Fishes in 1841; Notice of newly discovered Fish-beds and a Fossil Foot-mark in the Red Sandstone formation of New Jersey, 1843; On some Fossil remains from Broome county, N. Y., 1849; On the Post-Permian date of the Red Sandstone Rocks of New Jersey and the Connecticut Valley, as shown by their Fossil Remains, 1851; On the Fossil Rain-marks found in the Red Sandstone Rocks of New Jersey and the Connecticut Valley, and their authentic character, 1851; and on the relations of the Fossil Fishes of the Sandstone of Connecticut and other Atlantic States to the Liassic and Oolitic periods, 1856.

Jacob W. Bailey was born April 29, 1811, and died Feb. 26, 1857. He was distinguished as a chemist, mineralogist and botanist, but is best known to the world for his microscopic researches. For more than twenty years he was engaged in investigating and publishing discoveries in microscopy. With the exception of what Ehrenberg did, microscopic geology in this country seems almost alone indebted to him for its advancement up to the time of his death.

Michael Tuomey was born in the city of Cork, of Irish parents, September, 29, 1805, and died at Tuscaloosa, Alabama, on the 20th day of March, 1857. In 1844 he was placed in charge of the Geological Survey of South Carolina, and four years afterward published his final report in a large quarto volume. Subsequently he was appointed Professor of Geology and Natural History in the University of Alabama, at

Tuscaloosa, and placed in charge of a geological survey of that State. He died before his second biennial report had been published. He was also associated with Prof. F. S. Holmes in the preparation and publication of a splendid work, describing and illustrating the Pliocene Fossils of South Carolina, but died just before the work was completed.

James Deane, of Greenfield, Massachusetts, died on the 9th day of June, 1858, at the age of 56. His contributions to geology consist of papers on the Footprints in the Sandstone Rocks of the Connecticut Valley.

Parker Cleveland was born in Essex, Massachusetts, January 15, 1780, and died at Brunswick, Maine, on the 16th day of October, 1858. He was for many years a Professor at Bowdoin College, and distinguished as a mineralogist. He published a book on mineralogy in 1816, to which was annexed a sketch of geology.

William W. Mather was born in Middlesex co., Conn., May 24, 1804, and died at Columbus, Ohio, February 27, 1859. He was for six years an instructor in the U. S. Military Academy, where he graduated in mineralogy, geology and chemistry. In 1836 he resigned his commission in the army and accepted the position of Assistant Geologist on the Geological Survey of New York, which position he held until 1843. He was State Geologist of Ohio from 1837 to 1840. He also made a Report on the Geology of Kentucky.

David Dale Owen was born June 24, 1807, at Braxfield House, Lanarkshire, Scotland, and died at New Harmony, Indiana, November 13, 1860, in his 54th year. He came to the United States in 1829, and shortly after returned to Europe, but in 1833 returned to the United States, and in 1835 received his Medical diploma from the Ohio Medical College in Cincinnati. In 1837 he made a geological reconnoissance of Indiana, and from that time to his death was actively engaged in making geological surveys for the general government, and for the States of Indiana, Kentucky and Arkansas. His works are voluminous, and characterized by original research and no ordinary amount of learning and judgment.

S. A. Casseday was born in Louisville, Ky., and died at the same place, in September, 1860. He is remembered for his valuable publications upon the Crinoidea.

John Evans was born February 14, 1812, at Portsmouth, Massa-

chusetts, and died at Washington city, on the 16th day of May, 1861. He was an assistant upon Owen's Geological Survey of Wisconsin, Iowa, and Minnesota. He was the first scientific explorer who visited the Mauvaises Terrès of Nebraska, and collected fossils from that cemetery of extinct animals. The collections were described by Dr. Leidy in his work on the Extinct Fossil Fauna of Nebraska. In 1850 he was appointed U. S. Geologist for Oregon, a position which he filled for five years.

HIRAM A. PROUT died at St. Louis, on the 21st day of April, 1862. He was one of the founders of the St. Louis Academy of Sciences, and though a physician by profession, took a deep interest in Natural History, and described a great many fossils. His geological work will be found in the Transactions of that Academy.

SAMUEL P. HILDRETH was born in Methuen, Essex county, Massachusetts, September 30, 1783, and died at Marietta, Ohio, July 24, 1863, in his 80th year. He is best known, probably, for his meteorological observations ; but his "Observations on the Bituminous Coal Deposits of the Valley of Ohio, and the accompanying strata," in 1836, very justly gave him the reputation of a geologist. He was afterward an assistant on the Geological Survey of Ohio.

EBENEZER EMMONS was born in Middlefield, Mass., May 16, 1799, and died at Brunswick, North Carolina, October 1st, 1863. He graduated at Williams College in 1818, and received the degree of M.D. from the Berkshire Medical school in 1830. He was appointed one of the Geologists of New York, and made the survey of the 2d district, the geology of which was unknown before the publication of his report, in 1842. His report on Agriculture, which contains his "Taconic System," was published in 1846. He published a work under the name of American Geology in 1856. He was appointed State Geologist of North Carolina, and made a Report on the Midland counties in 1856, and a general report in 1860, and was engaged in the survey of that State when the war broke out and forced its discontinuance.

FRANCIS ALGER was born in Bridgewater, Massachusetts, March 8, 1807, and died at Washington, November 27, 1863. He was a mineralogist of more than ordinary ability. His geological explorations were usually only incidental to his favorite pursuit. The greater part of his work was published by the Boston Society of Natural History.

BENJAMIN SILLIMAN was born in North Stratford, Connecticut, August 8, 1779, and died in New Haven, November 24, 1864, at the age of 85 years. He established the American Journal of Science and Arts, and maintained it during his life. His work on geology and kindred sciences will be found in that journal.

ABRAHAM GESNER was born at Cornwallis, Nova Scotia, in 1797, and died at Halifax, April 29, 1864. He was a physician, chemist and author of several works on the Geology of Nova Scotia and New Brunswick.

EDWARD HITCHCOCK was born at Deerfield, Massachusetts, May 24, 1793, and died at Amherst, February 27, 1864. His life was devoted to educational matters, and especially to the science of geology. His first geological paper, entitled "Remarks on the Geology and Mineralogy of a section of Massachusetts on Connecticut River," appeared in the first volume of the American Journal of Science and Arts, and was dated at Deerfield, October, 1817 ; and his last article, entitled, "New Facts and Conclusions respecting the Fossil Foot-marks of the Connecticut Valley," was published in the eighty-seventh volume of the same journal, in July, 1863. It was at his suggestion that the State of Massachusetts added a geological surveyor to the corps charged with the preparation of a trigonometrical survey of the State in 1830. He was State geologist of that State for many years, and his reports are both voluminous and valuable. His reports on the Geology of Vermont contain a large part of what we know of the geology of that State. But the great work of his life was the study and determination of the "Fossil Foot-marks of the Connecticut Valley, or the Ichnology of New England."

JOHN L. RIDDELL was born in Leyden, Massachusetts, February 20, 1807, and died in New Orleans, October 7, 1865. His writings relate, chiefly, to chemistry, botany and medicine, though he was active in procuring the first geological survey of Ohio, and wrote a preliminary report.

HENRY DARWIN ROGERS was born in Philadelphia, in 1809, and died at Glasgow, in Scotland, on the 29th day of May, 1866. He was State geologist of New Jersey in 1835, and in 1836 became State geologist of Pennsylvania. The survey of the latter State was prosecuted for six years, and then suspended for want of the necessary appropriations by the Legislature. The work was, however, taken up again in 1851, and the final reports were published in 1858. This was the great

work of his life, and, with the exception of his unfortunate nomenclature of the strata, ranks with the labors of the best geologists of the time. He became Regius Professor of Geology and Natural History in the University of Glasgow, in 1857, which position he held until his death. He was the first American who ever filled a scientific chair in a European University. His contributions to science were numerous in the American and European scientific journals and periodicals, but especially in the Edinburgh New Philosophical Journal, of which he was for some years one of the editors.

Robert W. Gibbes was born in Charleston, South Carolina, July 8, 1809, and died in September, 1866. He was the author of a Monograph on the Fossil Squalidæ of the United States, a Memoir on the Fossil Genus Basilosaurus, another on Mosasaurus and the three allied new genera, Holocodus, Conosaurus and Amphorosteus, and other scientific papers, as well as important papers on medical subjects, and a Documentary History of the American Revolution.

George W. Featherstonhaugh died at Havre, on the 28th day of September, 1866, in his eightieth year. His work was of little value.

John R. Cotting was born in Acton, Massachusetts, in 1784, and died at Milledgeville, Georgia, on the 18th day of October, 1867. He was for two years State Geologist of Georgia.

Caleb Atwater was born at North Adams, Massachusetts, December 25, 1778, and died at Circleville, Ohio, March 13, 1867. He was an attorney at law by profession, but wrote a number of articles upon geological subjects, which appeared in the American Journal of Science and Arts.

B. F. Shumard was born at Lancaster, Pennsylvania, November 24th, 1820, and died at St. Louis, on the 14th day of April, 1869. He was an assistant geologist in the U. S. Government Survey of Iowa, Wisconsin and Minnesota, from 1846 to 1850. In 1847, in connection with Dr. Yandell, he published Contributions to the Geology of Kentucky. He was an assistant, and prepared a palæontological report of the geological survey of Oregon, in 1851. He prepared the palæontological part of Marcy's Red River Exploration, and the Geological Survey of Missouri. He was appointed State geologist of Texas in 1858, and made a geological reconnoissance of that State. His contributions to the Transactions of the Academy of Science, of St. Louis, gave to that journal a European as well as an American reputation. He was

among the foremost of the original discoverers of his day in geological and palæontological matters.

Edward Hartley was born in 1847, and died in Pictou, Nova Scotia. November 10, 1870, at the age of 23 years. He was appointed an assistant geologist upon the Geological Survey of Canada, in July, 1868, and mining engineer in 1869. His principal work was done in connection with a survey of the Pictou Coal basin.

Sidney S. Lyon was born in Cincinnati, Ohio, Aug. 4, 1808, and died at Louisville, Kentucky, on the 24th day of June, 1872. He was at one time surveyor of the public lands of Texas, and afterward assistant geologist on Owen's Geological Survey of Kentucky, where he distinguished himself as a palæontologist. He subsequently became eminent as an authority in the order Crinoidea. His papers appeared in the American Journal of Science and Arts, in the Proceedings and Transactions of the American Philosophical Society, and in the Proceedings of the Philadelphia Academy of Sciences.

John B. Perry died on the 3d day of October, 1872, in his 47th year. He was a Professor at Harvard College, and wrote several valuable essays upon the Taconic Rocks in Northern Vermont.

John W. Foster was born at Petersham, Massachusetts, March 4th, 1815, and died at Chicago, Illinois, on the 29th of June, 1873. In 1850 and 1851 he surveyed the Copper Lands of Lake Superior Land District, in connection with Prof. J. D. Whitney. The two reports and the atlas made his name familiar to all geologists. He was the author of several ethnological papers. His last work, entitled "Pre-Historic Races of the United States of America," appeared at about the time of his death.

Louis John Rudolph Agassiz was born May 28, 1807, at Mottier, near Lake Neufchatel, Switzerland, and died December 14, 1873, in Cambridge, Massachusetts. His works upon Natural History are voluminous, and some of them are devoted to matters relating to American Geology, and especially to vertebrate remains and surface phenomena.

William Logan was born in Montreal, April 23, 1798, and died at Castle Malgwyn, Llechyrd, South Wales, June 22, 1875. He was at the head of the Geological Survey of Canada, from 1842 to 1870. His labors contributed vastly to our knowledge of Canadian geology. He was careful in his investigations, and rarely theorized beyond the

ascertained facts. No man ranked higher as a stratigraphical geologist during his time. The Wallaston Palladium Medal of the Geological Society of London, was awarded him in 1856, and he was knighted by Queen Victoria the same year. He was the first to find that the Laurentian Rocks were capable of arrangement into a series beneath the Huronian.

Increase A. Lapham was born March 7, 1811, and died Sept. 14, 1875, at Milwaukee, Wis. His "Antiquities of Wisconsin" was published in the Smithsonian Contributions in 1855. He was known as a meteorologist and archæologist, and at one time was State geologist of Wisconsin.

Charles Lyell was born in Forfarshire, Scotland, November 14, 1797, and died at his residence on Harley street, London, February 22, 1875. He was educated as a lawyer, but soon turned his attention to the study of geology. He came to America in 1841, and remained a year. After his return to England he published his "Travels in North America." He came to America again in 1845, and after his return to England published his "Second Visit to the United States." He also wrote numerous papers on American Geology, which appeared in the Proceedings, Transactions and Journal of the Geological Society of London.

Archibald R. Marvine was born at Auburn, New York, September 26, 1848, and died at Washington, March 2, 1876. He was an assistant in 1871 on the Wheeler Expedition; in 1872 he was an assistant to Pumpelly, in an examination of the Keweenaw copper region, for the State of Michigan; and in 1873 became an assistant in the Geological Survey of the Territories under Dr. Hayden. His geological work will be found in the State and Government publications.

Augustus Wing, of Rochester, Vermont, died in Whiting, Vt., on the 19th of January, 1876, at the age of sixty-seven years. He studied the crystalline limestone, quartzite and slates of the central part of that State, and his discoveries in relation thereto will be found in the American Journal of Science and Arts.

Elkanah Billings was born near Ottawa, Canada, May 5, 1820, and died June 14, 1876. He commenced the study of law in 1839, and followed the pursuit of a barrister until about 1856, when he was appointed Palæontologist to the Geological Survey of Canada. For several years, however, his time had been in large part devoted to the study and collection of fossil organic remains, and he had published

several important papers. From 1856 to the time of his death, no man did more to make us acquainted with the geology and palæontology of the palæozoic rocks of America than did Mr. Billings. His writings are clear, his descriptions are accurate, and his publications voluminous.

FIELDING BRADFORD MEEK was born at Madison, Indiana, December 10, 1817, and died at Washington, D. C., December 21, 1876. He was an assistant on the Geological Survey of Missouri, and on the Survey of Iowa, Wisconsin and Minnesota, from 1848 to 1852. He was the author of a Memoir on the Cretaceous Fossils of Nebraska, in conjunction with Prof. Hall, in 1856. He did excellent palæontological work on the Geological Survey of Illinois, and also on the Surveys of California and Ohio, but his greatest work seems to have been in connection with Hayden's Surveys of the Western Territories. His "Palæontology of the Upper Missouri," appeared in 1865; "Report on the Palæontology of Eastern Nebraska," in 1872; and the most important work of his life, "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," constituting Vol. ix. of the United States Geological Survey of the Territories, appeared in 1876, only a short time before his death.

TIMOTHY A. CONRAD was born in August, 1803, and died at Trenton, New Jersey, on the 9th of August, 1877. He commenced publishing essays on Marine Conchology and Tertiary Fossils as early as 1831, which were continued without intermission to the time of his death. He had charge of the palæontological department of the Geological Survey of New York, from 1838 to 1841. He described the fossils collected by several government exploring expeditions, and also for several State geological surveys. His writings are exceedingly voluminous, and are distributed through a great many books. The greater part of them, however, seem to be in the Proceedings and Journals of the Philadelphia Academy of Natural Sciences. He described invertebrate fossils from all the formations, from the Silurian to the most recent, and an immense number of recent shells.

SANBORN TENNEY was born in 1827, and died July 11, 1877, at Buchanan, Mich., while on his road from Williams College to the Rocky mountains, on an exploring expedition. He is best known for his textbooks on Geology and Zoology.

MOSES STRONG was born June 17, 1846, and was accidentally

drowned in Flambeau river, Wisconsin, on the 18th day of August. 1877. He had been an assistant on the Geological Survey of that State for about four years.

Stephen Reed died on the 12th day of July, 1877, at Pittsfield, Massachusetts, at the age of seventy six years. He investigated the drift of Western New England, and is known for his early account of the drifted bowlders across the central part of Berkshire.

William M. Gabb was born in Philadelphia, on the 20th day of January, 1839, and died at the same place, on the 30th day of May, 1878. In 1862 he was appointed as a palæontologist, to the Geological Survey of California, where he described and illustrated sixty plates of Cretaceous and Tertiary fossils. He contributed largely in the Transactions of the American Philosophical Society, and in the Proceedings of the Academy of Sciences, of Philadelphia. He was a man of great energy, with a clear mind, and habits of careful investigation.

Charles Fredric Hartt was born at Fredericton, New Brunswick, August 23, 1840, and died at Rio Janeiro, March 18, 1878. His first geological work was done in New Brunswick and Nova Scotia, and yet it was so well done that the eminent author of the Acadian Geology seems to have adopted it without hesitation. He was appointed one of the geologists of the Thayer Expedition to Brazil in 1865, and returned in 1866. In 1867 he went again to Brazil, to return in 1868. In 1868 he was appointed Professor of Natural History in Vassar College. In 1870 he published a work on the Geology and Physical Geography of Brazil, and the same year returned to that country. In 1876 he was made Chief of the Geological Commission of the Empire of Brazil, which position he held at the time of his death.

Frank Howe Bradley was born at New Haven, Connecticut, September 20, 1838, and was accidentally killed from the falling of a bank in a gold mine near Nacoochee, Georgia, on the 27th of March, 1879. In 1867 he was an assistant on the Geological Survey of Illinois, and in 1869 on that of Indiana. In 1872 he was an assistant on the Geological Survey of the Territories, under Dr. F. V. Hayden. From 1869 to 1875 he was Professor of Geology and Mineralogy in the University of Tennessee. He was the author of several papers upon geological subjects, and described a few species of fossils.

Benjamin F. Mudge was born August 11, 1817, and died Nov. 21, 1879. He resided at Manhattan, Kansas, and did much to make known the geology of that State.

E. B. ANDREWS died at his home in Lancaster, Ohio, on the 21st day of August, 1880, in his sixtieth year. He was engaged for many years in the study of the Coal Measures of Ohio, Virginia and Pennsylvania, and was an assistant Geologist on the Ohio Survey, where the result of his study may be found. The Reports for 1869 and 1870, and the final volumes of the Survey, present the greater part of his work. He described a few fossil plants, but seems not to have performed any other palæontological labor. He contributed to the American Journal of Science and Arts, and to other scientific journals, and shortly before his death became the author of a school text-book on geology.

CHARLES T. JACKSON was born June 21, 1805, and died August 29, 1880. He was State geologist of Maine, and made three annual reports from 1837 to 1839, and a report on the Geology of the Public Lands of Maine and Massachusetts in 1838. Later, he did much for the elucidation of the geology of the New England States, and was distinguished as an eminent mineralogist.

In addition, I may mention from among the Europeans, JOHN J. BIGSBY, who wrote upon the geology and palæontology of the Lake Huron region as early as 1823, and published several other papers before the appearance of his Thesaurus Siluricus, in 1868, and Thesaurus Devonico-Carboniferus in 1878. C. A. LESUEUR described three species of Devonian Corals from America in 1820. EDOUARD POULLETIER DE VERNEUIL attempted to parallelize the palæozoic rocks of Europe and America in 1846, and described two species of fossils. ALCIDE D'ORBIGNY described a few American fossils, from 1850 to 1852, in his Prodrome de Paleontologie Stratigraphique Universelle des Animeux Mollusques et Rayonnes. H. G. BRONN described some American fossils in 1835, in Lethæa Geognostica, oder Abbildung und Beschreibung der für die Gebirgsformationen bezeichnendsten Versteinerungen. EDWARD FORBES described a few fossils in 1855 in the Quarterly Journal of the Geological Society, which were collected in the Cretaceous rocks of New Jersey. WILLIAM LONSDALE, in 1845, described in the same journal some Cretaceous and Tertiary fossils from America. HARDOUIN MICHELIN described a few American corals in his Iconographie Zoophytologique, published in 1840–47. CHARLES STOKES described a few fossil Cephalopods from the palæozoic rocks of Canada in the Proceedings and Transactions of the Geological Society of London, in 1838–40. CHRISTIAN GOTTFRIED EHRENBERG was born at Delizsch, in Prussian Saxony, in 1795. He wrote his great work on Mikrogeologie in 1854–56, and described many infusoria and microscropic organisms from the Cretaceous and Tertiary strata of North America.

DESCRIPTION OF THREE NEW SPECIES AND REMARKS UPON OTHERS.

By S. A. Miller, Esq.

Subulites gracilis, n. sp.

Plate V., Fig. 5, natural size.

Shell slender. elongate, fusiform, terebriform, and consisting of nine or ten volutions. The body volution forms more than one third the length of the shell. The aperture is narrow, elongate and terminal below. Suture well marked on the cast. Surface of the shell unknown.

This species is distinguished from others by its slender form and numerous whorls, and from *S. terebriformis*, in rocks of the same age, by the additional fact that it has a much shorter proportional body whorl. The species is founded upon two specimens, one of which shows the lower whorls, and the other the upper whorls of the cast.

Formation and locality: In the magnesian limestones of the Niagara Group, at Chicago, Illinois. Collected by W. C. Egan.

Protaster miamiensis, n. sp.

Plate V., fig. 6, natural size; fig. 6*a*, oral pieces magnified eight diameters; 6*b*, portion of an arm magnified three diameters.

This species is large, with a proportionally small disk. A specimen having a disk four tenths of an inch in diameter, has rays an inch in length. Five specimens have been examined, all showing the ventral side. The dorsal side is unknown. Only that part of the disk between the rays is visible in any of the specimens, and the plates are so anchylosed together that no special definition of them can be given. The rays are long and coarser and stronger than usual in this genus, though they were quite as pliable and flexuous when living as others. Two series of subquadrangular plates, or ambulacral ossicle, alternating with each other, constitute the bottom of each ambulacral furrow; these are bordered by spinous adambulacral plates, which terminate at the angles of the mouth in only five oral plates.

This description does not conform exactly with some of the definitions of the genus Protaster, but, nevertheless, I am inclined to refer the species, without much hesitation, to this genus.

Formation and locality: From the upper part of the Hudson River Group, near Waynesville, Ohio, and belonging to the magnificent collection of I. H. Harris, Esq., of that place.

Orthonotella, n. gen.

[Ety.—*Orthos*, straight; *notos*, back; *ellus*, diminutive.]

Shell minute, thin, elongate, more or less elliptical, very inequivalve and inequilateral; hinge line straight behind the beaks; ligament external. Type, *Orthonotella faberi.* It is difficult to determine from the exterior of a single specimen the family affinity of this genus. The absence of a wing, and the straight hinge line back of the beaks, would not allow it to fall within the *Pterinidæ*, while the great inequality of the valves and minute size, evidently preclude it from the *Orthonotidæ* and *Mytilidæ.*

Orthonotella faberi, n. sp.

Plate V., fig. 7, left valve magnified 8 diameters; fig. 7*a*, hinge line magnified 8 diameters; fig. 7*b*, natural size of the shell.

Shell very small, thin, broadly elongate-elliptical in outline, two and a half times as long as wide; cardinal and basal lines for a short distance posterior to the beak, straight and parallel. Left valve slightly convex toward the posterior end, but more ventricose in the anterior part and on the umbonal region; beak rather large, obtuse and quite terminal. Surface marked by fine concentric lines. Right valve flat in the posterior half and lower part, but having a slightly convex umbonal elevation at the anterior end, terminating in an obtuse beak somewhat smaller than that on the left valve. Surface apparently smooth. Interior unknown.

Collected by C. L. Faber, Esq., in the Hudson River Group, at Cincinnati, Ohio, at an elevation of about three hundred and fifty feet above low water mark, in the Ohio River.

Lyriocrinus sculptus, S. A. Miller.

By mistake this species was erroneously printed *Lyriocrinus sculptilis*, in the July number of this Journal, page 83, and also opposite plate 3. The error was discovered in time to correct it in the author's edition. As *sculptilis* was a preoccupied specific name, *Lyriocrinus sculptus* must be used.

Calymene callicephala, Green.

Plate V., fig. 8, showing a spiral appendage beneath the fixed cheeks of the cephalic shield.

This specimen is from the upper part of the Hudson River Group, near Waynesville, Ohio, and belongs to the collection of I. H. Harris. The fixed cheeks upon each side have been worn away, showing a test below furrowed in the manner of a spiral appendage, as shown in the figure. It is figured for the purpose of calling attention to it, that it may be better understood.

DESCRIPTION OF A NEW SPECIES OF BOURGUETI-CRINUS.

By P. DeLoriol, of Switzerland.*

Bourgueticrinus alabamensis, n. sp.

Plate V., fig. 1, magnified 5 diameters; 1*a* & 1*b*, magnified 6 diameters; 1*c*, natural size.

This species is as yet known only by the basal cone which supports the calyx, and which is composed of several enlarging segments of the column surmounted by the basal plates. The height of the inverted cone is 5 mm.; the diameter of the basal plate is 3½ mm.; and that of the inferior segment of the column is 3 mm. in its major axis. Its form is faintly swollen in the middle; the surface is smooth. The sutures are very indistinct, and it is a difficult matter to determine what was the height of the basal plate. The superior face of the cone carries five slender, and comparatively elevated radiating ridges, which bound five deep depressions in which the basal pieces of the calyx were lodged; in the center an enlargement of the central canal constitutes the bottom of the calyx cavity. The articular face of the lower joint of the column forming the inferior end of the cone, is elliptical, but the length of its major axis does not, however, much exceed that of its minor axis. It is slightly concave, and encircled by a feeble rim along the circumference line; the transverse articular ridge process is reduced to two elongated tubercles, which proceed from the marginal rim. Central canal comparatively large.

Relations and Differences.—Although this species is still very imperfectly known, one can affirm that it is certainly distinct from the *Bourgueticrinus ellipticus*, Miller, by the much less swollen form of the basal cone, which is but slightly convex in outline; and by the facts, that the lower segment of the cone is already elliptical, and already possesses the rudiments of a transverse articular ridge. Furthermore, the radiating carinæ are very much more salient, and consequently the depressions which they separate, very much deeper. Finally, by its central canal being relatively much larger.

Locality: Livingston, Alabama, Ripley Group, of the Cretaceous or at the top of the Rotten Limestone.

Collected by S. A. Miller.

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* The description is translated from the French MS. of the author, which may account for any imperfections found in it.—[Ed.]

REMARKS UPON A SPECIES OF CRISTELLARIA.

By C. Schlumberger, of Paris, France.*

Cristellaria rotulata. (?)

Plate V., figs. 2 and $2a$, magnified 17 diameters.

(Cristellaria rotulata, ? D'Orbigny, 1839. Foraminiferes de la Craie; *Mem. Soc. Geol. de France*, 1st ser., vol. iv., p. 26, pl. 2, figs. 15-18).

Shell discoidal, symmetrical, with the spire composed of very closely arranged cells. The sutures are fully indicated by faint undulations, which permit the recognition of about twelve cells in the outer whorl. The central portion of the shell is raised, and in young examples the outer margin is marked by a narrow keel. The star-shaped opening at the extremity of the last cell is sometimes situated upon the keel itself.

These characters ally the Alabama species to the *Cristellaria rotulata*, from the white chalk, without, however, there being a complete identity.

The four examples collected belong to one species, notwithstanding some differences in the keel and the prolongation of the last cell. In the most perfect example (figured) the star-shaped opening is on the keel, where as in the others, which are a little younger, the last cell is somewhat prominent. The same differences are found in analogous *Cristellariæ* from the Oxfordien and the Oolite. These specimens taking into account the variations which may be shown in the species, are too few in number to permit a satisfactory specific determination, especially as they do not furnish any special ornament more or less certain. It would then be premature in the absence of more specimens to establish a new species.

Locality: near Livingston, Alabama, from the Ripley Group or upper part of the Rotten Limestone.

Collected by S. A. Miller.

DESCRIPTION OF TWO NEW SPECIES OF CRINOIDS FROM THE SHALES OF THE NIAGARA GROUP, AT LOCKPORT, NEW YORK.

By E. N. S. Ringueberg.

Macrostylocrinus fusibrachiatus, n. sp.

Plate V., fig. 4, natural size.

Body medium, five eighths inch high; bowl-shaped; resting below on

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* Also translated from the French MS. of the author.—Ed.

a slightly projecting rim; interradial areas depressed, transverse section sub-pentagonal; surface covered with small, semi-regularly arranged granules. Column stout, ornamented with projecting nodose rims. Arms very large, robust, fusiform, over two inches long, and having on either side compressed tentaculæ.

Plates: Basal of moderate height, broad at the top, and having a projecting rim at the base, composed of large, closely arranged nodes. First radials large, hexagonal; four sides are of equal length, while the two outer upper margins that support the lower interradial plates, are short. Second radials quadrilateral, twice as broad as high, central portion of the upper side curved upward; between the lateral sides are interposed the lower interradials. Third radials semi-crescent shaped, very wide and narrow, with a central elevated angle. Brachials ten, one being placed on each of the opposite upper slopes of the third radials, and meeting at the upper angle, the latter ends rest against the second interradials. First interradials five, long hexagonal, they are placed between the second radials, with the two lower sides resting on the adjoining first radials; and their upper sides partially support the lateral sides of the third radials. Second interradials ten, two being placed above each first interradial, and in one interradial space two more can be seen superimposed upon these. Column composed of thin joints, with central nodose elevations; basal portion of the arms cylindrical, composed of wedge-shaped plates, that are irregularly placed upon each other, each plate extending but half way through the arm, at about three sixteenths inch above the base a regular double series of alternating joints, that meet in the center of the arm, commence, and are continued as far as known; these joints have the outer margins rounded, and the margins of juncture beveled to a right angle; on the inner side of the arm the joints are curved away from each other, thus producing a shapely defined groove; the inner angle of each joint bears a laterally compressed tentaculum, of which only one long joint can be observed.

Calceocrinus radiculus, n. sp.

Plate V., figs. 3 and 3*a*.

Body compressed, cylindrical; arms three, one dorsal and two lateral; dorsal arms rounded above; lateral arms cylindrical, bifurcated; basal plate narrow, triangular; lateral angles sharp; column inserted in the interior angle, where there is a circular depression with strongly projecting margins, forming a socket to receiye the rounded end of the column. Dorsal plate linear, wedge-shaped; dorso-lateral plates pen

tagonal, with the lower margin strongly curved to receive the broadly rounded lateral ends of the crescent-shaped ventral plate; upper dorsal plate triangular; crescent-shaped ventral plate broad, with rounding ends; dorsal, dorso-lateral and upper dorsal, and the crescent ventral plates are anchylosed together; basal plate free; lateral brachial plate narrow. The dorsal arm is broad at the base, and contracts rapidly for three joints, after which it tapers gradually, throwing out two lateral branches from the sixth joint, and upon the fourth joint from this are two more. Base of lateral arms formed of three plates, the first of which is triangular, upon the two outer faces of which there rest two plates; meeting in the center from each of these there proceeds an arm; these arms are again branched upon the upper side, apparently at every third joint. In the specimen from which this description is taken, the upper arm can be traced ten joints; upper branch of the lateral arms ten, and lower twelve joints. The column was unfortunately lost, but its matrix shows it to have been small, cylindrical and smooth. Lower part of the shale.

AMERICAN PALÆOZOIC BRYOZOA.

By E. O. Ulrich.

The researches of Dybowski and Lindström, and especially those of Nicholson, amply demonstrate the fact that *Chætetes* is eminently distinct from the *Monticuliporidæ*, and anything I might say upon that subject would simply be a reiteration of what those excellent observers have already shown. The question of the systematic position of the *Monticuliporidæ*, however, is not so firmly settled, and it is to show, I hope, more clearly than it has been done heretofore, that this family truly belongs to the Bryozoa, that the following remarks are placed before my fellow laborers in this very difficult group of fossils. I do not claim to know the reasons for, nor the uses of many of the characters belonging to the *Monticuliporidæ*, and my line of argument is, I may say almost entirely, a comparative one, inasmuch as I only attempt to show that the same features, more or less modified, are present in a great number of undoubted *Bryozoa* belonging to the sub-order Cyclostomata.

Before proceeding with the subject it is necessary to explain the

terms used to designate the various parts of these *Bryozoa*: The term *zoarium* is used to designate the entire colony (*Polyzoarium*, *Cœnœcium*, etc.) The term *frond*, I have sometimes used in an equivalent sense, in describing species of *Ptilodictya*, *Fenestella*, etc. In speaking of the external characters the true cells are called simply *cells*; in describing the internal characters, of the tubular forms, the same are termed *tubes*. *Interstitial cells* and *interstitial tubes* are used in the same way to distinguish the more irregular, and usually smaller pores situated between and often completely surrounding the true cells. *Interstitial pits*, I have called the shallow interstitial cells found in some of the *Ptilodictyonidæ*. These are well developed in *Stictoporella*, nov. gen. The axial tube is the central cavity in such forms as are afterwards described under *Cœloclema*. The tube is lined with an epitheca (*Axenrohr*, Dybow.) The *spiniform tubli* are equivalent to the "spiniform corallites" of Nicholson, and the "Wandröhrchen" of Dybowski. *Connecting foramina* is a term applied to the minute pores in the walls of the tubes, by means of which contiguous cells are connected. These are found in numerous Bryozoa, and probably existed in many of the *Ptilodictyonidæ*, and at least some of the *Monticuliporidæ*. The straight plates (tabulæ) crossing the tubes are called *diaphragms*. The convex plates which line one side of the tubes as in *Monticulipora*, or both sides, as in *Prasopora*, I have termed *cystoid diaphragms*.

In *Fistulipora*, *Crepipora* (nov. gen.), and other genera, are found small spots ("maculæ") produced by an aggregation of the interstitial cells. They are usually depressed below the general surface. The "monticules" are usually constituted by groups of larger-sized cells than the average, which are elevated above the general surface.

GENERAL STRUCTURE.

1. *Form of the Zoarium.*—In the mode of growth of the zoarium, and the form ultimately assumed by the colony, we find great variations. By this is not meant that individual species are specially variable in shape, for nearly all exhibit a tolerably constant form when adult, and sometimes even all the forms placed in a genus may adhere more or less strictly to some particular method of growth.

The zoarium of the *Monticuliporidæ* and *Fistuliporidæ*, usually exhibits one or other of the following conditions:

1. The simply *massive* zoarium, of which *Monotrypa undulata*, Nicholson, is a good example.

2. The *discoid* zoarium, the upper or convex surface of which is occupied by the cell-apertures, while the lower surface is covered with a striated and wrinkled epitheca. Good examples of this form are found in *Diplotrypa petropolitana*, Pander, *Monotrypa petasiformis*, Nicholson, *Prasopora selwyni*, Nicholson, and *Amplexopora discoidea*, James.

3. The *dendroid* or *ramose* zoarium, in which the entire free surface is covered by the cell-apertures. This type may be variously modified, by the flattening of the branches, etc. Of species possessing a ramose zoarium may be mentioned, *Callopora elegantula*, Hall, *C. ramosa*, D'Orb., *Batostomella gracilis*, James, *B. tumida*, Phillips, *Monotrypella quadrata*, Rominger, and *Batostoma implicata*, Ulrich.

4. The *frondescent* zoarium, which consists of a widely expanded, and compressed frond, in which the tubes are vertical in the median or axial portion of the expansion, and diverge outwards to open on both surfaces as growth proceeds. This type of growth is represented by *Heterotrypa frondosa*, D'Orbigny (not Nicholson), *Trematopora dawsoni*, Nicholson.

4. The *laminar* or *double-leaved* zoarium, in which the tubes diverge from a central plane, marked by a thin, but double, calcareous lamina or epitheca. Species possessing this type of growth are well represented by *Peronopora decipiens*, Rominger. *Fistulipora flabellum*, Rominger, and *Didymopora appressa*, Ulrich.

6. The *encrusting* zoarium, which is parasitically attached by the whole of the under surface to foreign bodies. The tubes are short. Of these may be mentioned, *Nebulipora papillata*, McCoy, and all the species of *Spatiopora* and *Atactopora*, Ulrich.

7. Another type of growth is formed by *Monotrypa ? calceola*, Miller and Dyer, *M. ? clavacoidea*, James, and *M. ? concava*, Ulrich. In these the zoarium is free, and the tubes arise more or less abruptly from a horn-shaped (*M. ? calceola*), an elongated conical (*M. ? clavacoidea*), or simply concave cavity, which is lined with a thin and finely striated epithecal membrane.

II. *Surface characters.*—There are only two superficial features which I propose to mention under this head, and these are the "monticules," and the "maculæ." The first of these are circumscribed areas on the surface of the zoarium, which are more or less elevated above the general level, so as to constitute a more or less regularly distributed series of conical, rounded, or elongated eminences. Sometimes the monticules are occupied by cells differing in no special feat-

ure from those occupying the intervening spaces (*e. g.*, in *Prasopora ? cincinnatiensis*, James, and *Spatiopora montifera*, Ulrich). In such species as *Monticulipora mammulata*, D'Orb. (*M. molesta*, Nich.) the size of the cells occupying the monticules is about equal to that of the average cells, but their walls are somewhat thicker; while again in other cases (*e. g.*, *Monotrypella pulchella*, E. and H., *Monotrypa undulata*, Nich., and *Discotrypa elegans*, Ulrich), the cells which form the monticules are conspicuously larger than the average. The "maculæ" are stellate or irregular spaces constituted by aggregations of interstitial cells, which take the place of "monticules." They may be level with the general surface, or slightly depressed below it (as for example in *Amplexopora variabilis*, Ulrich, *Heterotrypa subpulchella*, Nich., and a great number of the species of the *Fistuliporidæ*); or they may be considerably elevated above the general level, as in *Atactopora maculata*, Ulrich.

III. *Structure of the Walls of the Tubes.*—Of much greater consequence, from a zoological point of view, than the mere outward form of the zoarium, is the minute structure of the walls of the tubes. This subject has been exhaustively treated by Nicholson in his "Palæozoic Corals—Monticulipora," and with the exception of a few remarks on the connecting foramina, I can add nothing that he has not already pointed out. Besides, in this writing it is not necessary that I do more than simply mention the principal features of structure.

(*a.*) Each tube of the *Monticuliporidæ* and *Fistuliporidæ*, whatever its form may be, always possesses a perfectly independent and complete wall. In such species as *M. pulchella*, E. and H., and *M. petasiformis*, Nich., this independence of the wall of each individual tube is clearly preserved throughout the entire growth of the zoarium. In other cases, of which *Diplotrypa petropolitana*, Pander, *Monotrypa undulata*, Nich., and *M. briareus*, Nich., are examples, this character is not so apparent. That the walls are, however, really double, is proved beyond a doubt by the fact that in fractures of the zoarium the tubes always separate cleanly one from another, each carrying with it its own complete wall.

(*b.*) *Connecting Foramina.*—Up to the present time I have seen but a single specimen of an undoubted Monticuliporoid species, which showed in an unmistakable manner that adjacent tubes were brought into connection by minute foramina. The sections showing this character were taken from a good example of *M. obliqua*, n. sp. The foramina are developed only in the "mature" or cortical region, and the

walls of the tubes in the "immature" or axial region are certainly entire and without perforations of any kind. The "connecting foramina" are preserved in only a portion of the specimen alluded to, for in sections taken from other portions of the same specimen, they are either very obscurely preserved, or no traces of them whatever can be detected. From the fact that so many species, more or less nearly allied to *M. obliqua*, have been most carefully examined, and no traces of connecting foramina found, their discovery in a single example of *M. obliqua* must be looked upon in the light of a fortunate accident. Why they have not been detected in many other species of the *Monticuliporidæ*, I can not certainly decide, but I will suggest that the foramina were in use, or I should rather say open, only in the outermost region of the zoarium, *i. e.*, between the last diaphragm and the cell-aperture. As growth proceeded, and a new layer of cells was developed, the walls of the preceding layer of cells were thickened by layers of sclerenchyma, which of course closed the minute connecting foramina. The foramina would consequently be shown only in sections of such specimens, or portions of same, in which the secondary layers of sclerenchyma were of a lighter or darker color than that of the layers forming the original boundary of the cell.

(*c.*) *Immature or Axial, and Mature or Cortical Portions of the Tubes.*—In all cases, whatever may be the structure of the walls of the tubes in their final and most developed condition, they commence with thin and apparently indivisible walls. This I have called the "immature" portion of the tubes, and in the ramose and frondescent forms, occupies the axial and deeper regions of the zoarium, and almost invariably terminates at, or very near, the point at which the tubes bend more or less abruptly outwards in their course to the surface. In the "immature" region of the zoarium, the diaphragms are often entirely wanting, and always more remote than in the "mature" or cortical region. Cystoid diaphragms and spiniform tubuli are never developed in this region, nor are the true interstitial tubes, all three of these structures first making their appearance in the cortical, or what I would call the "mature" region. The peripheral portion of the zoarium, in the great majority of the forms under consideration, differs more or less conspicuously from the "immature" or axial region just described. The tubes bend outwards, the walls become more or less extensively thickened, and if at all present, the cystoid diaphragms, the interstitial tubes, the spiniform tubuli, and the connecting foramina, are developed; besides, the diaphragms become more

numerous, and in some forms at least, appear to be of a different nature from those crossing the tubes in the "immature" region. Take for instance any species of *Callopora*, such as *C. elegantula*, Hall, or *C. ramosa*, D'Orb. (*Monticulipora ramosa*, D'Orb.) At the ends of the branches where the "immature" portion of the tubes is exposed, the cells are always found to be open, while over the sides of the branch the cell-mouths are commonly closed by opercula, with a central opening. In tangential and longitudinal sections, the tubes in the "mature" region of the branch sometimes show a diaphragm which is in all respects identical with the opercula closing the cell-apertures at the surface of the zoarium, excepting that the central opening has been filled with a secondary deposit of either a lighter or darker colored sclerenchyma than the surrounding matter. It is due to the last fact that we are enabled to know that these diaphragms have ever been perforated, and I believe that we may now safely assert, that the diaphragms of the "mature" portion of the tubes (in at least the species of *Callopora* and *Stenopora*), formed successively the opercula of the preceding layer of cells. In *Dekayia*, at the final period of growth of the outer layer of cells, a thin pellicle is drawn over the orifices of the cells, which becomes the floor to the next succeeding layer, and eventually a diaphragm in the tubes thus formed by the superposition of numerous layers of cells. The thickening of the walls of the tubes is one of the most conspicuous features of the "mature" region. It is accomplished either by an addition of concentric laminæ, as for example in the group of species typified by *M. pulchella*, E. and H. (*Monotrypella*, nov. gen.); or by a succession of obliquely arranged and overlapping laminæ. In the latter cases the addition of this calcareous matter may take place regularly and continuously, as in *Batostomella gracilis*, James, *B. tumida*, Phil., *Amplexopora cingulata*, Ulrich, and many others, or periodically, as in *Stenopora*, Lonsdale. The "mature" and "immature" regions are quite as easily distinguished in the laminar, discoidal, and incrusting zoarium, as in the frondescent and ramose forms. It is, however, not always so easy to detect the two zones in the massive species, since in some of them the walls of the tubes remain thin throughout their length, the diaphragms are remote, and neither interstitial tubes, nor spiniform tubuli are developed. Of such forms *Monotrypa undulata*, Nich., is a good example, and I confess it is no easy matter to point out the two zones in a species of that nature. However, there are other massive species of the same genus, wherein it is not so difficult, and *Monotrypa*

filiasa, D'Orb., is one of these. I have specimens of this species in which no less than twenty successive "immature" and "mature" zones may be counted. The "immature" zones are marked by very thin tube-walls, and remote diaphragms, *i. e.*, from one to two tube-diameters apart; while in the "mature" zones the walls are slightly thickened, and the diaphragms crowded.

IV. *Interstitial Cells and Tubes.* — Though these are present in greater or less number, in the most of the *Monticuliporidæ*, they are never so numerous as in the *Fistuliporidæ.* In the *Monticuliporidæ* the interstitial tubes always have distinct walls, and more numerous diaphragms than the true tubes. The diaphragms too are always complete and approximately straight. In the *Fistuliporidæ* the interstitial cells are not produced into tubes as in the *Monticuliporidæ*, and the cells of each of the various interstitial cell-layers are quite independent of those of the preceding layer, inasmuch as they are not placed directly over each other, but indiscriminately fill the spaces intervening between the true cells ; this produces a characteristic feature of the *Fistuliporidæ*, *i.e.*, the vesicular interstitial tissue, which is always a conspicuous feature in a longitudinal section. I am not certain that the minute tubes forming the "maculæ" of some species, as for instance, *Atactopora maculata*, Ulrich, are really of the same nature as the usual interstitial tubes. They are, however, identical in structure with the tubuli forming the "maculæ" of some of the *Ceramoporidæ* (*e.g.*, the species of *Crepipora*, Ulrich).

V. *Spiniform Tubuli*—A majority of the species of the *Monticuliporidæ*, and some of the *Fistuliporidæ*, present, when well preserved, a greater or less number of blunt, spine-like structures, which are placed at the angles of junction of the cells, or on the line separating adjoining cells ; or, as is not infrequently the case, they are included within the substance of the walls of the cells. From what is now known of these structures, there seems to be little room to doubt, that in almost all cases, they were primarily hollow, though it is very rare that an aperture may be detected at the summits of these spines. This fact may be easily accounted for by the excessive minuteness of these apertures, and the readiness with which they would be obscured by the infiltration of calcite. From sections we learn that the "spiniform tubuli" extend into the substance of the zoarium to a depth equal to that of the interstitial tubes, and "mature" portion of the zoarium. They usually exhibit in their centers either a dark or clear circular spot, which is surrounded by a concentrically laminated sclerenchyma.

The question, what is the true purpose of these remarkable structures, is indeed a most difficult one. That they should, in all cases, be merely appendages to the zoarium, and not possess some really important relation to the other parts of the zoarium, is scarcely probable; and I can hardly doubt that their purpose was, if not identical with, at least similar to, that of the small sockets which serve as a foundation for the vibracula of many of the recent Bryozoa. This suggestion is meant to apply only to the large and comparatively remote "spiniform tubuli" of *Dekayia*, E. and H., *Heterotrypa*, Nich., and a few others. I doubt considerably whether these are of the same nature as the smaller and much more numerous ones, characterizing the genera *Stenopora*, Lonsd., *Batostomella*, Ulrich, *Amplexopora*, Ulrich, *Atactopora*, Ulrich, and *Rhombopora*, Meek. A different and quite plausible explanation, I believe, can be given for the latter. We find, namely, among the *Cheilostomata*, many forms having a row of short and stout, chitonous or calcareous bristles, placed upon the walls of the cell-apertures, which after the death of the zooid fall off, leaving minute pits in the summits of small blunt spines. That in the *Monticuliporidæ* these hollow spines are drawn out into tubuli, I believe, is due simply to the fact that as growth proceeded, each successive layer of cells (*i.e.*, each portion of the tubes between succeeding diaphragms), was placed in all respects directly over the preceding layer, and in consequence the growth of the "spiniform tubuli," was carried on simultaneously with the formation of the walls of the new layer of cells.

VI. *Wall-Inflections.*—True "septa" do not occur in any species of the *Monticuliporidæ*, nor *Fistuliporidæ;* nor even anything of the nature of the "spiniform septa" of the *Favositidæ.* I believe that I can safely assert, that in the forms under consideration, where septate or irregularly indented cells are present, with the exception of *Didymopora*, they are always due to the development of "spiniform tubuli" in the spaces between the angles of the tubes. The floriform cell is most distinct in *Amplexopora septosa*, Ulrich, and in the species of *Atactopora*, in which forms, on cursory inspection, the inflections might be regarded as of the nature of septa. In other species, notably *Batostoma implicata*, Ulrich, these inflections are not nearly so abrupt, but the cell walls are simply bent inward, in two, three, or four places, according to the number of "spiniform tubuli" having an effect upon the contour of the cells. In *Didymopora*, a new genus of the *Fistuliporidæ*, we find either two inflections as in *Batostoma*, or two thin and converging lamellæ, which are placed on one side

of a line running through the center of the tube, so as to partially divide the tube into two unequal portions. These are not due to the development of "spiniform tubuli," as in the preceding instances, but I regard them as the remnants of the peculiar projecting lip with which the cells in this genus are provided. The feature constitutes a most interesting link between the *Ceramoporidæ* and *Fistuliporidæ*, since it also characterizes the new genus *Crepipora*, of that family. Hall, in his description of the type species of *Callopora* (*C. elegantula*) states that the cells are sometimes provided with radiating septa. For this misapprehension he is not seriously to blame, since without a careful examination of the species, by modern methods, any one might make a similar mistake. Perfect specimens of *C. elegantula*, and other species of the genus, such as *C. ramosa*, D'Orb., and *C. andrewsi*, Nich.. often have the cell-apertures closed by opercula with a central perforation, from which a number of delicate ridges radiate to the margin of the calices, thus imparting to the cell the appearanee of being really septate.

VII. *Epithecal structures.*—The only remaining point of general structure which deserves a few words of notice, concerns the development of an epithecal membrane, which, as a rule, is more strongly marked in those types which possess a discoidal zoarium; and in these the concave or flat under surface is covered by a concentrically wrinkled, thicker or thinner membrane. This epithecal membrane is not unfrequently marked also by fine radiating striæ, which indicate the bases of the cell-tubes; in other cases (*e. g.*, *Prasopora bellula*. n. sp.), it is provided with numerous short spinelets. This epitheca has no connection with the opercular structures, often closing the mouths of the cells, as Nicholson seems to think ("Palæozoic Corals,—Monticulipora," p. 54); nor do I believe that the opercula and epitheca of the Monticuliporoids can be compared to the cortical membrane of certain species of *Favosites* (*e. g.*, *F. turbinata*, Billings, *F. clausa* and *F. tuberosa*, Rominger). The membrane of these species of *Favosites* covers the base and sides of the corallum, so as to leave the corallites of only the upper end open, and it does not seem to indicate anything else, than that the portion of the corallum so covered is dead. On the other hand the epitheca of the *Monticuliporidæ* and *Fistuliporidæ*, forms a sole or base to the tubes of the zoarium, and is equivalent to the "lame germinale" (D'Orbigny), of so many Bryozoa, and it is really developed in advance of the cells which are to rest upon it. That this is true may be seen more or less readily in all perfectly

preserved specimens of incrusting species; these present a narrow strip of membrane beyond the range of the cells. This strip is especially well marked in *Petigopora*, Ulrich. There is therefore this primary difference between the epithecal membrane of the Monticuliporoids, and that of the species of *Favosites* mentioned; that while in the former it is developed in advance of the marginal cells, in the latter it is formed after the death of the corallites which it covers. Save under the expanded base for attachment, no epitheca is developed in the frondescent and ramose species; but in the laminar or double-leaved and incrusting types, it is always present. In the double-leaved species (*e. g.*, *Peronopora decipiens*, Rominger), the tubes of each leaf rest upon its own separate epitheca, which is thin, and somewhat wrinkled, as is shown in specimens split between the two epithecal membranes. In the thoroughly incrusting types the epitheca is excessively thin, while in such partially attached species as *Prasopora cincinnatiensis*, James, it is thick and strongly wrinkled.

In the following section of my article I must frequently refer to the type of the genus *Monticulipora*, and as some difference of opinion exists in the determination of the species really entitled to that claim, I have thought it advisable to briefly point out my reasons for considering Dr. Nicholson's identification of the type species as erroneous; and I will endeavor to show that the identification of *M. mammulata*, D'Orb., *must not*, in the meanwhile, "remain a matter of individual preference or individual opinion."

The first species given under D'Orbigny's description of his genus *Monticulipora*, is his *M. mammulata*, from the Lower Silurian of Ohio. This species, must, therefore, be accepted as the type of the genus. Nicholson, in his various publications on the genus, has identified a common species from Cincinnati with the *M. mammulata* of D'Orb. The form he has so identified, I believe, is the *M. frondosa*, of the same author. The specimen mentioned by Nicholson in his "Genus Monticulipora," near the bottom of page 107, I see little difficulty in recognizing as an example of the common large variety of *M. filiasa*, described by D'Orbigny at the same time with the two preceding species. Nicholson, on page 108 of the work cited, proceeds to give his reasons for his selections of the type of the genus, but subsequently he freely admits that his selection was an entirely arbitrary one. He remarks: "The difficulties which environ this question arise from the fact that there are at least three, possibly four, distinct structural

types of *Monticulipora* which occur in the Cincinnati Group of Ohio. all of which are more or less identical in *external* characters, and any one of which might, therefore, be supposed to be the genuine *M. mammulata*, of D'Orbigny, and of Milne-Edwards and Haime. These three or four types are the following :

"(*a*). The form which I have here described as *M. mammulata*, which grows in thin undulated fronds, and has its surface covered with monticules, which are sometimes low and rounded, sometimes conical, sometimes elongated."

"(*b*). The form which I have spoken of above as probably a variety of the preceding, which it resembles generally in its microscopical characters, except that it has a much smaller number of interstitial corallites. In its mode of growth it is *massive*, and its monticules are pronounced and conical or elongated."

(*M. filosa*, D'Orb. I would suggest that Dr. Nicholson again examine this form, when I think he will find that the interstitial cells are not only much less numerous, but that, in reality, true interstitial tubes are entirely wanting).

"(*c*). The form which I shall describe subsequently, under the name of *M. molesta*, and which reliable investigators regard as the true *M. mammulata*. This form is most commonly frondescent, and has the form of a thin undulated lamina, but it is occasionally massive; its surface is covered with well marked conical monticules, which are sometimes elongated, and its microscopical structure is entirely different to that of the two preceding types."

"(*d*). A form which has a frondescent corallum, and a surface covered with prominent elongated monticules, but which has an entirely peculiar microscopic structure, unlike that of any of the forms previously mentioned. This will be subsequently described under the name of *M. dawsoni*, Nich."

Of these four species, D'Orbigny, without any doubt, had three before him when he described the genus, *i. e.* types *a*, *b* and *c*. *M. dawsoni*, Nicholson (type *d*), should fall from this list of possible type species, for it is a rare species, and does not appear to occur at Cincinnati, and, consequently, the probabilities are strong that the species was not in the possession of D'Orbigny. Nicholson goes on to state: "As before remarked, any one of the above, so far as its external features go, might very well stand for *M. mammulata*, D'Orb.: and in attempting to decide to which of these this title really belongs, we do not get much help from the descriptions given either by D'Orbigny, or

by Milne-Edwards and Haime, as was to be expected, in view of the fact that these descriptions relate solely to superficial characters. D'Orbigny's original description of *M. mammulata* (Prodr. de Paleont., p. 25, 1850), is simply: 'Espèce en lame, dont les monticules sont allongés.' This, clearly, might apply to any of the forms I have enumerated (except *b*), since all are frondescent, and all have the monticules sometimes or always elongated and compressed. The description given by Milne-Edwards and Haime is much fuller than the above, and is accompanied by figures (Pol. Foss. des Terr. Pal., p. 267, Pl. xix., fig. 1, 1851). It is as follows:

"Polypier de forme très-variable, diversement gibbeuse et lobée, en général en frondes larges. épaisses de 6 millimètres environ ; mamelons bien prononcés, sauvent un peu allongés, distant d'une fois ou deux leur largeur. Calices polygonaux. peu inégaux, larges d'un cinquième de millimètre, a peine distincts sur le sommet des mamelous."

"The above-quoted diagnosis would quite well apply to any one of the four similar-looking forms I have previously enumerated. The *figure* of the species given by Milne Edwards and Haime represents a lobate sub-massive specimen, and is perhaps more like the form which I have above designated by the letter *b* than it is like any of the others. It seems tolerably evident, however, that without a microscopical examination of the actual specimens described by Milne Edwards and Haime, it must remain an impossibility to determine accurately which of the above types formed the basis for their description." If it is difficult (I do not think it is impossible) to determine exactly what type formed the basis of their identification of *M. mammulata*, it is certainly much easier to recognize the form which they considered to be D'Orbigny's *M. frondosa*. The figure given by Milne-Edwards and Haime of the latter species represents an unequivocal specimen of the type *a* (the form Nicholson identifies with *M. mammulata*, D'Orb.) Those learned authors were most certainly not in doubt as to which form should bear the name of *M. mammulata*, or *M. frondosa*, since upon the same plate they give excellent figures of each, and describe them as distinct. Their figure of *M. mammulata* represents a common enough form about Cincinnati, and I have in my collection specimens that are as nearly fac-similes of the specimen figured by them, as it is possible to be, for individual examples of a species which is so variable in its growth (from massive and lobate to distinctly frondescent); while their description of the species applies in all respects, which is more than can be said for any of the other forms in dispute. The species agreeing so

nearly both with the figures and description of *M. mammulata*, given by Milne-Edwards and Haime, is the type *c*, which Nicholson has named *M. molesta.* The figure given by the same authors of *M. frondosa* (pl. xix., fig. 5), represents such a characteristic specimen of a common variety of Nicholson's *M. mammulata*, that I am rather surprised to find that he does not recognize it, but considers that his specimens of a species described by Rominger, under the name of *Chætetes decipiens*, "present such a close resemblance to the figure of *M. frondosa*, D'Orb., given by Edwards and Haime, that he (I) can hardly believe that they are not in reality identical." In opposition to this belief, which I must regard as a sincere one, I can only urge that I did not allow myself to become fully convinced of the validity of the ground I have taken, without corroborative evidence. This I obtained by showing Edwards and Haime's figure of *M. frondosa*, to a number of Cincinnati collectors and students in this branch of palæontology. Without a single exception all, almost immediately, recognized that the figure represented an example of an abundant variety of Nicholson's *M. mammulata.* There is one feature represented by the figure in question, that I will venture to say, Dr. Nicholson has never seen on any specimen of the form he has identified with *M. frondosa*, D'Orb. (*Chætetes decipiens*, Rom.), and that is the *subcylindrical* character of the lower right hand portion of the frond represented by their fig. 5, pl. xix. In his remarks upon *M. frondosa* and *decipiens*, Nicholson, on page 223 of his "Palæozoic Corals," makes the following remark, and misquotation: "The only point worthy of notice in this connection is that Rominger himself recognizes (Pro. Acad. Nat. Sci., Phil., 1866, p. 116), the similarity of his *M. decipiens* to *M. frondosa*, D'Orb., and merely says that it is 'more delicate in all respects,' and that its intertubular tissue is less developed." To distinguish his *Chætetes decipiens* (*M. decipiens*) from *M. frondosa*, Rominger says: "This species has likewise much similarity with *Ch. frondosus*, but it is more delicate in all respects, and in *Ch. frondosus* the intertubular tissue is considerably less developed, its tubules being usually in immediate contiguity." However vague the above differentiation may be considered, it is nevertheless certain that by *Ch. frondosus*, Rominger, meant the *M. mammulata* of Nicholson (not D'Orbigny). Furthermore, we find that Milne-Edwards and Haime's description of *Ch. frondosus*, D'Orb., applies in all respects to Nicholson's *M. mammulata*, and not to *M. decipiens*, Rominger (*M. frondosa*, Nich.); and although Nicholson states that he is not acquainted with any

frondescent species in which the difference in size between the largest and smallest cells is at all comparable with the difference stated to exist by Edwards and Haime, I can assure him that, though rare, specimens do occur in which very nearly those extremes of size do exist. Lastly, it is almost certain that Edwards and Haime actually had D'Orbigny's specimens before them, since, at the close of the description, they accredit the specimens to the collections of D'Orbigny and D'Verneuil.

More might be said upon this rather unpleasant subject, but it is scarcely necessary, and I have little doubt that, after a re-examination, Dr. Nicholson will agree with me in considering his identification of *M. mammulata* and *M. frondosa* as incorrect. In the course of this memoir I frequently have occasion to criticise the views of Dr. Nicholson, as expressed by him in his "Genus Monticulipora." This work shows extraordinary industry and observation, and I consider it entitled to the first rank in this branch of palæontological literature. While I intend to do every justice to Dr. Nicholson and the great advance in our knowledge of this most difficult group of organisms effected by his work, I am sorry to find it impossible to accept the greater part of his general conclusions.

Affinities and Zoological Position of the Monticuliporidæ and Fistuliporidæ.

As regards the zoological affinities of the *Monticuliporidæ* and *Fistuliporidæ*, some tendency has been developed on the part of palæontologists to remove them from the *Cœlenterata*, and to place them among the *Cyclostomatous Bryozoa.* Little direct evidence in favor of this step has been brought forward. Rominger (Proc. Acad. Nat. Sci. Phil. 1866), boldly asserts that their affinities are with the *Bryozoa*, though it must be confessed the arguments employed by him are entirely insufficient to demonstrate the assertion. In 1873 Lindström published (Ann. Nat. Hist. Ser. 4, Vol. xviii., p. 5, *et seq.*) his theory of the development of the *Monticuliporæ.* Nicholson ("Genus Monticulipora"), after quoting at length Lindström's views of the development, proceeds to criticise them, and argues with much effect that they are untenable. In his discussion of the subject (*loc. cit.* p. 60), he says: "The colonies of *Ceramopora* are usually (always ?) *fixed*, being attached parasitically by a portion of the whole of the lower surface to some foreign body; whereas the corallum in the discoid species of *Monticulipora*, supposed to be developed out of the

former, is unusually and normally *free;* but it is very difficult to explain this fact, if there be any developmental relationship between the two. Thirdly, as regards matters of actual observation, I have never been able to detect anything of the nature of a "*Cerampora* stage" in young *Monticuliporæ.* This is a point which is most easily observed in young examples of the discoidal species of *Monticulipora*, such as *M. petropolitana* and the various forms allied to this; and I can only say that the most minute examples of these forms which have come under my notice, differ in no respect whatever, that I can detect, except size, as regards their external and internal characters, from fully grown specimens. Fourthly, if it were the case that discoidal species of *Monticulipora*, such as *M. petropolitana*, Pand., grew out of the thin parasitic crusts to which Hall applied the name of *Ceramopora*, we ought to be able to detect the primitive "Ceramoporoid" portion of the colony at the base of thin vertical sections of colonies of the former. I have, however, examined a large number of such sections, and I have been unable to detect any difference in the structure of the lowest portion of the tubes, resting directly upon the basal epitheca, as compared with that of the full grown portion of the corallites. Dr. Lindström states that the basal surface of a *Monticulipora*, when its epitheca is very thin, "clearly shows that it is a *Ceramopora*," but I am unable to concur in this statement. If the specimen be undoubtedly one of *Monticulipora*, then I have never seen anything in its epithecal surface which could be compared with the structure of *Ceramopora*." My own views upon the subject are, probably, in some points, intermediate between those of the authors quoted. I agree with Dr. Nicholson in rejecting the theory that *Monticulipora* was developed from a *Ceramopora;* but I believe him to be in error when he makes the statement that there is no difference between the lowest portion of the tubes, as compared with that portion some distance above the epitheca. In the massive, incrusting and double-leaved species of *Monticulipora*, that portion of the tubes resting directly upon the basal membrane, is prostrate, remaining so a short time, when they bend abruptly upward, attaining an erect position and the characters of a fully developed tube. This character gives to specimens with a thin epitheca a peculiar appearance, which is especially well shown in the incrusting species. At Cincinnati, collectors frequently obtain specimens which had grown upon the inside of the body chamber of some cephalopod or bivalve shell. The shells of these mollusks having been destroyed during the process of fossil-

ization, the basal membrane of the incrusting bryozoan is brought to view, and sometimes beautifully preserved. When moisture is applied to these specimens the tubes show through the epithecal membrane as small oblong patches, frequently with a length equaling five or six times the breadth or true diameter of the tubes. Although the basal membrane of certain species of *Ceramopora* present a very similar appearance, it does not follow that the one is developed out of the other. It might as well be urged that species of *Ptilodictya*, in their primitive stages, were *Ceramoporæ*, since we find on an examination of the median membrane, or germinal plate, that an essentially identical structure is present. The incrusting and double-leaved species of the *Monticuliporidæ*, species of *Ceramopora*, *Lichenopora*, *Berenicea*, *Crescis*, and other genera of the *Bryozoa*, show at the margin of the colony an extension of the germinal plate (epitheca), which is always occupied by the young and undeveloped cellules. That this character, upon which Dr. Lindström based his assertion, that *Monticulipora* is developed from *Ceramopora*, is of much importance in the consideration of the zoological position of the *Monticuliporidæ*, can not be doubted. So far as the writer is aware, no analagous feature is present in any of the undoubted *Cœlenterata*: and as it is invariably present in so many indubitable genera of the *Bryozoa*, we must regard the character as furnishing one of the strongest arguments in favor of uniting the *Monticuliporidæ* with the Bryozoa. The typical species of *Ceramopora* (*e. g. C. imbricata*, Hall, etc.), are quite distinct from all of the *Monticuliporidæ*, but through *C. ohioensis*, Nicholson, and *C. whitei*, James, and the species of *Crepipora*, Ulrich, the limits of the family *Ceramoporidæ* are laid quite close to those of certain genera of the *Monticuliporidæ*. In *Ceramopora whitei*, James, the cells are tubular, and occasionally a few diaphragms are present; the cell apertures are very little oblique, and, in consequence, the characteristic feature of the family (the overhanging lip), is but slightly developed. On the whole, the species affords a zoarium not very unlike that of species of *Spatiopora* (*S. crustulata*, James, and *S. lineata*, Ulrich). In the *Crepiporæ* the cell-apertures are direct, and the lip is scarcely developed at all; diaphragms are present, as well as spiniform tubuli; very distinct "maculæ" are also developed, which, in all respects, are like those of *Atactopora maculata*, Ulrich, and with the exception of one generic character (*i. e.* the two converging lamellæ, which are situated one on each side of one of the angles of a tube), the species of *Crepipora* possess zoaria which would pass very well for those of

Monticuliporoids. On the other hand, the generic character excepted, points to a relationship with the *Fistuliporidæ*, since in *Didymopora*, a proposed genus of that family, precisely the same feature is present. This relationship is further assured by some Upper Silurian species of *Cœloclema*, Ulrich, which approximate quite closely to some of the hollow-branched species of *Fistulipora;* and I have several undescribed species from the Sub-carboniferous strata of Kentucky, which *fully establish* the relationship. That others may be able to recognize these forms, I will here briefly describe two of them. They possess certain characters which our present knowledge of such types justifies me in considering of generic importance; and as I am very much in doubt whether they are more properly arranged with the *Ceramoporidæ* or the *Fistuliporidæ*, the propriety of proposing a new genus for their reception becomes eminent. Following is a brief description of the characters of the genus proposed.

Eridopora, nov. gen.

Zoarium thin, incrusting. Cell-mouths sub-triangular or ovate, and more or less oblique, with the margin strongly elevated on one side, or the "lip" may extend unequally all around the aperture, it being always more prominent on one side than on the other. Cell orifices surrounded by from one to three series of smaller, angular interstitial cells, which, when the zoarium is well preserved, are covered by an interstitial membrane. Longitudinal sections show that the interstitial cells do not form tubes, but, instead, the intertubular spaces are occupied by vesicular tissue.

Type, *Eridopora macrostoma*, n. sp.

As may be gathered from the above description, the genus is exactly intermediate between *Ceramoporella*, Ulrich, and *Fistulipora*, McCoy. Externally its species resemble the former, while their external characters simulate very closely those of certain species of the latter genus.

Eridopora macrostoma, n. sp. (Plate VI., figs. 2, 2*a*.)

Zoarium incrusting, forming thin expansions over foreign bodies. Cells oblique, large, about six in the space of .1 inch, with triangular orifices and prominent lip. The single or double series of small interstitial cells are readily observed only in worn specimens, the large cells in a perfectly preserved example appearing contiguous. Scattered over the surface, at somewhat irregular intervals, are groups of

cells, which are made conspicuous by the fact that they are slightly larger than the average, and are separated by more numerous interstitial cells. In tangential sections the tubes are sub-triangular or oval, and surrounded by usually two rows of very irregular interstitial cells. In vertical sections the interstitial spaces are occupied by a vesicular tissue.

Formation and locality: In the shaly limestones of the Kaskaskia Group, near Point Burnside, on the line of the Cincinnati Southern Railroad. At this locality the slabs of limestone are, to a great extent, made up of the remains of Bryozoa.

Eridopora punctifera, n. sp. (Plate VI, fig. 3).

Externally this species differs conspicuously from the preceding, in having smaller, sub-circular and less oblique cells, comparatively wider interstitial spaces, and more pronounced "lip," which completely surrounds the cell-aperture, but is always more prominent on one side than on the other. Besides, small but distinct "maculæ" are developed at intervals of about .2 inch. About eight cells occupy the space of .1 inch. The cells over a portion of the surface of a specimen of this species, have their mouths closed by opercula with a central perforation. In tangential sections the tubes are usually sub-ovate and surrounded by two or three rows of very irregularly shaped interstitial cells, which also vary very much in size. Many of the true tubes present two longitudinal lamellæ, or spines, which project into the tube cavity, and are placed on opposite sides of the tube. Longitudinal sections demonstrate that the interstitial spaces are occupied by a close network of vesicular tissue. The tubes are nearly at right angles to the surface, and occasionally are crossed by a delicate diaphragm.

Formation and locality. Same as the preceding.

All unbiassed students of this difficult class of fossils must, after a careful examination into the facts I have here laid before them, come to the conclusion that an intimate relationship exists between the *Ceramoporidæ* and the *Fistuliporidæ*, which, as I believe I have shown, admits of being readily demonstrated.

Spatiopora crustulata, James, and *S. lineata*, Ulrich, in their oblong cell-apertures, exceedingly thin and parasitically attached zoaria, are not unlike the typical species of *Palæschara*, Hall. The only differences of any importance between such species of *Spatiopora* and *Palæschara* are that (1), a few large spiniform tubuli are developed in

the former, and none, so far as I have been able to determine, in the latter; and (2), the thickness of the cell-walls is more variable in those species of *Spatiopora* than in *Palæschara*. In the second feature, *Spatiopora* probably resembles more nearly such species of *Ceramopora*, as *C. whitei*, James. On the other hand, *Palæschara* strongly resembles certain species of *Membranipora*, and I am inclined to regard the genus as a member of the *Membraniporidæ*. Through the channel thus indicated (if the step between the species of *Spatiopora* and *Palæschara* be not considered too great), a relationship is established between the Cheilostomatous Bryozoa and the *Monticuliporidæ*. *Myriozoum*, *Donati*, a genus of the Cheilostoma, like some of the *Ceramoporidæ* and *Fistuliporidæ*, has the interstitial cells closed by a calcareous membrane, and has the true tubes provided with two lamellæ, which are placed near together, and remind one strongly of *Crepipora* and *Didymopora*, Ulrich.

Stellipora, Hall, and the nearly allied form for which Dana proposed the name *Constellaria*, show many points of resemblance to several genera of the Cyclostomata; and, in fact, Jules Haime, in his Monograph of the Jurassic Bryozoa, regarded such undoubted Bryozoans as the species collected together by D'Orbigny, under the name of *Radipora*, to be congeneric with species of *Constellaria*, and he consequently placed *Radipora* as a synonym under Dana's genus. Though I am not prepared to follow that authority in his disposition of *Radipora*, I admit that the resemblance between the Silurian and Mesozoic forms is very strongly marked. I can scarcely believe that any one will question the relationship between *Stellipora* (and *Constellaria*) on the one side to the *Monticuliporidæ*, and on the other to the *Fistuliporidæ;* and also that the genus has certain characters which separate it from all other genera of those families. The most important of these characters is found in the arrangement of the cells. In the center of the "maculæ" is a depressed space from which proceed in all directions a greater or less number of slender rays. Both the rays and the central space are occupied solely by interstitial cells. Between the rays the surface is raised, and each of the *elevated* rays is occupied by the apertures of eight or more true cells. *Lichenopora*, *Buskia*, and *Radipora*, have similar stellate protuberances, and with the exception that in those genera diaphragms are only sparingly developed, I can find no characters of more than generic value to separate them from *Stellipora*.

The family *Stictoporidæ*, through several of its members, approx

imates closely to both the *Fistuliporidæ* and *Monticuliporidæ.* In *Stictopora*, *Stictoporella* and species of *Pachydictya*, the zoarium has a definite form, the lateral growth of the fronds being limited by the thickening at the edges of the median epitheeal laminæ, and the formation of a non-poriferous margin. In the first genus the cells are of one kind only; in the second, beside the true cells, interstitial pits are developed; and in the third, a greater or less number of interstitial tubes are present, which at maturity are covered by an interstitial membrane. In *Phyllodictya* the differentiation is carried still further, and we have a flabellate or irregular zoarium, with the cell-structure like that of *Pachydictya*, excepting that in the perfect state the margin of the cell-apertures is prominent on one side so as to form a small "lip." Diaphragms are developed in both kinds of tubes in *Pachydictya* and *Phyllodictya*, and occasionally small spiniform tubuli are present. The zoarium now before us has, beside, a small number of spiniform tubuli, two sets of tubes, both of which are provided with diaphragms, with those in the interstitial tubes more numerous than those which cross the true tubes. The tubular structure is, therefore, like that of many Monticuliporoids; and the closing of the interstitial cells by a thick membrane, points to a decided affinity with the *Fistuliporidæ.* And this relationship is nearly assured by the remarkable genus *Cystodictya*, in which not only an interstitial membrane is developed, but the interstitial space, as is shown by vertical sections, is occupied by a vesicular tissue precisely like that of the *Fistuliporidæ.* A similar interstitial membrane is developed in *Ceramoporella*, Ulrich, and many of the Mesozoic Cyclostomatous Bryozoa. The structure of the cell-tubes of such species of *Ptilodycta*, as *P. pavonia*, D'Orb., *P. falciformis*, Nich., *P.* (*Heterodictya*) *gigantea*, Nich., and *P. maculata*, Ulrich, is not irreconcilably different from that of the *Monotrypellæ;* and distinct "monticules" are present in *P. pavonia* and *P. maculata*, while "maculæ" are characteristic of *Phyllodictya*, *Pachydictya* and species of *Phænopora.*

Despite the arguments used by Dr. Nicholson ("Gen. Monticulipora," p. 73, *et seq.*) to demonstrate his view of the relations between *Heteropora* and the *Monticuliporidæ*, I shall attempt to show that there *does exist* decided and true affinity between the *Heteroporæ* and certain genera of the *Monticuliporidæ.* The species of *Batostomella*, Ulrich, ranging in time from the Trenton Group to the Carboniferous, are the first which will be specially considered in this question.

The genus includes the following described species: *Chætetes granuliferus*, Ulrich (Trenton); *C. gracilis*, James (Cin. gr.), *Trematopora annulifer*, Whitfield (Cin. gr.); and *M.* (*Calamopora*) *tumida*, Phillips, and var. *miliaria*, Nicholson (Carboniferous). Besides these I have one species from the Cincinnati Group, and two from the Sub-carboniferous strata of Kentucky, which are as yet undescribed. In *B. gracilis*, James, and *B. tumida*, Phill., we have a slender ramose zoarium, the surface of which is without "monticules," and, with the exception of a few irregular "maculæ," is covered uniformly by the calices of the true cells, and a variable number of interstitial cells. In well-preserved specimens the cell-walls are usually studded by a large number of small spines or granules. In longitudinal sections the walls of the tubes are very thin in their "immature" portion, and remarkably thickened in the cortical or "mature" region of the branch. In neither species are the diaphragms numerous. In tangential sections of both species, the tube orifices are surrounded by a laminated ring, and the intervening spaces are occupied by a few similarly constructed interstitial tubes, and more or less numerous spiniform tubuli.

Callopora punctata, Hall, a Sub-carboniferous form, has characters that are very distinct from *C. elegantula*, Hall, the type of the genus *Callopora*, and I here propose the generic name *Leioclema* for the species.

The genus may be briefly characterized as follows:

Leioclema, nov. gen.

Zoarium ramose, branches slender, smooth, and sometimes hollow. Cell-apertures small, rounded, and with two or three series of subangular interstitial cells surrounding them. Longitudinal sections show the tubes in the axial portion of the branch to be thin-walled, and crossed by remote diaphragms. In the peripheral region the interstitial tubes and spiniform tubuli are developed in great numbers. The walls of all the tubes are much thickened, and the diaphragms in the interstitial tubes are straight and remote, while in the true tubes they appear to be wanting. In tangential sections the visceral cavity of the proper zoœcia is often indented by the encroachment of the rather large spiniform tubuli, of which there are, in the type species, from four to seven around the orifice of each tube. The interstitial tubes are small, and of irregular shape; two or three rows occupy each intertubular space.

Type, *Callopora punctata*, ? Hall. (Pl. VI., figs. 1, 1*a*.)

In *Callopora*, Hall, the interstitial tubes are not so numerous, and spiniform tubuli are wanting. In *Fistulipora*, McCoy, the intertubular spaces are occupied by a vesicular tissue, and the interstitial cells do not form tubes. Besides, spiniform tubuli appear to be entirely absent. From *Batostomella*, Ulrich, *Leioclema* is distinguished by the much greater number of interstitial tubes in the latter.

The only other Monticuliporoid deserving mention in this connection, is the one described by the author under the name of *Callopora cincinnatiensis* (JOUR. CIN. SOC. NAT. HIST., vol. i., p. 93.) This species is not a *Callopora*, nor do I know of any described genus to which it may be properly referred. It appears to be related to certain Upper Silurian and Devonian species, and until these have been fully examined I prefer to leave the species as first described, with the exception of adding an interrogation point to the generic name. In *Callopora (?) cincinnatiensis*, we have an irregularly ramose zoarium. The true cells are nearly circular, and surrounded by a single row of angular and rather large interstitial cells. In a tangential section we find that the two sets of tubes are more or less rounded, and not distinguishable from each other except by their size, their walls are moderately thick, and composed of concentrically arranged laminæ with no distinct line of demarcation between them, the spaces intervening between the walls of both sets of tubes being filled by structureless sclerenchyma. A few spiniform tubuli may also be detected in sections of this kind. Longitudinal sections show that the tubes in the axial portion of the branches are thin-walled, and crossed by remote diaphragms. In the peripheral region, the walls, as usual, become thickened ; the diaphagms in the true tubes are often entirely absent in this region, and when present they are from one to two tube-diameters apart. In the interstitial tubes the diaphragms are about one and a half times an interstitial tube-diameter distant from each other.

In *Heteropora neozelanica*, Busk, we have a frequently branching zoarium, the branches smooth and with a diameter varying from .1 inch to .2 inch. In the axial region the tubes are thin-walled, and crossed by a few diaphragms. In the cortical ("mature") region the walls of the tubes are much thickened, and are here pierced by numerous connecting foramina. In a tangential section we find that the two sets of tubes are rounded and not distinguishable from each other except by their size; their walls are thick, and composed of laminæ arranged concentrically around the cavity, with no distinct line of demarcation

between them, the intervening spaces being filled by structureless sclerenchyma. Besides the connecting foramina, which are well shown in a section of this kind, Dr. Nicholson has described "numerous delicate radiating spines, which spring from the wall and are directed inwards for a longer or shorter distance, usually falling short of the center."

In *Heteropora conifera*, Lamx., we have in the main the same internal characters as above ascribed to *H. neozelanica*, with this difference, that in tangential sections, the spaces on the walls of the tubes between the connecting foramina, are concentrically laminated, and inclose a dark spot (or sometimes a light one), thus giving the same appearance as is presented in species with numerous spiniform tubuli. I have not been able to detect any traces of radiating "spines."

In *Heteropora pustulosa*, Michelin, according to Jules Haime's figures (*Mem. de la Soc. Geol. de France*, 2d ser., vol. v., pl. xi.), the surface is covered with "monticules," and diaphragms are developed in considerable numbers in the cortical portion of the zoarium.

I have also examined three species of *Heteropora*, and one of *Zonopora*, D'Orb., from the Cretaceous of Arkansas. One of the species of *Heteropora* is very similar to *H. conifera*, Lamx. Another is a small slender species reminding one in its external appearance very strongly of *Batostomella gracilis*, James. The third is still more slender. *Zonopora*, so far as I have been able to ascertain, differs from *Heteropora*, only in having the interstitial cells aggregated into groups, which may be drawn out laterally to such an extent that they completely encircle the branch. The species from Arkansas is nearly allied to *Zonopora variabilis*, D'Orb., from the Cretaceous of France. The second species above mentioned, I will provisionally call *Heteropora consimilis*, n. sp., and it may be characterized as follows:

Heteropora consimilis, n. sp. (Plate VI., fig. 11.)

Zoarium growing in frequently bifurcating, rarely anastomosing, small ramulets, with a diameter of about .1 inch. Branches expanded at the base, and attached to some foreign substance. Surface smooth. Cells, small, frequently contiguous. Cell-mouths, circular, about $\frac{1}{170}$ inch in diameter, usually with thickened margins. Intertubular spaces of variable width, occupied by irregular cells, the diameter of which is always less than that of the true zoœcia. Interstitial cells never developed in greater number than would constitute a single series around the true tubes; the number of the latter in the space of .1 inch,

varies from eight to twelve, according as there is a greater or less development of the interstitial cells. Longitudinal and tangential sections give the usual characters of *Heteropora*, excepting that no traces of connecting foramina, nor of "radiating spines," can be detected in my specimens. Diaphragms are usually wanting; occasionally a few very delicate ones may be detected in the peripheral region.

Formation and locality: Cretaceous strata (probably of the Niobrara Group). Pulaski county, Arkansas.

The third species of the Arkansas *Heteroporæ*, I will also here provisionally characterize under the name of

HETEROPORA ATTENUATA, n. sp. (Plate VI., fig. 12.)

Externally the zoarium differs from that of *H. consimilis*, in being more slender, the branches having a diameter of only about .05 inch. The proper zoœcia have their margins somewhat raised, and are sometimes arranged in transverse or oblique series. The interstitial cells are small, and usually a single transverse series is developed between the transverse rows of the true cells; or sometimes a few of the true cells may be surrounded by a single series of interstitial cells. Longitudinal sections show that the tubes in the axial or "immature" region are of one kind only, and that they are thin-walled, and without diaphragms. In the "mature" or cortical region the walls of the tubes become thickened, and the interstitial tubes are developed. Between the upper wall of each true cell-tube, and the lower wall of the interstitial tube, may be detected, almost invariably, a lighter-colored streak, indicating the presence of a "spiniform tube," between the upper side of the cell-aperture, and the interstitial cells. Not having been successful in making a good tangential section of this small form, I am unable to say positively whether or not spiniform tubuli are developed in other positions, but for reasons I am inclined to believe they are.

Formation and locality: Same as the preceding.

Having now briefly considered the principal structural characters of several species of *Heteropora*, we will summarize the points of difference and resemblance between the *Heteroporæ* on the one side, and *Batostomella*, *Leioclema*, and *Callopora* (?) *cincinnatiensis*, and other members of the *Monticuliporidæ* on the other.

(1.) Aside from the general form of the zoarium, which is of little importance in a question of this kind, we find on comparison that in *Heteropora* and the ramose types of the *Monticuliporidæ*, the zoarium is composed of slender fasciculate tubes, which are nearly vertical in

the axial region of the branches, and then curve outward more or less abruptly to reach the surface. In both, therefore, there are established two distinct regions, an axial ("immature"), and a peripheral ("mature") region. In both, these two regions are very different in their internal structure, the tubes in the axial region of their course being thin-walled and polygonal, while in the peripheral region their walls are thickened, and they often become rounded in form. In both, moreover, the interstitial tubes that may be present, are developed in the peripheral region only, and they do not extend into the axial region at all.

(2). As regards the *dimorphism* of the zoarium of such types of the *Monticuliporidæ* as *Batostomella*, *Leioclema* and *Callopora* (?) *cincinnatiensis*, we find that they consist of two distinct sets of tubes, which differ from each other (1), more or less in size; (2), in one set having more numerous diaphragms than the other; and (3), in their time of development, the smaller or interstitial tubes being developed only in the peripheral region. A fourth distinction is presented in *Leioclema;* the cavities of the true tubes in that genus being surrounded by a series of spiniform tubuli. In *Heteropora* the zoarium similarly consists of a series of large tubes surrounded by smaller interstitial tubes, and with the exception of one feature, the same differences between the two sets of tubes are noted. The characters excepted, is that in *Heteropora*, so far as I have been able to determine from actual examination, diaphragms are usually absent in the peripheral region, and consequently in the interstitial tubes they are entirely wanting. That this difference should be considered of importance in the determination of the *real* question at issue (*i. e.*, the zoological position of the *Monticuliporidæ* and allied types), I can not admit, since transverse partitions occur in organisms of such exceedingly diverse affinities, that we can not attach much value to the fact that they appear to be absent in a portion of the zoarium of *Heteropora*. Besides, I believe that diaphragms were developed even in the peripheral region of the tubes of that genus, and I attribute their absence to the supposition that the opercular plates which closed the cell-apertures, and which subsequently formed the base of a new layer of cells, were of such a nature that they were incapable of preservation during fossilization. This supposition is made a probability by the fact that in the recent species, *H. neozelanica*, Busk, the cell-mouths are closed by a thin chitinous covering, which in the fossil state would scarcely have been preserved.

(3). As regards the structure of the *wall*, we know of at least one species of *Monticulipora*, the *M.* (*Trematopora*) *obliqua*, n. sp., in which the walls of the tubes, in the peripheral portion of their course, are pierced by connecting foramina. On the other hand, there are a number of species of *Heteropora* in which no traces of these foramina have yet been clearly proved to exist. In all other respects the minute structure of the walls appears to be the same in both.

(4). Nothing of the nature of radiating "septa" are known to exist in any Monticuliporoid species. In *Heteropora neozelanica*, Busk, Dr. Nicholson has shown that the tubes in the peripheral part of their course are intersected by numerous delicate spinules, which are arranged in a radiating manner, and extend sometimes nearly to the center of the tube-cavity. He says of this feature: "These spinules in form and arrangement precisely resemble the "septal spines" of many species of *Favosites;* but admitting the Polyzoan affinities of *Heteropora*, it is obvious that they can not be compared homologically with the septa of any Cœlenterate." So far as my observations have extended, I have never seen any species of *Favosites* in which the "septal spines" were nearly so slender as the spinules figured by Dr. Nicholson in the tubes of *H. neozelanica*. As a solution of these remarkable structures, I would suggest that they may have originally constituted calcareous ribs in diaphragms that otherwise were constructed of a material which during maceration was destroyed.

(5.) "*Spiniform tubuli*" are developed in a majority of the *Monticuliporidæ*, and the appearance presented by similar structures in tangential sections of *Heteropora conifera*, is precisely like that seen in a like section of *Leioclema punctatum*. These structures are also present in *Heteropora attenuata*.

(6.) Lastly, we will weigh the points of resemblance and difference. On the one hand we have a strong external resemblance, a general similarity in the construction of the zoarium, and an agreement in the facts, that in both—(1) the colony is composed of two sets of tubes; (2) both have their tubes crossed by diaphragms; (3) in such types of the *Monticuliporidæ*, as *Leioclema punctatum*, and *Callopora* (?) *cincinnatiensis*, the interstitial tubes are in no other way structurally different from the proper zoœcia, than in being crossed by more numerous diaphragms. Again, while no traces of connecting foramina have yet been detected in several species of *Heteropora*, such foramina are now known to exist in at least one undoubted Monticuliporoid species.

On the other hand, to set against the very important points of resemblance above noted, we have—(1) to chronicle the discovery of delicate radiating spines in *Heteropora neozelanica*, which character is not developed in the *Monticuliporidæ*; nor have I been able to detect such structures in the five species of *Heteropora* examined by me. (2.) The connecting foramina are more generally developed, or at least more readily recognized, in the *Heteroporæ* than in the *Monticuliporidæ.* As before remarked, I do not attach any weight to the fact that in *H. neozelanica*, radiating spines intersect the tube cavity, since if it were a character of real importance, such as the "septa" of the Cœlenterata, it would be developed in all the species, which our present knowledge of these forms justifies us in saying, is not the case. A somewhat analogous instance is met with in *Ptilodictya maculata*, Ulrich, in which the tubes usually are distinctly, as we may loosely term it, septate. Still there is no reason to doubt that the species is intermediate between *P. falciformis*, Nicholson, and *P. pavonia* D'Orbigny. In these that condition is only rarely met with, and then it is not nearly so distinct as in *P. maculata.* On the whole, it is not necessary to discuss the subject any further, since the points of difference are so much outweighed by the points of resemblance, that they can not possibly be considered of greater value than would constitute a family distinction. Besides, we must bear in mind that I have not attempted to demonstrate a generic identity, but only to establish the relationship which I am convinced exists between the *Monticuliporidæ* and *Heteropora.*

Comparisons affecting the zoological position of the *Monticuliporidæ* and allied types might be carried on almost indefinitely, and the various genera and families which I have, to a greater or less extent, reviewed in the preceding pages, are so inextricably interwoven, that by separating them a positive injury is done to natural classification; and in fact it would be preferrable to remove the whole assemblage from the Bryozoa. But as this step would be as inadmissable as the first, the only course left open for systematists is to leave them where they really belong, with the Bryozoa. However, after extended study of these forms, it becomes evident that they differ widely from the typical *Cyclostomata* (*e. g. Diastoporidæ*, *Idmoneidæ*, and *Tubuliporidæ*), and just as widely from nearly all of the *Cheilostomata.* On the whole I have come to the conclusion that there are good reasons for the establishment of a fifth sub-order of the GYMNOLÆMATA, which would include the original Bryozoa, from which later types of the sub-orders *Cyclos*

tomata and *Cheilostomata*, were probably developed. Accordingly, in my scheme of classification I propose the new sub order *Trepostomata*. It is at present impossible to determine with any degree of certainty the exact limits of the sub-order proposed, but they may be indicated, as it is partially done in the following tabulated list of Bryozoa, possessing one or more of the important characters of the *Monticuliporidæ* and *Fistutiporidæ*.

Of the various characters ot the *Monticuliporidæ* and *Fistuliporidæ*, we find—

(1). A zoarium composed of tubular cells: In the majority of the *Cyclostomata*, and some of the *Cheilostomata*.

(2). Zoarium divided into "immature" and "mature" regions: In the *Cerioporidæ*, Busk, *Ptilodictyonidæ*, Zittel, and *Stictoporidæ*, Ulrich.

(3). A germinal or epitheca1 plate ("lame germinale," D'Orb.): In a large number of the *Cyclostomata*.

(4). Diaphragms—
In several genera of the *Ceramoporidæ*, Ulrich; and *Ptilodictyonidæ*, Zittel; and in many of the *Cerioporidæ*, Busk.

(5). Vesicular interstitial tissue—
In *Cystodictya*, Ulrich (of the *Stictoporidæ*); and *Eridopera*, Ulrich, (? a genus of the *Ceramoporidæ*).

(6). Interstitial cells—
In *Ptilodictya*, Lonsdale (several species).
Pachydictya, Ulrich.
Phyllodictya, Ulrich.
Stictoporella, Ulrich (pits).
Graptopora, Ulrich (pits).
Ceramopora, Hall.
Ceramoporella, Ulrich.
Cheiloporella, Ulrich.
Crepipora, Ulrich.
And in the forms arranged by D'Orbigny, under his family names—
Clausidæ.
Caveidæ.
Crescisidæ.
Cytisidæ.
Also, among the *Cheilostomata*, in the family *Myriozoumidæ*, D'Orb.

(7). Interstitial membrane—
In *Ceramoporella*, Ulrich.
Eridopora, Ulrich.
Pachydictya, Ulrich.
Phyllodictya, Ulrich.
Cystodictya, Ulrich.
Heteropora, Blainville.
Defrancia, Bronn.
Claviclausa, D'Orb.
Clausimultelea, D'Orb.
Nearly all the forms placed by D'Orbigny under his family *Clausidæ*.
Myriozoum, Donati.

(8). Spiniform tubuli—
Rhinidictya, Ulrich.
Crepipora, Ulrich.
Rhombopora, Meek.
Bythopora, Miller and Dyer.
Species of *Heteropora*, Blv.
Small hollow spinelets, supposed to be analagous to the spiniform tubuli, are developed in—
Membranipora.
Lepralia.
Flustrellaria.
And other genera.

(9). Wall inflections and "radiating spines"—
Wall inflections in the *Monticuliporidæ* are generally (? always) due to the encroachment of the spiniform tubuli upon the tube cavity. However, in such species of *Ptilodictya*, as *P. maculata*, Ulrich, in which no spiniform tubuli are developed, similar and very distinct inflections are present. The same may be said of certain species of *Neuropora*. "Ra-

diating spines" have been observed in species of *Discoporella* and *Heteropora.*

(10). Two teeth or lamellæ, projecting from one side of the tube-walls into the zoœcial cavity—

In *Crepipora*, Ulrich.
Discoporella, Gray.
Myriozoum, Donati.

(11). Opercular plates covering the tube-orifices, as in *Callopora*, Hall—

In *Cystodictya*, Ulrich.
Eridopora, Ulrich.
Clausimultelea, D'Orb.
Meliceritites, Roem.
Nodelea, D'Orb.
Myriozoum, Donati.

(12). Connecting foramina—

In many of both the *Cheilostomata* and *Cyclostomata.* (This character has been proved to exist in only two genera of the *Monticuliporidæ, i. e., Stenopora*, Lonsdale, and *Monticulipora*, D'Orb.

(13). Monticules and maculæ—

These are developed in a great many types now placed with the *Cyclostomata.* As examples of monticulifer ous genera may be mentioned—

Nodicava, D'Orb.
Nodicrescis, D'Orb.
Heteropora pustulosa, Michelin.
Ptilodictya, Lonsd. (several species).

Examples of genera with "maculæ," are—

Ditaxia, Hag'w.
Zonopora, D'Orb.
Radiopora, D'Orb.
Phænopora, Hall.
Pachydictya, Ulrich.
Crepipora, Ulrich.

SCHEME OF CLASSIFICATION OF THE AMERICAN PALÆOZOIC BRYOZOA.

Order Gymnolæmata, Allm.

Sub-order Cyclostomata, Busk.

Family *Tubuliporidæ*, Busk.

Stomatopora, Bronn.—Zoarium adnate, with the cells in a single branching series. Cell-mouths elevated, sometimes tubular, and situated near the end of the cells. Trenton to recent.

Proboscina, Audouin.—Like the preceding, but with the cells in two or more series. Cincinnati* to recent.

Berenicea, Lamx.—Zoarium much like that of the foregoing, but forms rounded or irregular patches. Cincinnati, Mesozoic and recent.

Ropalonaria, Ulrich.—Cells slender fusiform, in a single amastomosing series. Cell-mouths situated near the middle of the cells. Cincinnati.

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* By the term "Cincinnati group," I mean the strata included between the lowest exposed in the bed of the Ohio river near Cincinnati, and the overlying Upper Silurian strata. They are in all probability equivalent to the Utica Slate, and Hudson River groups of New York.

Family *Theonoidæ*, Busk.

Scenellopora, Ulrich.—Zoarium broad, obconical, with the cell apertures occupying the summits of ridges which radiate from the sub-solid and depressed center of the flattened upper surface. Trenton.

Family *Entalophoridæ*, Reuss.

Mitoclema, Ulrich. (compare *Spiropora*, Blv.)—Zoarium ramose, slender. Cell mouths more or less prominent, and arranged in transverse series around the branches, or irregularly spiral. Trenton.

Family *Fenestellidæ*, King.

Fenestella, Lonsdale.—Zoarium flabellate or infundibuliform. Cells only on one side of the branches, in two rows, one on each side of a median ridge. Dissepiments without cells. Cincinnati group to Carboniferous.

Polypora, McCoy.—Zoarium like that of *Fenestella*, from which it differs in wanting a median ridge, and in having from three to five rows of cells. Upper Silurian to Permian.

Septopora, Prout.—Like *Fenestella*, but the dissepiments carry cells. Subcarboniferous.

Fenestralia, Prout.—Like *Fenestella*, from which it differs in having two rows of cells on each side of the median ridge. Sub-carboniferous.

Phyllopora, King.—Zoarium, infundibuliform, composed of anastomosing branches; meshes rounded; branches with two or more rows of cells on one side, finely striated on the other. Trenton to Devonian.

Archimedis, Lesueur.—Zoarium consisting of a spirally turned, solid axis, from which, at regular intervals, numerous infundibuliform expansions are thrown out. These expansions have an upward direction, and when separated from the axis, they are indistinguishable from those of *Fenestella*. Sub-carboniferous.

Lyropora, Hall.—Zoarium consisting of two strong diverging prongs, between which is spread a reticulated expansion, the branches of which carry from three to five rows of cells. Dissepiments strong, without cells. Fenestrules, small, ovate. Subcarboniferous.

Carinopora, Nicholson, *Cryptopora*, Nich., *Ptilopora*, McCoy.—Not examined.

Family *Acanthocladidæ*, Zittel.

Penniretepora, D'Orb. (*Glanconome*, Lonsd.)—Zoarium very slender; branches, few, springing from the main stem at almost a right angle. Celluliferous face of both main stem and branches, carrying

two alternating longitudinal series of cell apertures. Non-poriferous side longitudinally striate. Sub-carboniferous and Carboniferous.

Family *Arthronemidæ*, Ulrich.

Zoarium dendroid, composed of numerous small, sub-cylindrical segments, carrying cells on one or both sides.

Arthronema, Ulich.—Segments small, slender, poriferous on one side only; opposite side longitudinally striate. Cells in two to four rows. Trenton and Cincinnati.

Arthroclema, Billings.—Segments cylindrical, with cell-apertures on all sides. Trenton.

Sub-order Trepostomata, Ulrich.

This sub-order is proposed for the reception of the majority of the Palæozoic, and many of the more recent Bryozoa. The principal distinguishing features of the sub-order are—(1) that the zoarium is composed of slender fasciculate tubes, which do not (as is the case in the *Cyclostomata*) gradually enlarge as they approach the surface, but remain throughout nearly of the same diameter; and (2), that at a certain point in the course of the tubes to the surface, they bend outward more or less abruptly, and *change* in character. Besides the following Palæozoic families, the *Cerioporidæ* should be referred to the *Trepostomata*.

Family *Ptilodictyonidæ*, Zittel emend. Ulrich.

Zoarium jointed, consisting either of a single leaf-like or compressed ramose segment, which articulates with the expanded and attached base; or of numerous similar segments. The segments are composed of two layers of closely-arranged tubular cells, grown together back to back. No interstitial cells. Diaphragms are often developed.

(The forms described by me (This Journal, vol. ii., No. 1) under the name of *Crateripora*, are now known to be the attached bases of the *Ptilodictyonidæ*. The forms described as *C. lineata*, and var. *expansa*, belong to species of *Ptilodictya*. The bases of *Arthropora* were called *C. erecta*.

Ptilodictya, Lonsdale.—Zoarium below, sub-solid, wedge-shaped or pointed; above, either an undivided leaf-like expansion, or branching dichotomously. Margin non-poriferous. Cell-apertures quadrate or hexagonal. Trenton to Lower Helderberg.

Graptodictya, Ulrich.—Zoarium pointed below, branching above. Cell-apertures circular, and separated by interstitial pits or sulci. Cincinnati Group.

Arthropora, Ulrich.—Zoarium jointed, segments short, with several branches or spurs projecting from each edge. Cell-apertures sub circular, separated by interstitial pits or sulci, and occasionally closed by an operculum. Lower Silurian.

Dicranopora, Ulrich.—Zoarium jointed; segments divided dichotomously at the upper end. Cell-apertures oblong, quadrate or elliptical, arranged between elevated longitudinal lines. Lower Silurian.

Clathropora, Hall.—Zoarium anastomosing and forming a regular net-work.

Family *Stictoporidæ*, Ulrich.

Zoarium not jointed, consisting of compressed branches or leaf-like expansions, which are attached to foreign bodies by a continuousan d expanded base. Branches and expansions composed of two layers of cells grown together, as in the *Ptilodictyonidæ*, by the adhering of their epithecal laminæ. Interstitial cells, diaphragms, and opercula often present. Vesicular interstitial tissue occasionally developed.

Stictopora, Hall.—Zoarium attached to foreign objects by a basal expansion, which is continuous with the frequently branching frond above. Edges of branches non-poriferous. Cell-apertures circular or elliptical. Silurian, Devonian.

Stictoporella, Ulrich.—Like the preceding, but smaller, cells elliptical, with two or more interstitial pits situated between the longer diameters of the cell-apertures. Lower Silurian.

Rhinidictya, Ulrich.—Zoarium narrow, branching at long intervals Cells surrounded by a close series of small spiniform tubuli. Trenton Cincinnati.

Cystodictya, Ulrich.—Zoarium like that of *Stictopora*, but with wider interstitial spaces. Sections show that the intertubular spaces are occupied by a vesicular tissue. Sub-carboniferous.

Phænopora, Hall.—Zoarium forming simple, palmate, or irregularly branching fronds, without a distinct non-poriferous edge. Cells arranged between elevated longitudinal lines. "Maculæ" often developed. Trenton to Niagara.

Pachydictya, Ulrich.—Zoarium composed of large, thick, somewhat irregularly branching fronds. Cells ovate, separated by angular interstitial tubes, which are closed by an interstitial membrane, and at intervals form "maculæ." Diaphragms are developed in both sets of tubes. The median epithecal plates perforated by minute foramina, so as to bring the two sides of the frond into connection. Trenton to Lower Helderberg.

Phyllodictya, Ulrich.—Zoarium forming simple leaf-like expansions, sometimes partially and very irregularly branched. Cell-apertures small, oblique, with the lower margin lipped. Interstitial spaces minutely granular or punctate. Trenton.

Family *Monticuliporidæ.* Nicholson.

Monticulipora, D'Orb. Zoarium submassive, incrusting, or irregularly frondescent. Surface with monticules, or smooth. Cells polygonal, apparently of one kind only. Tubes crossed by straight diaphragms and at intervals cystoid diaphragms are developed. Spiniform tubuli more or less numerous. Trenton and Cincinnati.

Sub-genus *Trematopora*, Hall.—Ramose to sub-frondescent, with or without monticules. Interstitial cells few, sometimes gathered into groups. Tubes throughout the greater portion of their length "immature," and provided with few or no diaphragms ; just before opening at the surface cystoid diaphragms are developed. Cincinnati and Niagara.

Peronopora, Nicholson.—In double leaves. Interstitial cells and spiniform tubuli more or less numerous. Tubes with numerous cystoid diaphragms. Interstitial tubes provided with closely arranged straight diaphragms. Cincinnati.

Prasopora, Nicholson and Ethridge.—Free, or loosely adhering to foreign objects, forming hemispherical masses, or thin expansions, with a wrinkled epitheca covering the lower surface. Tubes cylindrical or prismatic, and having one or both sides lined with cystoid diaphragms. Interstitial tubes often completely isolating the proper zoœcia, and crossed by numerous diaphragms. Spiniform tubuli sometimes nearly absent, in other cases more numerous. Trenton and Cincinnati.

Diplotrypa, Nicholson.—Zoarium free, hemispherical. No spiniform tubuli. In other respects like *Prasopora*, excepting that the tubes are provided with straight diaphragms only. Niagara.

Monotrypa, Nicholson.—Irregular, hemispherical, or globular masses. Surface smooth, or with low monticules carrying groups of larger cells than the average. Tubes thin-walled, prismatic, and traversed by straight diaphragms. No interstitial cells nor spiniform tubuli. Trenton to Carboniferous.

Monotrypella, Ulrich.—Ramose, smooth or tuberculated. Cells apparently of one kind only. Walls very thin in the axial portion of the branches, but much thicker in the peripheral region. Diaphragms straight. No spiniform tubuli. Trenton and Cincinnati.

Amplexopora, Ulrich.—Ramose, free, or incrusting. Cellular structure as in *Monotrypella*, excepting that more or less numerous spiniform tubuli are developed, which sometimes completely encircle the tubes. Cincinnati to Sub-carboniferous.

Stenopora, Lonsdale.—Zoarium ramose, or sub-lobate. In the peripheral region the tube walls are periodically thickened. Comparatively large spiniform tubuli are developed at the angles of the cells. Diaphragms straight, not numerous. Connecting foramina occasionally preserved. Carboniferous.

Batostoma, Ulrich.—Irregularly ramose, with a large basal expansion, by means of which the zoarium is attached to foreign bodies. Cell-apertures in the outer portion of the branches irregularly ovate or circular, and surrounded by a distinct ring like wall. Interstitial tubes more or less numerous, very irregular in shape and size. Spiniform tubuli numerous and well developed. Cincinnati.

Batostomella, Ulrich.—Ramose, branches smooth, usually small. Cell apertures small. Interstitial cells and spiniform tubuli few to numerous. Walls of tubes in the peripheral region thick, and seemingly fused together. Trenton to Carboniferous.

Leioclema, Ulrich.—Ramose, slender, not tuberculated. Proper zoœcia small, surrounded by two or three series of angular interstitial cells. Spiniform tubuli well developed; numerous, but restricted to the walls of the proper zoœcia. Diaphragms stout, but rather remote in both sets of tubes. Carboniferous.

Atactopora, Ulrich.—Incrusting; surface usually studded with "monticules" or "maculæ." Cell-apertures more or less petaloid, surrounded by from one to three rows of small blunt spines. Interstitial cells gathered into clusters, or scattered more equally among the proper cells. Tube-walls inflected by the encroachment of the numerous spiniform tubuli. Diaphragms occur in both kinds of tubes. Occasionally cystoid diaphragms are present. Trenton and Cincinnati.

Callopora, Hall.—Ramose to sub-frondescent, smooth or tuberculated. Cell-tubes cylindrical, their apertures often closed by an operculum, with a very small central perforation, from which usually radiate small ridges. Interstitial cells, more or less numerous, sometimes completely isolating the proper zoœcia. Diaphragms numerous. Spiniform tubuli and cystoid diaphragms wanting. Cincinnati, Niagara and Lower Helderberg.

Calloporella, Ulrich.—Free and probably incrusting thin expansions. Tubes cylindrical, with thick walls, and separated by one or

two rows of angular interstitial cells. Diaphragms numerous, straight. Spiniform tubuli small, not numerous. Cincinnati.

Aspidopora, Ulrich.—Very thin free expansions, with a concentrically and radially triated epitheca covering the lower side. Composed of (according to age) from one to many unequal convex spaces. Cells gradually increasing in size from the margin of each convex space to near the center of same. Interstitial cells numerous. Both kinds of tubes crossed by diaphragms. Spiniform tubuli present. Cincinnati.

Heterotrypa, Nicholson (restricted).—Zoarium frondescent, rarely incrusting. Tubes prismatic. Interstitial cells developed in moderate numbers, sometimes collected into "maculæ." Spiniform tubuli small, more or less numerous. No cystoid diaphragms. Cincinnati.

Dekayia, Edwards and Haime.—Ramose, with branches cylindrical or compressed. Interstitial cells wanting. Spiniform tubuli few but very large. They constitute a conspicuous external feature of the zoarium. Cincinnati.

Dekayella, Ulrich.—Ramose, branches often compressed. Interstitial cells more or less numerous, often aggregated into irregular "maculæ." Spiniform tubuli of two kinds; large ones arranged as in *Dekayia*, and a much greater number of small ones. Diaphragms in both sets of tubes straight. Cincinnati.

Petigopora, Ulrich.—Small patches adhering to foreign objects, with a narrow non-poriferous band or germinating membrane along the outer margin. Interstitial cells wanting. Spiniform tubuli well developed. Cincinnati.

Nebulipora, ? McCoy.—Thin crusts, with slightly elevated monticules. Cells thin-walled, prismatic, and at intervals are groups of a larger size. Diaphragms straight. Interstitial cells and spiniform tubuli wanting. Cincinnati and Niagara.

Discotrypa, Ulrich.—Free and very thin circular expansions. Cells very regular in their arrangement, with rhomboidal or hexagonal apertures. The summits of the low and broad monticules are occupied by larger cells than the intervening spaces. Interstitial cells and spiniform tubuli entirely absent. Cincinnati.

Spatiopora, Ulrich.—Incrusting, and forming very thin, large expansions, with a smooth or strongly tuberculated surface. Cells shallow, with oblong and irregular apertures. Interstitial cells sparingly developed. Spiniform tubuli generally of considerable size.

Stellipora, Hall.—Zoarium incrusting. Surface studded with stellate "maculæ;" from the depressed central portion of these radiate

five to twelve or more equally depressed rays. Between the rays the surface is elevated into small ridges, which are occupied by the apertures of proper zoœcia. Depressed portions of "maculæ" occupied by interstitial cells. True tubes cylindrical, with thick walls and remote diaphragms. Interstitial tubes angular with numerous diaphragms. Cincinnati.

Sub-genus *Constellaria*, Dana.—Zoarium ramose or sub-frondescent; in other respects like *Stellipora.*

Family *Fistuliporidæ*, Ulrich.

Zoarium massive, ramose or frondescent. Cell-apertures circular or ovate, with or without a slightly projecting lip, and separated by one or more series of angular interstitial cells. Tubes with straight diaphragms. Walls of interstitial cells not continuous, but form a loose vesicular tissue between the proper zoœcia.

Fistulipora, McCoy.—Zoarium massive, ramose, or forming free or attached expansions. When ramose the branches are large, often irregular, and sometimes hollow. In tangential sections the proper zoœcia are regularly circular or elliptical. Niagara to Carboniferous.

Didymopora, Ulrich.—Proper zoœcia with two delicate longitudinal lamellæ springing inwardly from the walls of the tubes; or they are simply contracted by two inflections of the wall. In other respects like *Fistulipora.*

Besides *Fistulipora* and *Didymopora*, and several undescribed genera, I believe that *Rhinopora*, Hall, *Lichenalia*, Hall, and *Coscinium*, Keyserling (as identified by Prout), will be found to belong to the *Fistuliporidæ.*

Fam. *Ceramoporidæ*, Ulrich.

Zoarium usually incrusting, in other cases ramose, with the branches hollow (*i. e.*, provided with an "axial tube") or flabellate. Cell-apertures triangular or ovate, with a prominent and arched "lip" usually on one side. Interstitial cells from very few to numerous. Connecting foramina sometimes present. Diaphragms (if at all developed) straight.

Ceramopora, Hall.—Usually incrusting. Cells angular, with the "lip" strongly arched, the aperture oblique, and radiating from one or more centers. Insterstitial cells sometimes absent; always few. Connecting foramina usually present. Diaphragms occasionally developed. Cincinnati to Lower Helderberg.

Ceramoporella, Ulrich.—Incrusting; composed of a single thin

layer, or numerous superimposed layers. Tubes short, with the apertures rounded, and more or less oblique. Interstitial cells numerous, and in the matured state covered by a thin membrane. Cincinnati.

Cheiloporella, Ulrich.—Forming heavy crusts, or rising upward into flabellate fronds. Tubes long, traversed by few straight diaphragms. Cell-apertures ovate. Interstitial cells numerous. Cincinnati.

Crepipora, Ulrich.—Usually incrusting, sometimes irregularly ramose with hollow branches. Cell-apertures very little oblique, rhomboidal, with a slightly projecting "lip." Interstitial cells usually restricted to the "maculæ," which are distributed at rather regular intervals over the surface. Two delicate longitudinal lamellæ are present in each tube. Diaphragms are developed in moderate number. Cincinnati.

Eridopora, Ulrich.—External characters as in *Ceramoporella*. Longitudinal sections demonstrate that the intertubular spaces are occupied by a well developed vesicular tissue. Sub-carboniferous.

Sub-order Cheilostomata, Busk.

Fam. *Membraniporidæ*, Busk.

? *Paleschara*, Hall.—Zoarium incrusting; tubes very short. Cell-apertures direct, angular, and more or less oblong. Cincinnati to Lower Helderberg.

A few American Palæozoic genera of Bryozoa have been omitted from the above classification, because I have not yet been able to give them the attention required for a full elucidation of their characters and affinities.

DESCRIPTIONS.

Genus Berenicea, Lamx.

The dividing lines between the genera *Berenicea*, *Proboscina*, and *Stomatopora*, are, especially among Palæozoic forms, not strongly marked, since it is mainly in their mode of growth that they differ. As, however, these generic names are convenient in classifying the numerous species placed under each by such authorities as Busk, Haime, and Reuss, I have thought it proper to recognize the genera in classifying the Lower Silurian species.

Berenicea primitiva, n. sp. (Plate VI., fig. 4.)

Zoarium attached to foreign bodies, and forming small subcircular

or irregular patches. Cells small, mostly immersed, somewhat irregular in their arrangement, with the rounded and slightly oblique apertures raised conspicuously above the general surface. Cell apertures usually about twice their own diameter distant from each other; about eight occupy the space of .1 inch.

Formation and locality: Rare at Cincinnati, Ohio, near the tops of the hills; more abundant in the upper half of the Cincinnati Group.

BERENICEA VESICULOSA, n. sp. (Plate VI., fig. 5.)

Zoarium adnate, very delicate, growing usually upon smooth crinoid columns. Cells showing distinctly upon the surface as elliptical convex spaces, with the circular aperture situated upon the forward slope of the same. The cells are closely arranged in rather irregularly alternating series; measured along the length of the cells, about eight may be counted in the space of .1 inch; and across their width eleven or twelve occupy the same space.

From the preceding species *B. vesiculosa*, is readily distinguished by its less immersed, and more closely arranged cells.

Formation and locality: Rare at Cincinnati, Ohio, from low-water mark in the Ohio river, to 200 feet above that horizon.

SCENELLOPORA RADIATA, nov. gen. *et* sp. (Plate VI., figs. 6, 6*a*, and 6*b*.)

Scenellopora, gen. char., *ante* p. 150.

Zoarium depressed, conical in form, with the cell apertures occupying only the base of the cone; the sides are lined with a thin and striated epitheca. The celluliferous surface is slightly concave, and in the example before me, the central portion is smooth and without cell-apertures. Radiating from this space to the outer margin are about twenty rather unequal ridges, which carry either a single or double row of cell-apertures; cells elliptical, oblique, about five in the space of .1 inch, measured along the length of the ridges. The intervening spaces like the central space appear to be solid. That is, however, scarcely probable, and I believe that they were occupied by interstitial cells, the mouths of which are closed by an interstitial membrane. Height of zoarium, .15 inch; diameter of celluliferous surface, about .4 inch.

Scenellopora is nearly allied to some of the species of *Aspendesia*, Lamx., and consequently must be referred to the family *Theonoidæ*, Busk.

Formation and locality: The specimen upon which this species

and genus is found, was collected from strata of the Trenton group, near Knoxville, Tenn.

MITOCLEMA CINCTOSA, nov. gen. *et* sp. (Plate VI., figs. 7, 7*a.*)

Mitoclema, gen. char. *ante* p. 150.

Zoarium ramose, branches very slender, and divided dichotomously at intervals, varying from less than one quarter inch to one half inch. Cells radiating from an imaginary central axis, with the apertural portion tubular and partially free; cell apertures rounded, and arranged in transverse series around the branches; there are eight of these rows in the space of .3 inch; and from twelve to fifteen cell apertures in each series. Diameter of branches about .035 inch.

Mitoclema bears considerable resemblance to the Mesozoic and recent genera *Spiropora*, Lamx., and *Entalophora*, Lamx., and doubtless belongs to the same family of Bryozoa. However, neither those genera nor any other genus of the *Entalophoridæ* is known to occur in older strata than Jurassic. Another species of *Mitoclema* occurs in the Trenton rocks of New York, which (if I have correctly identified the form) was described by Hall under the name of *Gorgonia ? perantiqua.* (Pal. N. Y., vol. i, p. 76, 1847.)

Formation and locality: This species was collected by Prof. A. G. Wetherby and the author, at the bottom of the gorge of the Kentucky river, near High Bridge, Ky. Trenton.

FENESTELLA OXFORDENSIS, n. sp. (Plate VI., fig. 13.)

Zoarium broadly, and usually incompletely funnel-shaped; branches slender, five or six in the space of .1 inch, regular, and somewhat rigid in appearance; on the non-poriferous side they are rounded, and apparently always smooth. Dissepiments about one half the width of the branches, and expanding at their junction; five or six in the space of .1 inch. Fenestrules elliptical to sub-quadrangular, with a width about equal to that of the branches, and a length from once and a half to twice the width. Cell-apertures in two ranges, one on each side of a moderately developed median ridge, generally three in the space of each fenestrule, circular, and distant from each other usually less than half their diameter. A small node appears to be developed on the median ridge at the point of junction of the dissepiments with the branches.

This species is the only undoubted one of *Fenestella*, known to me from American Lower Silurian rocks. It is related to both *F. prisca*, Lonsdale, and *F. tenuis*, Hall, from the Clinton group of New York.

From the former it differs in having the cell-apertures much more closely arranged; from the latter it is distinguished by its less elongated fenestrules; and from both by its less robust habit of growth.

Formation and locality: In the upper part of the Cincinnati group, at Oxford, Ohio.

PHYLLOPORA VARIOLATA, n. sp. (Plate VI., fig. 14.)

Zoarium broadly funnel-shaped, or irregular in its growth, composed of anastomosing branches, having a width of about .015 inch. Fenestrules varying from elongate elliptical to sub-circular, with a width sometimes more, at other times less, than that of the branches; and a length varying from once to three times the width. Cell-apertures circular, arranged either in two series or three alternating rows; inter-cellular spaces thin, raised into small nodes where larger; about fourteen cell-apertures occupy the space of .1 inch. Branches on non-celluliferous side smooth.

This genus is represented by two species in the Cincinnati rocks—the one above described, and another which I belive is the same form that was described by Miller and Dyer under the name of *Intricaria clathrata* (Contributions to Palæontology, No. 2, 1878). Those authors however, describe their species as having but a single row of cell-apertures on the branches. If I am right in my identification, then that statement is incorrect, since there are usually three series of cell-openings, one along the center of the branch, and another on each side. The cells along the sides of the branches are easily overlooked, and in specimens having the fenestrules even partially filled with matrix they can not be detected, since they open almost directly into the fenestrules.

Formation and locality: At Cincinnati, Ohio, in strata from 150 to 325 feet above low-water mark, in the Ohio river.

ARTHRONEMA, nov. gen.

Zoarium ramose, composed of numerous slender segments. Segments sub-cylindrical, slightly swollen at each end, and celluliferous on one side only; the opposite side being longitudinally furrowed and striated. Cell-apertures, in two to four rows, arranged between elevated lines.

Type, *Helopora tenuis*, James. (Plate VI., figs. 8, 8*a*, 8*b*, and 8*c*.)

While making some excavations in the shales of the lower part of the Cincinnati group, I was fortunate enough to discover this minute and very interesting bryozoan in immense numbers. The shales were

literally covered with the detached segments, and many fine specimens were secured, some of which preserve several hundred of the small segments still in connection. As is shown by these specimens, each segment at its upper extremity articulates almost invariably with two succeeding segments, so as to produce a dichotomously branched zoarium. The segments are about two tenths of an inch in length, and less than one hundredth of an inch in diameter, and have, so far as I could determine, always three series of cell-apertures, which are situated in as many concave furrows. The fourth side is convex, and wider than any of the other three sides, and is marked by from six to eight distinct longitudinal striæ. The cell-apertures, when perfect, are provided with a delicate and prominently elevated rim; usually, however, they appear as so many rounded apertures at the bottom of the furrows. About nine cells occupy the space of .1 inch, and they are separated from each other a little more than their own diameter.

Arthronema tenue occurs in the Upper Trenton strata, of Kentucky, and is a common fossil in the lower half of the Cincinnati group.

ARTHRONEMA CURTUM, n. sp. (Pl. VI., fig. 9.)

The segments of this species differ from those of *A. tenue*, in being stronger, shorter, and more finely striated on the non-poriferous side; besides the articular faces at each end are more distinctly enlarged. The only specimen that I have seen presenting the poriferous side to view is considerably worn, and all that I can say of the cell-apertures is that they appear to be arranged in four series. Length of a single segment, .09 inch; diameter of same, .025 inch.

Formation and locality: In the Cincinnati group, at an elevation of from 250 to 300 feet above low-water mark in the Ohio river, on the hills west of Covington, Ky. Rare.

ARTHROCLEMA SPINIFORME, n. sp. (Pl. VI., figs. 10, 10*a*.)

Zoarium composed of numerous segments, which are cylindrical, poriferous on all sides, and pointed more or less obtusely at each end; their length varies from two to four tenths of an inch; their diameter from .015 inch to .04 inch. Cell apertures oblique, arranged between slightly elevated longitudinal lines, and in transverse rows around the stem. On account of their obliquity, well preserved examples have the lower margin of the aperture prominently elevated. There are from eight to sixteen longitudinal series of cell-apertures around the segments; seven of the transverse series occupy the space of .1 inch. Longitudinal sections show that the cells radiate from a central axis,

that their walls are thin near the axis, and become much thickened as they approach the surface. No diaphragms. In transverse sections the cells radiate from the central axis, and appear as so many wedges arranged around a central point.

It is possible that this species is not congeneric with the *Arthroclema pulchella*, Billings, upon which the genus was founded. But as I have had no opportunity to examine specimens of that species, I have deemed it prudent to refer my species provisionally to Mr. Billings' genus.*

Formation and locality: Quite abundant in middle Trenton strata, at Lebanon, Tenn., where it is associated with numerous other Bryozoa.

PTILODICTYONIDÆ.

The family *Ptilodictyonidæ* as defined by Zittel (Handbuch der Palæontologie, p. 603), comprises two distinct groups, which from the distinguishing character may be termed "articulata" and "inarticulata." Similar divisions have been made by Busk in both the *Cyclostomata* and *Cheilostomata*, and it is interesting to note that such divisions can also be established in the proposed sub-order *Trepostomata.* The group "articulata" of the new sub-order contains, so far as known, only the family *Ptilodictyonidæ* as restricted (*ante* p.), and is characterized by a jointed zoarium. This character I have considered of sufficient importance to warrant the separation of the genera having an unjointed zoarium, from those in which the zoarium is divided into segments. Consequently, the family *Stictoporidæ* has been established for the reception of the genera having a continuous zoarium.

PTILODICTYA, Lonsdale.

Heterodictya, Nicholson, Geo. Mag., vol. ii., n. s., 1875.

Fronds simple or branched, springing from a pointed or wedge-shaped, sub-solid, and finely striated base or articulating process, which fitted loosely in the socket of the expanded and firmly attached base. The free portion of the zoarium is two-edged, with the transverse section acutely elliptical, with the surface either smooth, montiferous, or marked by transverse ridges, and composed of two equal but distinct sides; each side is provided with a delicate epithecal membrane, from which the cells arise to open on the two opposite faces of the frond. Cells quadrate, rhomboidal, or hexagonal, and arranged in longitudinal

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* Since the above has been in press, I have been enabled, through the kindness of Mr. S. A. Miller, to examine authentic specimens of Billings' species, and I am now convinced that *A. spiniforme*, though differing in many respects from the type species, is properly referred to *Arthroclema*.

series, or in a quincuncial manner ; pseudo-septa are frequently present ; the walls in many species are pierced by connecting foramina. True interstitial cells usually absent ; but in the nodose species the summits of the monticules are often occupied by smaller cells than the average. In the robust species the tubes are crossed by diaphragms placed upon the same level in contiguous tubes.

Ptilodictya maculata, n. sp. (Pl. VI., fig. 17, and Pl. VII., figs. 4, 4*a.*)

Zoarium consisting of a single, unbranched, flattened, two-edged frond, which is more or less curved, and gradually expands from the pointed articulating "head" upwards. The width of the frond above varies in different examples from one half an inch to one and a half inches. The total length may exceed five inches, while the greatest thickness of a robust specimen does not exceed one tenth of an inch. From one to two tenths of an inch above the extremity of the striated and more or less pointed articulating process, the zoarium suddenly expands and forms a kind of shoulder. Cells rhomboidal or hexagonal, with oval or circular apertures, and arranged in intersecting diagonal lines, the regularity of which is interrupted at intervals of about .1 inch, by groups of cells of a larger size than the average, which occupy slight elevations of the surface. Between these groups about twelve cells occupy the space of .1 inch. Walls of cells at the surface moderately thin. Sections show that the walls are thick and perforated by connecting foramina; and that diaphragms are developed at corresponding levels in contiguous tubes. In tangential sections the cells are usually, irregularly petaloid; the pseudo-septa number in each tube from one to five.

The characters of this species are intermediate between those of *P. falciformis*, Nicholson, and *P. pavonia*, D'Orbigny. From the former it is distinguished by its much more robust fronds, and groups of larger-sized cells. From the latter it is separated by its comparatively narrow fronds, which never expand so irregularly, nor nearly so much as those of *P. pavonia.*

In this connection, it is proper to consider the characters of *Ptilodictya pavonia*, D'Orb., since Dr. Nicholson ("Monticulipora," p. 196, 1881), has questioned my view of the affinities of this species. D'Orbigny originally referred the species to the genus *Ptilodictya*, which course I believe to have been unquestionably correct. In his discussion of the subject, Dr. Nicholson says (*loc. cit.*): "This beautiful form presents a considerable superficial resemblance to *Ptilodictya*, and has been referred to this genus. It wants, however, the definitely cir-

cumscribed and peculiarly marked lateral margins of the fronds of this Polyzoan type; and, what is more important, it is without the peculiarly striated central lamina of the *Ptilodictyæ.* It is true that the bases of the corallites in *M. pavonia*, D'Orb., are so united with one another as to give rise to an irregular calcareous membrane, which separates the two halves of the corallum; but none of the specimens that I have seen exhibit any tendency to split along the line of this membrane, nor can the corallites be forcibly removed from one side of it, exposing the median lamina as a definite structure. In both these respects the *Ptilodictyæ* would show quite different phenomena." The first character—*i. e.*, the nonporiferous margin which Dr. Nicholson erroneously regards as lacking in *P. pavonia*—is, of course, not developed along the growing margin of the fronds, but in all specimens preserving the "articulating process," the non-poriferous margin may be traced along the edges of the lower portion of the frond. The non-poriferous margin in *P. pavonia* (Plate VII., fig. 3*a*), is precisely like that of either *P. falciformis* or *P. maculata.* Judging from the above quotation, it would appear that Dr. Nicholson has entirely misconceived the character of the median laminæ of the *Ptilodictyonidæ.* If I understand him correctly, he believes that the axis is constituted by a *definite structure* from which the two layers of cells may be striped. This impression is manifestly erroneous, nor do I know of a single double-leaved Bryozoan in which such a structure may be demonstrated. In *Ptilodictya* the facts are, simply, that we have two layers of cells which are grown together back to back by the adhesion of the epithecal laminæ of each layer. This fact may be readily demonstrated either in thin sections or fractures. In both tests the characters presented by *P. pavonia*, are precisely like those observed in other species of the genus. On plate VII., figs. 3 and 3*a*, are represented two specimens of *P. pavonia*, both of which preserve a portion of the frond and the articulating process. The importance of the fact that this species possesses a jointed zoarium can not be over-estimated, since it completes the chain of evidence that establishes the near relationship of *P. pavonia* to some of the more typical species of the genus.

Formation and locality: *P. maculata* is not an uncommon fossil in strata about 300 feet above low-water mark in the Ohio river, at Cincinnati, Ohio, Covington, Kentucky, and other localities.

Ptilodictya ramosa, n. sp. (Plate VII., figs. 5, 5*a*.)

Zoarium ramose, branching dichotomously about three times, at in-

tervals of from one fourth to one half an inch. The branches vary in width in different examples, from one to two tenths of an inch. Distance between the first bifurcation and the pointed articulating process, usually less than one half inch. Transverse section of a branch acutely elliptical. Non-poriferous margin broad, distinctly striated. The cells are hexagonal, with circular or oval apertures, and arranged quincuncially; those near the non-poriferous margin are considerably larger than those along the middle of a branch, where nine or ten occupy the space of .1 inch.

I know of no species to which *P. ramosa* is nearly enough allied to necessitate a comparison.

Formation and locality: Middle Trenton strata, at Lebanon, Tenn., and High Bridge, Ky.

PTILODICTYA BRIAREUS, n. sp. (Plate VII., figs. 6, 6*a* and 6*b*.)

Zoarium digitate, from four to six closely approximated and flattened stems arising almost simultaneously from the wedge-shaped, articulating process. As growth proceeds, these stems are dichotomously divided at a very small angle, but at rather iregular intervals (usually about one inch). The non-poriferous margin is wide and striated, the cells are rhomboidal or quadrate, and usually arranged quincuncially. Walls very thick; cell-apertures oval. About seven cells occupy the space of .1 inch, measured longitudinally; in the same space diagonally there are ten. The thickness of the branches varies from .05 inch to .1 inch; the width from .15 inch to .3 inch. The length of the complete zoarium may be three or four inches.

Formation and locality: The remarkable specimens upon which this species is founded, were collected by Prof. James Safford, from middle Trenton strata at Lebanon, Tenn.

GRAPTODICTYA, nov. gen.

Zoarium in the general characters like that of *Ptilodictya*, from which it differs in being smaller, in having subcircular cells, which are surrounded by sulci, or interstitial pits. Non-poriferous margin well developed, striated. Articulating process slender, pointed. Frequently branched above.

Type, *Ptilodictya perelegans*, Ulrich. (This JOURNAL, vol. i., p. 94, Pl. IV., figs. 16 and 16*a*.)

Since the publication of the description of *Graptodictya perelegans*, I have examined other specimens, which preserve the articulating process. This is sub-cylindrical and pointed at its lower extremity. About .3 inch above the extremity the first bifurcation takes place.

GRAPTODICTYA NITIDA, n. sp. (Pl. VII., figs. 8 and 8*a.*)

As will be seen by a comparison of the enlarged view of the surface of *G. perelegans* (Pl. VIII., fig. 3), with that of this species, the cellular structure in the two forms is almost identical. *G. nitida* differs from that species only in its mode of growth. It is dichotomously divided at about .6 inch above the pointed extremity of the articular process, and none of the examples which I have seen are again divided above the first bifurcation. Besides, its zoarium is somewhat more slender than that of *G. perelegans.*

Locality and formation: In the Cincinnati group, five miles northwest of Hamilton, O., in strata equivalent to a height of 550 feet above low-water mark in the Ohio river at Cincinnati.

DICRANOPORA, nov. gen.

Zoarium large when complete, composed of numerous small ligulate joints. The segments are flattened, from one fourth of an inch to one inch in length, with the edges sub-parallel to near the upper end where they suddenly diverge, and are dichotomously divided into two short branches, the ends of which are thickened and solid, and articulate with the next succeeding segments. Cell-mouths ovate to subquadrate, and arranged between raised longitudinal lines. Usually the cells in from one to three rows along the margins have an oblique direction, No interstitial cells.

Type, *Ptilodictya internodia*, Miller and Dyer. (Pl. VII., figs. 9, 9*a.*)

The specimen illustrated by Messrs. Miller and Dyer is an abnormal segment, being simple instead of bifurcated. That condition is frequently found in *D. internodia*, but I have not yet seen an undivided segment of any other species. *Dicranopora* will include probably all of the ligulate species of *Ptilodictya.*

DICRANOPORA LATA, n. sp. (Pl. VI., figs. 16, 16*a.*)

The segments of this species are about one inch in length ; their width at the lower or simple end is about .08 inch ; at the bifurcated end the width is usually about .16 inch ; the greatest thickness rarely reaches .03 inch. The two articulating branchlets are remarkably short, being generally only about .05 inch ; they are only indicated by a narrow cleft in the widest end of the segment. Cells with thick walls and very small oval apertures. There are about ten longitudinal rows of cells near the lower end, and at least twenty just below the bifurcation. Measured along the length of a segment eight cells occupy the space of .1 inch. There are two rows of obliquely arranged cell-apertures along each of the acute margins.

The wide segments, thick cell-walls, and remarkably short articulating branchlets constitute the distinguishing features of the species.

Formation and locality: From the upper part of the Cincinnati group, near Oxford, Butler county, Ohio.

DICRANOPORA TRENTONENSIS, n. sp. (Plate VI., figs. 15, 15*a.*)

A segment of this species gave the following measurements: from the point of bifurcation to the extremity of the simple end, .7 inch; from do. to the upper or articulating end of each of the two branches, .3 inch; width of main stem, the sides or edges of which are nearly parallel, .08 inch; width of branches, .07 inch; angle of bifurcation, about 80 degrees. The cells are arranged between slightly raised longitudinal lines; there are nine of these rows, besides one obliquely directed series along each edge; measured longitudinally, seven cell-apertures occupy the space of .1 inch. Cell-walls comparatively thin Non-poriferous margin distinct but narrow.

The thin cell-walls and long branches of the segments are the distinguishing characters. So far as the length of the two branches is concerned, the extremes noticed are shown in this and the preceding species.

Formation and locality: From the middle Trenton strata, exposed at Lebanon, Tenn.

ARTHROPORA, nov. gen.

Growth of Zoarium similar to that of *Dicranopora*, but not so regular. Each segment has several short spurs or branchlets proceeding from each edge, some of which may or may not be tipped for articulation with succeeding segments. The main stem however is always slightly thickened and solidified at each end, where it joins the preceding and succeeding segments. The cell-mouths are oval or circular, and separated by interstitial pits or sulci. Often the cells are closed by sculptured opercula.

Type, *Stictopora shafferi*, Meek. (Plate VII., figs. 10 and 10*a.*)

Meek's description of this species is in the main correct, but he did not notice that the zoarium is a jointed one. I have in my cabinet a specimen which preserves no less than forty of the segments in connection. Figure 10, on plate VII., represents four of the segments of that specimen, and gives a tolerably clear idea of the growth of the zoarium. Besides *Arthropora shafferi*, the Cincinnati group furnishes at least one, and probably two other species, having the characters above ascribed to the genus.

STICTOPORA, Hall.

Zoarium attached to foreign objects by an expanded base, ramose, branches compressed, and composed of two layers of cells, which open upon the two flattened faces of the branches, and have their bases brought into juxtaposition by the adhesion of their epithecal laminæ. Branches with an acutely elliptical transverse section, from less than .1 of an inch, to sometimes a little more than .2 of an inch in width; the edges are marked by a more or less distinct non-poriferous margin. Cell-apertures oval or circular, usually arranged between raised longitudinal lines, with the interspaces smooth, rarely finely striate. Thin sections show that the tubes are of one kind only, with walls very thin near the median laminæ, but much thickened just below the surface; between the rows of cells are dark lines, indicating the raised longitudinal lines observed on the surface of the branches.

This genus has usually been considered, either as an exact synonym for *Ptilodictya*, Lonsdale, or as based upon types only sub-generically distinct from typical species of that genus. That I regard both these views as erroneous, I need scarcely say, since my opinion of the relations of these forms is amply shown in the foregoing scheme of classification.

As I have before stated, I consider the differences between *Ptilodictya* and *Stictopora* to be not only of generic importance, but of sufficient value to constitute the basis for the establishment of a separate and distinct family, for which I have proposed the name of *Stictoporidæ.*

STICTOPORA ACUTA, Hall. (Pl. VIII., figs. 1, 1*a* and 1*b*.)

Stictopora ? acuta, Hall, 1847. Pal. N. Y., vol. i., Pl. XXVI., fig. 3.

This species is a common fossil in the upper strata of the Trenton group, at Burgin, Ky., on the line of the Cincinnati Southern Railroad. The Kentucky specimens differ from typical New York examples, in being somewhat more robust. In all other respects they are the same. Hall in his original description of the species, expressed a doubt whether a central axis was developed. A central axis or lamina is present in the same sense as it is in all double-leaved Bryozoa known to me. That is, the two adhering epithecal membranes constitute an "axis" from which the cells proceed in opposite directions.

STICTOPORA GILBERTI, Meek. (Pl. VIII., figs. 2 and 2*a*.)

Ptilodictya (*Stictopora*) *gilberti*, Meek, 1871 ; Proc. Acad. Nat. Sci., Phil., p. 7 ; and Pal. Ohio, vol. 1, p. 194, 1873.

This neat species is mentioned in this connection, only because it shows a variation in one character from the typical species of the genus. Namely, the branches of this species do not retain a certain width throughout (as is very nearly the case in the more typical species), but vary, from below upwards, between the extremes of one tenth and three tenths of an inch. The rows of cells are increased by interpolation. In all other respects, *S. gilberti* has the characters of the genus as above specified.

Stictopora basalis, n. sp. (Pl. VIII., figs. 4 and 4*a*.)

Zoarium branching at intervals of about .2 inch, and attached to foreign bodies below by a broad, striated, and non-poriferous basal expansion. Branches from .08 inch to .12 inch in width ; thickness of same, not exceeding .03 inch. Non-poriferous margin rather wide, smooth. Cells small, with thick walls and elliptical apertures ; arranged in from ten to twelve alternating longitudinal series, between more or less elevated lines. Measured longitudinally, eight cells occupy the space of .1 inch; transversely, there are twelve rows of cells in the same space.

The small cells, and the profuse branching of the zoarium, are the distinguishing features of the species.

Formation and locality: Trenton group. Collected by Prof. J. M. Safford, at Shelbyville, Tenn.

Stictoporella interstincta, nov. gen. *et* sp. (Plate VIII., figs. 9, 9*a*.)

Stictoporella, gen. char. *ante*, p. 152.

Zoarium small, branching several times at intervals of from .1 inch to .3 inch. Branches thin, with a width usually a little less than .1 inch. Cells comparatively large, with elliptical apertures, and rather thin walls; arranged in somewhat irregular, alternating, longitudinal series, without any raised lines between them. Measured diagonally, eight cells occupy the space of .1 inch; in the same space longitudinally there are six cells. Between the ends of the cell-apertures there are always two, sometimes three or four, elongated interstitial pits, and along the edges of the branches there are from one to three obliquely directed series of similar pits.

This species is closely allied to *Stictoporella flexuosa (Ptilodictya flexuosa*, James), from which it differs in having wider, and oftener divided branches, and less regularly distributed cells. Besides the type species and *S. flexuosa*, James, the genus will probably embrace *Ptilodictya excellens*, Billings, from the Anticosti group, of Canada.

Formation and locality : At river quarries, opposite the city of Cincinnati, Ohio.

RHINIDICTYA NICHOLSONI, nov. gen. *et* sp. (Plate VIII., figs. 6, 6*a* and 6*b*.)

Rhinidictya, gen. char. *ante*, p. 152.

Zoarium slender, branching at intervals of from one half an inch to one inch. Branches varying in width, in the extremes of the examples noticed, from .07 inch to .12 inch; in thickness, from .02 inch to .04 inch. Cells small, with oval apertures, which in young examples are somewhat oblique; the cell-walls, which with age become much thickened, carry a closely arranged series of small spines or granules, which tangential sections show are the surface extensions of small spiniform tubuli. The cells are regularly arranged in alternating longitudinal series, of which there are from ten to fourteen in the width of the branches of the different specimens examined. Measured longitudinally, seven cells occupy the space of .1 inch; transversely, there are seven of the alternating longitudinal rows in .05 inch.

Young nor worn specimens do not show the spiniform tubuli, and for that reason Mr. U. P. James has described a Cincinnati species of this genus under the two names of *Ptilodictya granulosa*, and *P. paralella*. Mr. James' species is in all respects more delicate, nor does it appear to be so variable in its characters as the Trenton group species above described.

Named in honor of Dr. H. Alleyne Nicholson, whose numerous works have added so much to our knowledge of the Palæozoic Corals and Bryozoa.

Formation and locality: Trenton group, at High Bridge, Ky., a station on the Cincinnati Southern R.R.

CYSTODICTYA OCCELLATA, nov. gen. *et* sp. (Plate VIII., figs. 3, 3*a*).

Cystodictya, gen. char., *ante* p. 152.

Zoarium branching at intervals of from .25 inch, to .80 inch ; width of branches from .15 inch to .20 inch ; thickness of same about .04 inch. Non-poriferous margin smooth, not very acute, rather narrow. Cell-apertures circular, occupying the summits of small papillæ, frequently closed by centrally perforated opercula. In the central portion of the branches the cells are regularly arranged in longitudinal and intersecting diagonal series ; measured longitudinally, six cells occupy the space of .01 inch ; in the same space diagonally there are seven. Along the edges of the branches there are several rows of cells, which are somewhat larger than those over the central portion, and which have a transverse arrangement; between these transverse series of cells the surface is depressed into distinct and wide grooves, so that

the cell-apertures occupy the summits of small transverse ridges, nine of which occupy the space of .2 inch. Where a branch has a width of .2 inch, there are in all fourteen longitudinal rows of cells. At the surface no interstitial cells can be detected, the space between the cell-apertures being smooth.

Longitudinal sections show that the tubes, in the axial region, are thin-walled, and prostrate for about one half of their entire length, when they bend abruptly outward and proceed directly to the surface. The intertubular spaces, having a width equaling twice the diameter of the tubes, are occupied on each side of the axial or epithecal membranes, to the point of outward bending of the tubes, by vesicular tissue; and above that point to the surface, by dense, irregularly laminated sclerenchyma.

In tangential sections the transverse section of the tubes is subpiriform; this appearance is produced by two slight inflections of the walls of the tubes, which are placed opposite to each other, but a little either to the right or the left of the longitudinal diameter line, in such a manner that the smaller end of the piriform tube-sections of one side of a branch, are directed toward the right, and on the other side, toward the left non-poriferous margin. Just below the surface the intertubular spaces are occupied by sclerenchyma, with numerous small, dark spots scattered through it, indicating a poriferous condition for the thick interstitial membrane. Nearer the axial laminæ one or two series of interstitial cells surround each tube.

Beside *C. occellata*, I have examined three other species that must be referred to this genus. Two of these are new, and the third was described by Meek under the name of *Ptilodictya (Stictopora) carbonaria* (Pal. Ohio, vol. ii., p. 328). Meek's species differs from the one above described, in having more slender branches, and only from seven to nine longitudinal series of cells, which are arranged simply in diagonally intersecting lines, without the marginal transverse grooves and rows of cells, which constitutes such a marked feature of *C. occellata.* In all of the four species the internal structure is essentially the same, and the inter-apertural spaces are without interstitial cells.

Formation and locality: Collected near Somerset, Kentucky, in Subcarboniferous strata, probably of the Keokuk group.

PHÆNOPORA (?) MULTIPORA, Hall. (Plate VIII., figs. 7, 7*a*, and 7*b*.)

Phænopora multipora, Hall, 1851, Geo. Lake Sup. Land. Dist., vol. ii.

Zoarium consisting of rather large, thin, irregularly branching

flabellate or undulated expansions, which are celluliferous on two faces, and have no distinct non-poriferous margin. Surface smooth. Cells arranged between rather prominently elevated longitudinal striæ, and in more or less regular transverse or diagonally intersecting series. Measured longitudinally nine cells occupy the space of .1 inch; transversely from nine to twelve occupy the same space. The cell-apertures are ovate to sub-quadrate, and the walls thick. Scattered over the surface at variable intervals are small, apparently solid spaces, which do not however interrupt the regularity of the arrangement of the cells.

Vertical sections show that the cells arise rather abruptly from the axial laminæ, near which their walls are very thin. Soon, however, the walls are suddenly thickened, and appear to contain interstitial cells, since each wall is crossed by two or three dark lines, which appear to be diaphragms. Between this zone and the outer surface, the sclerenchyma between the walls of adjacent tubes is seemingly structureless. In a single section of this kind the axial laminæ appear to be perforated. No diaphragms have been observed in the tubes of the proper zoœcia.

In tangential sections the transverse section of the tubes may present four different aspects, according to the distance from the median laminæ at which they are cut. Just above the central axis the cells are thin-walled and quadrate, and arranged between straight longitudinal lines. The lines between the ends of the cells are always slightly curved, and usually constitute flexuous transverse lines, that cross the longitudinal lines at either a right angle, or somewhat obliquely. A little nearer to the surface the cells become elliptical and have thin ring-like walls; the space between the ends of the cells is occupied by calcite, which in the third stage (Pl. VIII., fig. 7*b*) is filled by structureless sclerenchyma. In the fourth stage, representing a transverse section of the tubes immediately below the surface, the longitudinal lines are replaced by a close series of minute spiniform tubuli, and the appearance presented at this stage is almost identical with that of a like section of *Rhinidictya nicholsoni* (Pl. VIII., fig. 6*b*).

Of the three species, *Phænopora explanata*, *P. constellata*, and *P. ensiformis*, originally referred to *Phænopora* by Hall (Pal. N. Y., vol. ii., 1852), the last is an undoubted species of *Ptilodictya* (as restricted), since it possesses the pointed articulating process and cellular structure of that genus. The second species I believe should also be referred to that genus, since none of its characters, so far as I have been

able to ascertain, are sufficiently distinct from those of typical species of *Ptilodictya* to permit a generic separation. I do not know that any specimens of *P. constellata* have been discovered which preserved the basal extremity: but judging from the general characters of the zoarium and its cellular structure, I am inclined to believe that the species possessed an articulating process or head, similar to that which characterizes *Ptilodictya*. The description of *Phœnopora explanata* immediately follows that of the genus, and this species must therefore be regarded as the type of the genus. Through the courtesy of Prof. R. P. Whitfield, of the Amer. Mus. of Nat. Hist., New York City, I was permitted to see the specimens upon which this species was founded. These are, however, but poorly-preserved fragments, that do not preserve the basal portion of the zoarium, and, in consequence, I am unable to decide, with any degree of certainty, whether *Phœnopora* should be classed with the *Ptilodictyonidæ* or the *Stictoporidæ*. My only reason for placing the genus with the latter family is found in the fact that *P. (?) multipora* belongs there. That this species is congeneric with *P. explanata* is doubtful, and must remain so until good specimens of the type species can be subjected to microscopical examination.

Formation and locality: *P. (?) multipora* is not an uncommon fossil in the upper beds of the Trenton group, at Burgin, Ky.

PACHYDICTYA, ROBUSTA, nov. gen. *et.* sp. (Pl. VIII., figs. 10, 10*a*, 10*b*, and 10*c*.)

Pachydictya, gen. char., *ante* p. 152.

Zoarium robust, ramose, branching at intervals, varying from .3 inch to one inch. Branches varying in width from .2 inch, to over .5 inch, and in thickness from .05 inch to .15 inch. Non-poriferous margin usually well-developed, smooth. Cell-apertures comparatively large, oval to sub-circular, and arranged in more or less regular series; about six occupy the space of .1 inch. The interstitial cells usually can not be detected at the surface, and when most distinct they appear as only shallow elongated pits occupying the summits of the moderately thick cell-walls. At irregular intervals they are gathered into unequal "maculæ," which may be level with the general surface, or elevated into small monticules, and either smooth and apparently solid, or minutely punctate. When mature, the interstitial cells appear to have been covered by a minutely poriferous interstitial membrane.

In longitudinal sections the tubes arise very abruptly from the median axis, near which their walls are very thin; as they proceed toward

the surface, the walls become thickened, and separated from each other, the intervening space being narrow, and occupied by apparently structureless sclerenchyma. This is the appearance when the tubes are cut through their centers. When cut so as to pass along the side of the tubes, the interstitial cells are brought to view. These are crossed by numerous diaphragms, and remain open to near the surface, when they are filled by the interstitial membrane. This is usually traversed by very slender, vertical dark streaks. The median laminæ are apparently amalgamated and poriferous, the minute foramina passing very obliquely through them.

In tangential sections, near the axis (Pl. VIII., fig. 10*b*), the tubes are thin walled, sub-circular or broadly ovate, and usually in contact, though sometimes nearly surrounded by the interstitial tubes. Nearer the surface (Pl. VIII., fig. 10*c*), the tube-walls are slightly thickened and ring-like, while the interstitial spaces and "maculæ" are profusely dotted by minute tubuli (?spiniform tubuli).

Of *Pachydictya*, beside *P. robusta*, I have one other large branching species from the Niagara group of Kentucky, and a palmate and not distinctly branched species from the Trenton of Tennessee and Minnesota, which are, without any doubt, congeneric. All have rather large cells, and show more or less frequently the interstitial cells at the surface. One of the principal characters of the genus is shown in tangential sections. Namely, the cells are not separated into series by distinct longitudinal lines, but the arrangement is more like that of some of the *Monticuliporidæ* (*e. g. Prasopora newberryi*, Nich.) In all true species of *Stictopora*, such lines constitute a conspicuous feature in tangential sections.

Formation and locality: Collected by Prof. Safford in the lower beds of the Trenton group, near Knoxville, Tenn.

PHYLLODICTYA FRONDOSA, nov. gen. *et* sp. (Plate VIII., figs. 11, 11*a* and 11*b*).

Phyllodictya, gen. char. *ante*, p. 153.

Zoarium growing from a somewhat expanded, sub-solid, sometimes striated base, into erect, thin, simple and undulated expansions, which are celluliferous on both sides; the height of the fronds is always less than two inches, while their thickness is never more than .08 inch, and often not more than .04 inch. The edges of the fronds are provided with a distinct non-poriferous margin. Cell-apertures oblique, according to the age of the zoarium, from $\frac{1}{130}$ to $\frac{1}{160}$ of an inch in diameter, usually more or less regularly arranged in intersecting diagonal series; in the perfect state the lower margin is prominent and

forms a small "lip." Cell-interspaces of variable thickness, smooth when worn, and minutely pitted or granular when well preserved; nine or ten cells occupy the space of .1 inch. At intervals of usually less than .2 inch are developed distinct "maculæ," which are either minutely pitted or striated, and generally even with the surface. In one specimen they are prominently elevated.

In tangential sections taken just below the surface, the tubes are subcircular, with a thin, but disinct ring-like wall. The interstitial spaces are occupied by minute dots (? spiniform tubuli), and have a thickness often equaling the diameter of the tubes.

In longitudinal sections, the tubes proceed from the median axis to the surface very obliquely, and in a long and gradual curve. A line drawn from the aperture to the point at which a tube is developed, forms an angle of about 35° with the central axis. As the tubes approach the surface, they are slightly contracted in their diameter, and the interstitial spaces expand rapidly, until, near the surface, they have a thickness equal to the diameter of a tube; these spaces are occupied by nearly structureless sclerenchyma, which (when they are preserved) are vertically traversed by rather indistinct dark streaks. The tubes are crossed by remote diaphragms.

Another species of this genus occurs quite abundantly at High Bridge, Kentucky, where it is associated with *P. frondosa*, from which it differs mainly in external features.

Formation and locality: In middle Trenton strata, at High Bridge, Kentucky, and other localities in that vicinity.

[To be Continued.]

DESCRIPTIONS OF TWO NEW SPECIES OF CRINOIDS.

By E. O. Ulrich.

Heterocrinus (Iocrinus) œhanus, n. sp. (Pl. V., figs. 9, 9*a*, 9*b*.)

Body small, obconic, pentalobate, and gradually expanding upward from the column. Basal pieces pentagonal, about as high as wide. In over twenty specimens examined, the sutures between the body plates can scarcely be detected. As well as could be determined, their arrangement is as follows: First radial, in all the rays excepting the right posterior one, about as long as wide, and supporting in succession two shorter and smaller pieces which belong to the body. In the right posterior ray, the first radial is wider than long, and succeeded by a shorter pentagonal piece, which supports upon its superior sloping aces the next succeeding smaller radial, and the large irregularly

pentagonal anal plate ; succeeding the third radial is a fourth one, which is about as long as wide, and is still included within the body ; on the left side this piece articulates with the anal plate ; above the body plates the rays are constricted, and in the right posterior, and right anterior rays, there are four pieces in direct succession to the base of the arms, the last one being an axillary piece; in the three remaining rays there are five pieces to the base of the arms.

Arms ten, rather stout, long, rounded on the dorsal side, and composed of pieces which in the largest examples studied are slightly wider than long, and in young specimens, a little longer than wide; the fifth piece in each arm is somewhat wedge-shaped and slightly larger than those below it, and supports on the upper lateral sloping side of its thicker end, a small armlet; subsequently each succeeding fourth piece throws off alternately on each side of the arms, a similar armlet ; at the point of origin the width of the armlets is equal to about half of that of the arms ; they seem to extend upward as far as the arms themselves, and are composed of pieces that are nearly twice as long as wide; usually every sixth or seventh piece is axillary, and supports two equal divisions of the armlet.

The single anal plate is pentagonal, and once and a half times as large as the largest radial piece; it connects at the upper side with the ventral prolongation, which extended some distance beyond the end of the arms, and at intervals of about one eighth of an inch, or a little more, is constricted so as to give it a beaded appearance ; and is composed of numerous thin squamiform plates, that imbricate upward.

Column of moderate size, pentagonal, and composed near the body of alternately thicker and thinner pieces; several inches below the body the column becomes rounded, and the segments nearly equal.

Dimensions of a medium-sized specimen: Length of body, .18 inch ; breadth, .2 inch; length from last disk of column to base of arms, .34 inch; length of arms, about 1.5 inches; diameter of column .1 inch.

Named in honor of the discoverer, Mr. George Oeh, whose collection contains many fine specimens of Cincinnati crinoids.

Formation and locality: On the hills back of Cincinnati, Ohio, at an elevation of about 325 feet above low-water mark in the Ohio river.

HETEROCRINUS PENTAGONUS, n. sp. (Plate V., figs. 10, and 10*a*.)

Body small, a little longer than wide, with the breadth but slightly more above than below, in some specimens a little constricted above at the point where the rays become free; in old examples, pentalobate, as seen from below, in consequence of each radial series being convex,

and the vertical sutures between them a little excavated. Basal pieces comparatively large, a little wider than high, with a general pentagonal outline. First radial in the central and left anterior rays, and the left posterior ray, convex, longer than wide, and supporting another shorter piece above, that tapers more or less upward; and upon this rest, in direct succession, three other plates, that are considerably wider than long, the third one being axillary and supporting two arms. Right anterior ray with the first piece scarcely wider than long, and supporting in direct succession, two other slightly shorter pieces, the last of which tapers slightly upward, and again supports in succession, two still shorter pieces, and a third axillary piece. Right posterior ray, with the first piece slightly wider than long, while it supports above a somewhat smaller pentagonal piece, which in its turn again supports a smaller third radial, and on its left superior sloping side the first anal piece; above the third radial piece there are in direct succession three short pieces, and a fourth axillary piece, which, as in the other rays, supports two arms.

Arms ten, rather slender, of moderate length; above their origin on the last of the primary radial series, rounded, and composed of pieces usually a little wider than long, of which the third, and subsequently every fourth one, gives off on alternate sides of the arm, an armlet or branch nearly two thirds as large as the main arm above; armlets composed of pieces that are as long as those of the main arm, being, in consequence, considerably longer than wide.

Column proportionally large, its diameter equaling two thirds of that of the body at its widest point; distinctly pentagonal, with slightly prominent angles, and composed of alternating thinner and thicker disks; of the latter there are nine in the space of .3 inch below the basal plates. At a point about three inches below the body the column becomes rounded and the disks sub-equal.

Length of body, .2 inch; breadth, about .17 inch; length from last disk of column to first bifurcation, about .35 inch; length of arms, as far as observed, .62 inch; diameter of column, .12 inch.

This species is closely allied, in some respects, to *Heterocrinus juvenis*, Hall, from which it differs in its less slender and longer arms, comparatively smaller, and pentagonal instead of rounded column, and slightly in the plates of the body.

The three specimens examined were collected by Mr. George Oeh, who also discovered the preceding species.

Formation and locality: Cincinnati group, at Cincinnati, Ohio, about 375 feet above low-water mark in the Ohio river.

THE NERVOUS SYSTEM.

By A. J. Howe, M. D.

The Fly-trap of Venus and a few other plants, when gently touched, as by the alighting of an insect, display responsive movements as if to capture prey. The reflex action thus manifested does not prove that such energies come through the agency of a nervous system, but simply demonstrates that the vegetable fibre of certain plants is irritable or impressible to a responsive degree. The white lily of our ponds displays its delicate and odorous petals at night and in cloudy weather; and the heliotrope, as the name implies, turns with the sun; but there is no neural cell or nerve tubule in these interesting flowers.

Nerves are peculiar to animals. The stupid slug and the larval worm have two varieties of neurine in their composition; and these are displayed in groups of cells (ganglia), and plexuses of threads. The former corresponds to the "gray" matter of true brain, and the latter to the "white" or tubular neurine. The vesicles to be found in neural knots, nodules, ganglia or "centers," are soft, fatty and albuminous, with a perceptible admixture of phosphorus. Functional activity is kept up in these ganglionic bodies by the presence of oxygen, which is furnished through a circulating medium; for instance, the blood in elevated animal forms. Nervous energy is developed in ganglia as certainly as secretions come from glands.

A remarkable quality of neural endowment is, that the nervous system acts intelligently in the way of protecting the individual. The nervous filaments in the skin of an earth-worm warn the creature, as drouth approaches, to descend to planes where moisture is plentiful, and to return to the surface when warm rains render shallower planes agreeable. The lowly organism has no special senses, yet common cutaneous sensation does for all its needs.

The spider has no brain, yet a few neural nodules and commissural filaments excellently serve the creature. It manifests discrimination in the selection of a place in which nets may be profitably spread; it seemingly knows where game is plentiful, and removes to better grounds when the supply is exhausted. As a strategist, the spider has no equal among insects. The ant and the bee exhibit great instinctive wisdom, yet they do not know enough to patiently lie in wait that they may suddenly pounce upon unsuspecting victims.

Fishes and reptiles possess a low order of brains, and rather feeble instincts, except at certain seasons. The stickleback builds a nest

and defends it; and the pythoness broods her eggs. Yet most reptiles leave their young to hatch and take care of themselves.

The encephalon of fishes and reptiles is represented by a small amount of cerebral neurine. Four or five pairs of ganglia are distinct in the neural chain. Olfactory nodules are present, yet the sense of smell is feeble or altogether lacking. The optic lobes are prominent; the cerebellum is distinctly represented, as well as the swellings of the medulla oblongata, but the cerebral hemispheres are insignificant in size. The brain of a crocodile is not as big as that of a parrot or a goose. The great saurian knows little except to capture and drown prey.

Birds have a large cerebrum as compared with the weight of their bodies. The canary has comparatively more than twice as much brain as man. Yet the little thing is chiefly noted for song. The blue jay, a member of the crow family, is about as wise as any bird that lives; and, like the parrot, can mimic many voices. Some birds, to call attention from their nests, will feign lameness and inability to fly, as if wounded. The woodcock, having its first nest, will feign as well as a bird that has practised the stratagem a half dozen different years, therefore the execution is purely instinctive and inherited. Several kinds of small birds will combine an attack upon a discovered owl. Each assailant feels that a common enemy is to be punished and driven out. And what is more, the small birds assault timidly while the owl is in the dark retreat of a thicket, yet boldly when the night prowler is driven into the light of day where its sight is blinded.

The spinal cord in vertebrates is the basis of the nervous system, although there is a visceral combination of nerves and ganglia which is highly important to the carrying on of the digestive and secretory functions. This splanchnic system is not wholly independent of the crebro-spinal combination, yet it is wholly beyond volition. The intestines vermiculate, and the glands secrete, though the brain be thoroughly anæsthetized.

The lowest vertebrate, the lancelet, or amphioxus, has simply a spinal cord; no brain is developed on its cephalic extremity. The frog has appreciable cerebral hemispheres, yet a small amount of vesicular neurine in them. They seem to represent the beginning of that bulging on the anterior extremity of the spinal cord, which is thrown into convolutions in the higher vertebrates.

The ridged or convoluted state of the surface of the cerebral hemispheres is not seen in rats, squirrels, and the lower mammalia. The cerebrum is composed largely of "grey" neurine; and its functions are

presumed to be for the evolution of intelligence, or for carrying on mental efforts. The hypothesis has been ventured that men with deep sulci (cerebral furrows), and thick masses of "grey" material in the convolutions, are mentally the most competent.

Gall and Spurzheim mapped the surface of the brain, and ascribed certain functions to each segment of the exterior convolutions. Under the name of phrenology these enterprising scientists engaged the attention of the civilized world fifty years ago; but now their alleged "system" has fallen into neglect and disrepute. Flourens was the first to successfully assail the doctrine of the phrenologists. He showed by experiments on the lower animals that the functions of the cerebellum had not been rightly conjectured; that this great ganglion of gray and white neurine was not devoted to physical love—amativeness—but to muscular co-ordination. By excising a lateral half of the cerebellum, the animal—pigeon or guinea-pig—could no longer stand upright, but in a struggle whirled around and around. The removal of the entire cerebellar mass leaves the sufferer to fall in a sprawling attitude and to continue helpless.

Flourens called attention to the fact that only about one third of the cerebral convolutions are presented to parts of the cranium that can be manipulated; that all the double space between the hemispheres is covered with convolutions, as well as all that great expanse resting on the floor of the skull and the tentorium. He demonstrated, through vivisections, that certain parts of the cerebrum are "motor" in function, and certain other parts are "sensory," and none conformed to the fanciful notions of organologists.

The symptoms observed in different parts of the body, after lesion of certain convolutions, have done much toward a rational localization of the different regions of the cerebrum.

The famous "crow-bar case," in which a tamping-iron was blown through the frontal lobes of the cerebrum, shows that the anterior convolutions are neither motor nor sensory. The victim of the premature explosion rode home after receiving the injury, and gave an intelligible account of the accident. However, after recovery, except the loss of sight in one eye, Mr. Gage was uncommonly irritable, and was regarded as of unsound mind.

Abscess of either of the three tiers of frontal convolutions, results in coma, or disturbed intellect. If a part of the cerebrum, in the fissure of Sylvius, near the isle of Reil, be injured, the patient suffers from aphasia; and parts adjacent to the fissure of Rolando seem to be devoted to motility of the arm, leg and corner of the mouth. A spot on

the ascending frontal convolution, a locality corresponding to the seventh center of Ferrier, when injured, causes twitching of the zygomatic muscles on the opposite side. A point injured on the right ascending parietal convolution, produces twitching and paralysis of the muscles of a part of the left leg. Charcot, Hitzig and Cruveilhier have given testimony which substantiates the observations of Ferrier. Although this field of inquiry has not been cultivated but a few years, enough has already been discovered to show that earlier views of the functions of the encephalon were decidedly erroneous.

It is now generally believed that conscious intelligence does not have its seat in any particular part of the brain structure, but that it needs at least one half the cerebrum—a hemisphere—for an abode. It is known that one side of the cerebrum may be atrophied or destroyed, and intellection will be kept up by the sound half.

By comparing the general arrangement of the convolutions in different animals, it is found that the brain of the cat, for instance, presents few sinuosities or foldings, and these run in parallel ridges, the course being antero-posteriorly. The brains of the fox and the wolf show a similar arrangement of gyri, except they are a little more flexuous. The brain of a sheep has more cerebral gyrations than that of the beaver, yet the latter animal is far more circumspect in its general habits of living. The sheep is proverbially aimless and stupid. The complexities in the arrangement of the brain of the dolphin equal the disposal of the convolutions in man, yet the former can not be esteemed as especially intellectual. It is certain, however, that the convolutions of the cerebral hemispheres of idiots are disposed in horizontal or perpendicular tiers, and are not so "oblique" in direction, and flexuous as they are in the strong minded of our race.

The development of the cerebrum backward is a notable feature of the human encephalon. In man the cerebellum is completely overshot, while in the higher apes the posterior lobes of the cerebrum barely cover the "lesser brain." In the encephalon of the horse, the cerebellum is almost uncovered; and in felines the cerebrum, resting upon an osseous tentorium, does not extend as far backward as the cerebellum. And, as the scale of being is followed downward, the disproportion between the "little" and the "great" brain lessens, till, at length, they are nearly the same size, and are arranged on about the same level.

From the lowest to the highest of vertebrates there exists a serial gradation in the scale of intelligence. There is a vast difference between the mental qualities of man and those of a troglodyte; and so

there is between the intellectuality of a savage and that of a man possessing brilliant talents. However, it is at once conceded that the infant chimpanzee can only be trained into a bright ape, while the child of a Digger Indian can be educated to the average capacities of mankind. In the human brain there are qualities and possibilities not vouchsafed to the cerebral "centers" of inferior animals. Man's excellencies are most pronounced in his intellectual endowments.

Naturalists have arranged animals into groups for the convenience arising from classification, hence we have orders, families, genera and species; but from beginning to end—from the lowest to the highest—an unbroken kinship runs, the tendency in the ascent being to display *varieties.* The gnu, for example, combines bovine and equine features, yet so many characteristics of another kind of animals, that it is classed as an antelope.

If the most varied peculiarities of any group of animals be sought, individuals will be found that closely resemble the rarer form presented by strange representations in allied groups. There is not a marked difference between the lowest eagle and the highest vulture; between certain varieties of hawks and owls; between some elks and some oxen; between the hunting cheetah and felines on the one side, and canines on the other. There is not a wonderful difference between badgers and bears, seals and whales, some fish and some reptiles, and in a fossil state we find the remains of birds that had teeth and many reptilian features. The cerebral hemispheres of ancient saurian birds were not larger than those of turtles. The babyroussa or pig-deer of Sumatra, has such mixed features that it is difficult to give the creature its proper place in any well defined order. The descent from the elephant to the tapir should cover an intervening species that resembles both, yet differs from either, and such does exist in a fossil state. The horse then comes along with its prolonged upper lip and oddity as to toe; and then swine with their enormous snouts and even toes, though a "mule-footed" pig is occasionally seen, as well as a rare specimen with five digits.

If it were possible to restore transitional forms that have dropped out of line, there would be little difficulty in following the chain of ascent, link by link.

The infinite variety in form and function to be considered while estimating the changes which have taken place in the history of organic life, must be ascribed to the progressive tendencies of neural matter. In a given habitat, a humble creature needs spines or scutes to protect itself from enemies; and the nervous system, through its influence on

circulation and secretion, brings about the needed modification. In another habitat, where such weapons of defense are not wanted, they are not developed. If an additional phalanx be serviceable in the digit of a loon to give expanse to an inter-digital web, the extra bone is forthcoming. The transformation does not occur in the growth of the individual, but is begun in embryonic states where tendency to modify is greatest. Probably several generations are passed in making an appreciable modification. The two-toed sloth did not lose three digits in less than a hundred generations, though a *saltus* or leap is possible at any time. It can not be rationally conjectured how many generations it would require to establish two large toes in the African ostrich. Possibly it was a *lusus naturæ* at first, and the stronger state became permanent and prevailing, old forms being less desirable in sandy countries, at length died out. However, it is likely that the nerves distributed to a chick of four toes, failed gradually in the energy of two inner toes, and correspondingly gained in the two outer digits. In the hind foot of a kangaroo, the dwarfing process in inner toes is at present visible or appreciable. If kangaroos could be kept on the sands of Sahara for ten generations, it might be expected that the diminutive and insignificant digits on the inside of the hind feet would entirely disappear. It is easy to see that the flippers of penguins have either degenerated from wings, or have been evolved from fins. The modified form was inspired by function; and the latter leaned towards the physical transformation which would be beneficial to the race.

The outer gilled axolotl or siredon of New Mexico, under some circumstances becomes transformed into an inner gilled amblystoma. Plenty of food and increased light and heat favor the marked modification. Nervous energies must have much to do with the changes occurring in the larval, crysalis, and butterfly states of an insect. The worm has as many ganglia as it has pairs of legs, to say nothing of the group that presides over mastication and deglutition. In the winged and mature states, the ganglia are lessened in number, and greatly modified in function. It is not reasonable or logical to say that neural ganglia either make or modify themselves, but they embrace a vital attribute, which under the influence of a peculiar environment, leads to transformation. A nerve alone can not make or unmake a digit or phalanx; yet a preponderating influence brought to bear upon some of its filaments, cells, or tubules, could secure a change.

While nature seems to adhere to well known forms, "she" quite frequently manifests a disposition to take departures. This tendency

to variegate has given the world hideous, grotesque, and beautiful shapes and colors.

All degrees of intelligence, through a tendency to multiply energies, have been evolved. The humble worm has little "sense;" the bird has more; and man's psychic powers are marvelous. As we behold the developing of the child's brain, so we may see feeble instincts evolving into higher intelligencies. In the grand differentiation we encounter strangely specialized functions and forms; often a great gain in one direction being accompanied with a compensating loss. The ateles did not obtain a prehensile tail without losing its thumbs. The graceful swimmer among birds is a clumsy pedestrian. The beak and talons of a bird of prey would compel it to starve if no game were to be found. The falcon's entire organization is carnivorous in mould and inclination. Its stomach can not digest starchy food, if such were forced into its maw. A nervous system, then, must be harmonious in its entirety. The eyes, teeth and claws of a cat correspond with the desires and needs of its stomach.

In the study of lesions of the brain, disorders of the intellect, paralysis, exalted sensibilities and faulty functions, the blood-vessels distributed in certain areas of the encephalon, are to be observed and their integrity considered. Embolism of the middle cerebral artery, which supplies a motor tract, is invariably followed by paralysis of muscular action in those parts of the body in nervous connection or sympathy with the region of brain suffering through lack of blood supplies. Plugging (embolism) of the anterior cerebral arteries is attended with dementia—a circumstance confirming the prevailing notion that the frontal lobes are largely devoted to intellection. However, embolism of the posterior cerebral arteries, followed by "softening," has developed delirium, convulsions and dementia. Then, again, it is to be remembered that the sympathies of the brain are kept in some degree of harmony by the common envelopes—the meninges. There can not be sclerosis of the temporal lobes without disturbances of adjacent, if not remote, areas.

The brain has more blood sent to it than to other parts of the body, which indicates that cerebration is maintained through active circulation. Two sets of arteries, the vertebral and carotid, carry large currents inside the cranium; and in the brain there are free communications between branches of these vessels. This ensures blood supplies to regions that might otherwise suffer through the interposition of a thrombus.

ZOOLOGICAL MISCELLANY.*

A SYNOPSIS OF THE CINCINNATI FAUNA.

For the convenience of naturalists who are not specialists, we present below, in tabular form, a synopsis of our present knowledge of the fauna of the vicinity of Cincinnati, revised to date, so far as practicable.

As will be readily seen by a glance at the tables here presented, there are whole classes of animals, both vertebrate and invertebrate, that have hardly been touched upon by our local zoologists There is no lack, therefore, of untrodden fields for those who desire to add to the existing knowledge of our local fauna, while much of the ground heretofore cultivated will well repay working over anew.

As here considered, the "vicinity of Cincinnati" may be roughly limited to the territory comprised within a radius of twenty-five or thirty miles of this city, thus including the extreme southwestern corner of Ohio, and adjoining portions of Indiana and Kentucky. The favorable location, diversified landscape and abundant water supply of this region—traversed as it is by the Ohio, the Great and Little Miamis, the Licking and Whitewater rivers—are well adapted to the production and maintenance of a varied and abundant flora and fauna; and there is probably no one locality in the Mississippi Valley that would better repay the researches of the practical zoologist.

The various synoptical tables have been revised to date, so far as practicable, by persons familiar with the various subjects of which they treat; the *Insecta* for example, by Mr. Charles Dury; the *Mollusca*, by Dr. R. M. Byrnes, the *Arachnida*, by Mrs. Dr. Thomas Wood; the microscopic *Articulata*, *Cœlenterata* and *Protozoa*, by Dr. J. H. Hunt.

Subkingdom VERTEBRATA.

Class MAMMALIA: *Mammals.*

	Native.			Introduced.	Totals.
	Extinct.	Extirpated.	Existing.		
Species identified.........	2	9	30	3	44
Genera "	2	6	21	1	30
Families "	1	4	11	....	16
Orders "	1	1	5	....	7
Species of probable occurrence not yet identified	4	2	10	....	16
Genera in same category..	4	3	7	....	14
Families " " ..	3	1	1	....	5
Orders " " ..	....	....	....	....	......

*Edited by Dr. F. W. LANGDON.

Class AVES : *Birds.*

	Native.			Introduced.	Totals.
	Extinct.	Extirpated.	Existing.		
Species identified........	....	7	255	2*	264
Genera "	... .	6	166	2	174
Families "	....	2	44	... .	46
Orders "	....	1	12	....	13
The 264 identified species may also be divided in accordance with their times of occurrence, into—					
Constant residents........	....	5	26	1	32
Summer residents........	....	2	62	1	65
Winter visitants	....	....	12	....	12
Regular migrants..... ...	....	....	127	....	127
Irregular migrants and casual visitants.........	....	....	28	....	28
Known to breed†	....	....	89	2	91
Inferred to breed.........	....	6	7	....	13
Species not yet identified, whose range includes this locality, and whose occurrence, therefore, is probable or possible....	....	....	21	2‡	23
Genera in above category	....	....	10	....	10
Families " "	....	....	1	....	1
Orders " "	....	....	....	....	......
These may be also divided into—					
Constant residents.......	....	....	1	....	1
Summer residents	... .	....	1	....	1
Winter visitants....	....	....	3	....	3
Regular migrants.........	....	....	13	....	13
Irregular migrants and casual visitants........	....	.. ..	5	....	5

Class REPTILIA : *Reptiles.*

This class awaits a local biographer.

The following table is merely one of probabilities, compiled from the known range of the species as given in various standard works :

* The two introduced species here included as forming part of our fauna are, the European House Sparrow and Sky Lark. The fate of the other nineteen species introduced by the late Acclimation Society of Cincinnati can not be ascertained at present. See this JOURNAL, Vol. IV., pp. 342 and 343.

† Amongst those known to have bred here, are seven species classed as migrants.

‡ The two foreign species here included, are the European Tree Sparrow, *Passer montanus*, and the Ruff, *Philomachus pugnax*.

Species of probable occurrence	26
Genera " "	22
Families " "	7
Orders " "	3

Class AMPHIBIA : *Amphibians.*

The Amphibians, like the Reptiles, have been sadly neglected by our local zoologists, no systematic work having been done here in either class. The following table comprises those whose known range includes this locality :

Species of probable occurrence	20
Genera " "	10
Families " "	9
Orders " "	3

Class PISCES : *Fishes.*

It is to be regretted that no systematic work has ever been done on the fishes of this locality. We can give a synopsis of probabilities only.

	Native.	Introduced.	Total.
Species of probable occurrence	102	2	104
Genera " "	68	2	70
Families " "	23	....	23
Orders " "	5	....	5

Subkingdom ARTICULATA : *Articulates.*

Class INSECTA : *Insects.*

Order HYMENOPTERA : *Bees, Wasps, Ants, etc.*

No work has been done locally, in this order, so far as known.

*Order LEPIDOPTERA: *Butterflies and Moths.*

	Native.	Introduced.	Total.
Species identified	475	3	478
Genera "	226	....	226
Families "	13	....	13

Order DIPTERA : *Flies, Mosquitoes, etc.*

Not worked up.

*Order COLEOPTERA : *Beetles.*

	Native.	Introduced.	Total.
Species identified	1586	....	1586
Genera "	712	....	712
Families "	71	....	71

* For our synopsis of the Orders *Lepidoptera* and *Coleoptera*, we are under obligations to Mr. Charles Dury.

Order Hemiptera: *Bugs proper.*

Not worked up.

Order Orthoptera: *Grasshoppers, Crickets, etc.*

Not worked up.

Order Neuroptera: *Dragon-flies, etc.*

Not worked up.

Class Myriapoda: *Centipedes, etc.*

	Native.
Species identified	4
Genera "	3
Families "	3
Orders "	2

*Class Arachnida: *Spiders, Mites, etc.*

	Native.		Introduced.	
	Microscopic.	Macroscopic.	Macroscopic.	Total.
Species identified	1	144	1	146
Genera "	1	18	....	19
Families "	1	2	....	3
Orders "	1	2	....	3

The native macroscopic species of spiders are distributed, according to Mrs. Dr. Wood, as follows:

Family Araneides.

Genera.	Species.	Genera.	Species.
Dysdera	1	Epeira	30
Herpyllus	1	Thomisus	19
Clubiona	7	Dolmedes	4
Tegenaria	3	Lycosa	9
Agelena	2	Attus	31
Theridion	25	Phillyra	1
Pholcus	1	Mygale	2
Linyphia	1	Synemosyna	2
Tetragnatha	2	Micrommata	1

* We are greatly indebted to Mrs. Dr. Thomas Wood, who has kindly prepared the accompanying synopsis of this class. Dr. J. H. Hunt has added the microscopic portion of the table.

* Class Crustacea : *Crayfish, Lobsters, Crabs, etc.*

	Microscopic.	Macroscopic.	Total.
Species identified	9	2	11
Genera "	5	2	7
Families "	8	1	9

* Class Annelida : *Worms.*

	Microscopic.	Macroscopic.	Total.
Species identified	11	7	18
Genera "	5	6	11
Families "	5	4	9

†Subkingdom MOLLUSCA : *Slugs, Snails, Oysters, Cephalopods, etc.*

Class Cephalopoda : *Squids, Cuttlefish, etc.*

Fossil forms only represented here.

Class Gasteropoda : *Snails, Slugs, etc.*

	Native.	Introduced.	Total.
Species identified	103	1	104
Genera "	25	..	25
Families " 6	9	..	9
Orders "	1	..	1

Also represented by fossil forms.

Class Lamellibranchiata : *Oysters, Clams, etc.*

	Native.	Introduced.	Total.
Species identified	93	..	93
Genera "	3	..	3
Families "	1	..	1
Orders "	1	..	1

Also represented by fossil forms.

Class Brachiopoda : *Arm-footed Mollusks.*

Marine exclusively; fossil forms only represented here.

Class Tunicata : *Pouch-like Mollusks.*

Exclusively marine.

Class Polyzoa : *Moss-like Mollusks.*

Fresh water forms are represented here, but not identified. The class is largely marine.

* These classes include many microscopic forms; for the identification of those found in this vicinity we are indebted to Dr. J. H. Hunt.

† For our synopsis of the *Mollusca* here given, we are indebted to Dr. R. M. Byrnes.

Subkingdom ECHINODERMATA : *Star-fishes, Sea-urchins, etc.*

Class HOLOTHUROIDEA : *Sea-cucumbers.*

Class ECHINOIDEA : *Sea-urchins.*

Class ASTEROIDEA : *Star-fishes.*

Class CRINOIDEA : *Crinoids.*

The members of this subkingdom are exclusively marine. Fossil representatives of the last three classes are to be found in our rocks.

Subkingdom CŒLENTERATA : *Corals, Jelly-fishes, etc.*

Class CTENOPHORA : *Soft-bodied Polyps.*

Not represented.

Class ANTHOZOA : *Corals.*

Marine. Fossil forms only are represented here.

Class HYDROZOA : *Hydras, Jelly-fishes, etc.*

	Microscopic.
Species identified*	2
Genera "	1
Families "	1
Orders "	1

†Subkingdom PROTOZOA : *Primitive Animals.*

Class SPONGIDA : *Sponges.*

	Microscopic.
Species identified	1
Genera "	1
Families "	1
Orders "	1

Class INFUSORIA : *Ciliated Protozoans.*

	Microscopic.
Species identified	10
Genera "	7
Families "	8

Class RHIZOPODA : *Root-footed Protozoans.*

	Microscopic.
Species identified	4
Genera "	2
Families "	3
Order "	1

*By Dr. J. H. Hunt.

†We are indebted to Dr. J. H. Hunt for our synopsis of this subkingdom, the representatives of which are chiefly microscopic.

Class GREGARINIDA : *Gregarious Protozoans.*

The members of this class are parasitic worms, living in the alimentary canal of the cockroach, earthworm, etc. They have not been especially studied in this locality.

Class MONERA : *Structureless Protozoans.*

Not represented here so far as known.

GENERAL SUMMARY.

	Vertebrates.	Inverte.	Total.
Species	497	2457	2954
Genera	330	1017	1347
Families	107	131	238
Orders	31	20	51

GENERAL NOTES.

ORNITHOLOGY.

MYIODIOCTES MITRATUS, Aud.—*Hooded Warbler.*—Observed June 25, 1882, at Glendale, Ohio, in a small brush patch in open woods, and evidently breeding.

PANDION HALIAETUS CAROLINENSIS, Ridgway.—*American Osprey* or *Fishhawk.*—Observed as late as June 1, near Jones Station, Butler county, Ohio.

TOTANUS FLAVIPES, Vieillot.—*Lesser Yellow-legs.*

BARTRAMIA LONGICAUDA, Bp.—*Bartram's Sandpiper.*

RHYACOPHILUS SOLITARIUS, Cassin. — *Solitary Sandpiper.* — These sandpipers, usually considered migrants only here, were observed by me June 29 and 30, 1882, in Butler county, Ohio.—J. B. PORTER, Glendale, Hamilton county, Ohio.

HYLOTOMUS PILEATUS, Baird.—*Pileated Woodpecker; Logcock.*—A male of this species was shot, April 23, 1882, in Brown county, Ohio, about 50 miles from Cincinnati. A pair were observed making a nest at the same locality.

QUERQUEDULA DISCORS, Stephens.—*Blue-winged Teal.*—Bred in 1881, at Jones Station, Ohio; two females observed with young. Breeding this year (1882), at Port Union, Ohio, about a mile from Jones Station (Jones Station is 19 miles from Cincinnati on the C., H. & D. R. R.)

CHAULELASMUS STREPERUS, Gray.—*Gadwall Duck.*—A male of the Gadwall taken at ice pond, near Jones Station, Ohio, April 11, 1882.

FULIX AFFINIS, Baird.—*Little Blackhead.*—A pair of this species

were nesting at the ice pond near Port Union, Ohio, in June, 1882. —WALTER DOUGLAS, Mt. Auburn, Cincinnati, Ohio.

ORNITHOLOGICAL NOTES FROM BROOKVILLE, INDIANA.

I find the following in my note-book, under date of October 18, 1880. To-day I saw about twenty-five swallows; three or four were Barn Swallows (*H. horreorum*), the remainder either Bank Swallows (*C. riporia*), or more likely the Rough-winged Swallow (*S. serripennis*).

Fall had fairly begun, there had been severe frost, and winter birds had begun to arrive. On the same day I had shot a pair of Mallards (*A. boschas*), and several Butter Ducks (*B. albeola*).—E. R. QUICK, Brookville, Franklin county, Ind.

MIMUS POLYGLOTTUS, Boie.—*Mocking Bird.*—A rare summer resident. June 29, 1880, I observed two young birds scarcely able to fly, in my orchard; one of them I procured. This is my only record of their visits, though I have heard of a few other cases.

CISTOTHORUS STELLARIS, Cabanis.—*Short-billed Marsh Wren.*—I have never met with it except in one locality where a small stream passes through an open field, forming at times a sort of bog; this is about three miles from here. In September, 1879, I shot three specimens, and September 22 and 23, 1881, I saw five, and procured three from this locality.

ANTHUS LUDOVICIANUS, Licht.—*Tit-lark.*—Common as late as April 21, 1882.

SITTA CANADENSIS, Linn.—*Red-bellied Nuthatch.*—I have never seen this bird but once, and that at quite an unusual time. The first week in May, 1879, they were quite common in a tract of sugar woods.

HELMINTHOPHAGA CHRYSOPTERA, Baird.—*Golden-winged Warbler.*—The first specimen from this county was taken April 29, 1879. A half dozen or more have been taken since, mostly in the spring of 1881. They frequent oak and and sugar tree groves, near the tops of our highest hills.

PERISSOGLOSSA TIGRINA, Baird.—*Cape May Warbler.*—A rather rare migrant with us, frequenting the lower branches of oaks and sugar trees near the hill tops. I took three specimens in May, 1881.

DENDROECA DOMINICA ALBILORA, Ridg.—*White-browed, Yellow-throated Warbler.*—A common summer resident along streams, frequenting in spring the sycamore and cottonwood groves; they breed

rather commonly, and then distribute themselves over the lower lands, frequenting orchards in the autumn previous to their departure for the South. They generally arrive the early part of April, and are gone by October 1st.

Dendrœca pinus, Baird.—*Pine Creeping Warbler.*—A migrant, but not common. I took my first specimen in April, 1879. On April 15 and 22, 1882, I saw large flocks, and procured several; they frequented sugar groves on the hills, and apppeared to move in flocks.

Siurus motacilla, Coues.—*Large-billed Water Thrush.*—April 21, 1882, I shot a female which contained eggs almost ready to be layed. The season was quite backward, and the only warblers which had arrived were Yellow-rumps and Black-and-white Creepers.

Oporornis agilis, Baird.—*Connecticut Warbler.*—Generally a rare migrant. They are the latest of all the warblers to arrive, and frequent localities similar to those sought by the Maryland Yellow Throat. Rather common May 24 to 30, 1882. I killed four, and saw three others within this time.

Geothlypis philadelphia, Baird.—*Mourning Warbler.*—One specimen taken May 7, 1881.

Myiodioctes pusillus, Bp.—*Black-capped Yellow Warbler.*—A single immature specimen in the collection of the Brookville Society of Natural History, is the extent of its record in Franklin county.

A. W. Butler, Brookville, Ind.

LIST OF MICROSCOPIC *ARTICULATA, CŒLENTERATA* AND *PROTOZOA*, Observed in an Office Aquarium.

The general impression among our city microscopists has been that only those who may have access to the ponds and ditches of the country can ever have the opportunity of seeing anything of "pond life." This is a very great mistake. Any one who will take the trouble to fit up an aquarium in their home or office may be able to see during the year every form of pond life incident to their locality. My aquaria are made by taking the battery jars used in telegraph offices, filled with water from the hydrant, and stocked with the contents of an ounce vial that Prof. Stanton, of the Miami Medical College, brought to my office from the pond at the city work-house. From this small beginning life has continued daily to increase, both animal and vegetable. After about the tenth day I placed four drops of the water, by means of pipette, in my compressorium, and the result was the identification of twenty-three species of microscopical organisms. I give in connection with this a list of objects identified by me in this vicinity, which, however, does not include any of the vegetable forms, of which there are as many, if not more species.

Subkingdom ARTICULATA.

Class Arachnida.

Diplodontus mendax, Duge's.

Class Crustacea.

Branchipus stagnalis, Schæffer.
Bosminus longirostris, Baird.
Camptocercus macouris, Baird.
Chydorus sphericus, Leach.
Cyclops quadricornis, Müller.
Cypris fusca, Müller.
Cypris vidua, Müller.
Daphne pulex, Müller.
Diaptomus castor, Westw.

Class Annelida.

Brachionus bakeri, Hill.
Brachionus pala, Hill.
Brachionus urceolaris, Hill.
Chætonotus larus, Ehr.
Dinocharis pocillum, Ehr.
Hydatina senta, Ehr.
Monacerca ratlus, Ehr.
Pleurotrocha gibba, Ehr.
Rotifer vulgaris, Cuv.

Subkingdom CŒLENTERATA.

Class Hydrozoa.

Hydra fusca, Linn.
Hydra viridis, Linn.

Subkingdom PROTOZOA.

Class Spongida.

Spongilla fluviatilis, Lam.

Class Infusoria.

Astasia hematodes, Ehr.
Coccudina costata, Duf.
Englena longicanda, Ehr.
Englena viridis, Ehr.
Kerona polyporum, Müller.
Monas lens, Müller.
Paramecinum hyalinum, Hill.
Stintor muleri, Oken.
Trachleocerca olor, Ehr.
Trachleocerca viridis, Ehr.
Vorticella microstoma, Linn.
Vorticella nebulifera, Linn.

Class Rhizopoda.

Actinophrys sol, Ehr.
Amœba ———, Ehr.
Arcella vulgaris, Ehr.
Difflugia proteiformis, Leclerc.

J. H. Hunt, M.D., Cincinnati, Ohio.

THE JOURNAL

OF THE

CINCINNATI SOCIETY OF NATURAL HISTORY.

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PROCEEDINGS OF THE SOCIETY.

TUESDAY EVENING, *October* 3, 1882.

Dr. R. M. Byrnes, President, in the chair. Present, 20 members.

Prof. A. G. Wetherby gave an account of the botany and geology of Roan Mountain, North Carolina.

Joseph F. James read a paper upon parasitic plants.

Dr. F. W. Langdon, previous to exhibiting specimens of the *Bacillus anthracis* under the microscope, made a few remarks on the Bacteria in general, which, he stated, were usually classed as fungi, and divided by botanists into four main groups, namely: (1) Sphærobacteria or spherical bacteria (*e.g.* Micrococcus); (2) Micro-bacteria, or short rod-like bacteria (*e.g.* Bacterium); (3) Desmo-bacteria, or long rod-like bacteria (*e.g.* Bacillus); (4) Spiro-bacteria, or spiral bacteria (*e.g.* Spirillum). He stated that, in accordance with their supposed role, in the production of various infective diseases and fermentations, they might be divided, for practical purposes, into two groups, namely: (1) pathogenic, or disease-producing bacteria; and (2) beneficial bacteria; the bacteria of fermentation and putrefaction, being placed in the second group. Apropos of the benefits derived from the bacteria of putrefaction, he cited a well known French author (Magnin), who calls attention to the fact that organic matter, once dead, must necessarily undergo certain chemical changes before it can again enter into the stream of life; and it is the various bacterial organisms which are chiefly or entirely instrumental in bringing about these changes. Consequently, were the bacteria to all become annihilated, the surface of the earth would be encumbered everywhere with the bodies of dead animals and plants which had failed to decay; finally, all organic matter would be thus locked up, so to speak, and useless to succeeding generations; or, to use the words of the above named author, "it may be said that it is, thanks to them (the bacteria), that the continuation of life is possible on the surface of the globe."

Microscopical sections of lung tissue containing the *Bacillus anthracis*, the "germ" of Anthrax or Splenic fever, were then exhibited

to the members present. Under a power of 1000 diameters, the bacilli presented the appearance of numerous fragments of blue thread, about one fourth of an inch in length, thickly distributed throughout the walls of the air cells of the lung ; the blue color was due to the staining process used to make them more evident to the eye.

Donations were announced as follows : A. G. Wetherby, 19 species of plants from Roan Mountain, N. C., and four specimens of *Helicodiscus fimbriatus ;* Prof. John Collett, of Indianapolis, the 11th Annual Report of the Geological Survey of Indiana ; J. E. Bruce, two specimens of *Belostoma grandis ;* Smithsonian Institution, several pamphlets ; Signal Service Bureau, Weather Review ; U. P. James, a pamphlet ; Chas. S. Dolley, a pamphlet ; J. A. Warder, two pamphlets and a specimen of *Orgyia leucostigma* ; John Schimmell, specimen of steatite ; H. F. Myers, two arrow heads ; and D. L. James, the skull of a cow.

TUESDAY EVENING, *November* 7, 1882.

Dr. R. M. Byrnes, President, in the chair. Present, 20 members.

E. M. Cooper read a paper on sponges.

Joseph F. James read a paper on pitcher plants.

Mr. H. P. Ufford was elected a member of the Society.

Donations were announced as follows: From Department of the Interior, one pamphlet ; Boston Zoological Society, one pamphlet; F. W. Putnam, one pamphlet ; Signal service Bureau, Monthly Weather Review ; James L. Foley, six volumes Scottish Cryptogamic Flora; Mrs. Kendrick, lot of fossils and minerals ; E. F. Bliss, minerals from Colorado ; Jacob Hoffner, Agave americana ; Irvin B. Wright, three volumes Ohio Geology, vol. iii. ; E. M. Cooper, two sponges ; S. T. Carley, specimen Guinea corn ; Dr. H. H. Hill, seeds and one Unio; E. Schoenauer, specimen plumbago ; A. M. Robinson, coal fossil.

TUESDAY EVENING, *December* 5, 1882.

Dr. R. M. Byrnes, President, in the chair. Present, 15 members.

Miss Janet Knox was elected a member of the Society, and Ormond Stone was elected a corresponding member.

Jos. F. James read a paper upon archæological relics, and J. R. Skinner delivered an address upon a unit of measure found in a stone relic.

Donations were announced as follows: From Dr. R. M. Byrnes, specimens of Pasceolus globosus, and apatite from Canada ; O. M. Meyncke, 15 specimens of wood sections, and a like number of varieties of acorns and nuts ; J. B. Porter, five Indian skulls and a number of bones ; from the Smithsonian Institution two pamphlets, and from the Signal Service Bureau, one ; from R. J. Fennessey, copper ore; from Chas. Dury, 43 species of Coleoptera, and two fish from Chesapeake Bay ; from Dr. J. B. Welch, skin of Lewis woodpecker, from Yellowstone ; from J. W. Hall, Jr., Lindley's introduction to botany ; from Wm. A. Cook, larvæ of a moth ; and from Davis L. James, a specimen of Polyporus, and fragments of the castor oil plant.

DESCRIPTIONS OF NEW SPECIES OF FUNGI, COLLECTED IN THE VICINITY OF CINCINNATI.

By THOMAS G. LEA, and Described by REV. M. J. BERKELEY.

[Republished from "A Catalogue of the Plants of Cincinnati, by Thos. G. Lea."*]

AGARICUS (CLITOCYBE) OCHRO-PURPUREUS, n. sp.—On clayey soil, in woodlands. Cincinnati, Aug. 29, 1843; Waynesville, Aug. 31, 1844.

Pileo subhemispherico, demum depresso, carnoso, compacto, lento, pallidé alutaceo, leviter purpurascenti ; cute facilé secernibili ; margine inflexo primum tomentoso; mycelio albo ; stipite pallidiore, hic illic purpurascente, medio tumido ; lamellis crassis, non connexis, purpureis, posticé latioribus, decurrentibus.—*Berk. in Hook. Lond. Journ. Bot.*, vol. iv., p. 299.

Pileus two inches across; stem two inches and a half high, three quarters of an inch thick in the center, solid, above deflexo-squamose, occasionally equal. This species resembles in most points *A. tyrianthinus ;* but the gills are thick and distinct, resembling those of *A. laccatus*, and the mycelium (at least in the dry plant) is white. The spores when dry, are of a palish yellow, but Mr. Lea in his notes describes them from the plant when gathered as white.

AGARICUS (COLLYBIA) LACHNOPHYLLUS, n. sp.—On pieces of rotten wood amongst dead leaves in woods, Waynesville, Sept. 5, 1844.

Pileo carnosulo, conico-hemispherico, fulvo-spadiceo, velutino; stipite cavo, deorsum fusco-purpureo, nitido, sursum pallido subvelutino; lamellis liberis, fulvo-velutinis.

More or less tufted. Pileus three quarters of an inch across, subcarnose, conico-hemispherical, of a rich tawny brown, clothed with short, velvety pubescence, much wrinkled when dry. Stem two inches high, one line or more thick, tough, hollow, brownish-purple below, shaded off into white above, and clothed with scattered short pubes-

* The "Catalogue of Plants," collected in the vicinity of Cincinnati, Ohio, during the years 1834–44, by Thomas G. Lea (Cincinnati, 1849), contains a list of Fungi, with notes and descriptions of the new species by the eminent English mycologist, Rev. M. J. Berkeley, to whom Mr. Lea submitted his collections. These notes and descriptions are of great local value, and as the pamphlet is quite inaccessible to the student, by reason of its great rarity, the publishing committee of the society has kindly consented to reproduce them. The bare list was reprinted in Joseph F. James' Catalogue of the Flowering Plants, Ferns and Fungi of Cincinnati (*Jour. Cin. Soc. Nat. Hist.*, No. 2, vol. 1). Students will be glad to know that Prof. A. P. Morgan, lately of Dayton, but now of our city, has in hand a synopsis of the Hymenomycetes of the Miami Valley, which he hopes to have ready during the coming year.—[DAVIS L. JAMES.

cence; downy and rather bulbous where it roots into the wood. Gills narrow, close, quite free, velvety, with tawny pubescence. An exquisite species, allied apparently to *A. longipes.* The gills, as in that species, are densely velvety.

Agaricus cirrhatus, Fr.—On the ground near a dead stump. Waynesville, Sept. 10, 1844.*

Agaricus (Mycena) Leaianus, n. sp.—On dead trunks. Cincinnati, May; Waynesville, August, 1844.

Pileo convexo, umbilicato, tenui, margine striato minutissime miniato-virgato, stipiteque longo, deorsum tomentoso strigosoque, aurantiis, viscosis; lamellis distantibus, ventricosis, postice sinuatis, adnexis, aurantiis, coccineo-marginatis.—*Berk. in Hook. Lond. Journ.*, v. iv., p. 300.

Pileus rather more than half an inch across, convex umbilicate, orange, clothed with a viscid cuticle, smooth, wrinkled when dry; margin striate and streaked with vermilion flocci; stem two and a half inches high, scarce one line thick, orange, smooth and viscid above, with a few indistinct darker specks, below clothed with matted tawny down and stigose flocci, stringy, attached to dead leaves, etc., by a creeping, strigose orange mycelium. Gills distinct, broad, ventricose, remarkably sinuated behind, adnexed, orange, with a vermilion margin. —Allied to *A. pelianthinus.* The pileus when dry has somewhat the appearance of *A. palmatus* in consequence of its viscid cuticle. It must be highly beautiful when fresh.

Agaricus umbelliferus, L.—On pieces of sticks amongst dead leaves, in woods. Waynesville, Sept. 3, 1844.†

Agaricus niger, Schwein.—On beech bark. Cincinnati, March 3, 1842; Waynesville, Aug. 23, 1844.‡

Agaricus (Flammula) polychrous, n. sp.—On rotten trunks of trees, sticks, etc. Waynesville, Sept. 3, 1844.

Pileo plano, late umbonato, multicolori, primum purpureo, viscido,

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* The tubers, Mr. Lea observes, resemble the grains at the base of *Dielytra cucullata.*

† As the locality is curious, I subjoin Mr. Lea's notes. "Pileus brown, subhemispherical, pruinose; margin sulcate; stem buff, very smooth, tapering to the base, much enlarged and spreading into the pileus, so as to be clavate; gills brown, distant, broad, very decurrent."

‡ Very nearly allied to *A. applicatus.*

disco carnoso; stipite firmo, subligneo, primum furfuraceo; velo floccoso, flavo-purpureo; lamellis pallido-purpureis, demum flavo-fuscis, adnato-decurrentibus.

Pileus two and three inches across, solitary or tufted, when young convex, purple, soon expanding and flat, with a broad fleshy umbo, very viscid, varying from light yellow to buff, with the umbo brownish yellow or purple; stem one and one and a half inches high, two lines thick, hard and somewhat woody, nearly equal brownish-yellow, at first furfuraceous; veil fugitive, consisting of purple and yellow flocci; gills at first dirty white, then brownish purple, at length yellow brown, broad, rather distant, adnate, slightly decurrent, but easily breaking away from the stem. Frequently eaten by large larvæ, and then with the exception of the woody stem turning into a viscid mass. This beautiful species is evidently allied to *A. Harmoge*, but differs essentially in the nature of the gills.

AGARICUS (GALERA) MUCIDOLENS, Berk.—On a rotten trunk. Cincinnati, April 21, 1842.

Olidus, pileo pluteiformi, lobato, glabro, nitido, viscido, fuligineo; stipite fibrilloso; lamellis liberis.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 301.

Pileus two to three inches broad, of a dull smoky brown, viscid; stem two inches or more high, clothed with brownish fibres; gills free; spores dull, ferruginous, broadly subcymbiform, with a small nucleus; smell like that of decayed cheese. Allied to *A. reticulatus*, but differing in several points, and especially in its dull ferruginous, not croceo-ferruginous spores.

AGARICUS (CREPIDOTUS) CROCOPHYLLUS, n. sp.—On a dead trunk. Waynesville, Sept. 5, 1844.

Pileo sessili, sub-flabelliformi, ochraceo-fusco, adpresse squamoso: lamellis aurantiis.

Pileus scarce half an inch long, flabelliform, convex, ochraceous-brown, clothed with minute adpressed scales; stem none; gills rather broad, rounded behind, bright buff: spores subglobose, pale ochre yellow. I do not know any species with which to compare this. *Agaricus croceo-lamellatus* is, I believe, the same with *Paxillus Panuoides*. The only resemblance, however, is in the color of the gills. It is perhaps most like *Agaricus mollis*, but besides the color of the gills the spores are smaller and of a different form. It is not, I believe, resupinate in any stage of growth.

AGARICUS CAMPESTRIS, Linn.—On rotten dung. Cincinnati, April 18, 1842.*

AGARICUS (PRATELLI) FABACEUS, n. sp.—On the ground, amongst dead leaves in open woods. Waynesville, Sept. 10, 1844.

Pileo tenui, subcarnoso, umbonato, albo, demum plano ; stipite glabro, fibrilloso, basi bulbosa excepte æquali, albo; velo amplo, extus floccoso ; lamellis confertis, tenuissimus, liberis, brunneis.

Pileus four to five inches across, thin, almost submembranaceous, umbonate, conical when young, becoming nearly plane as it expands, white, viscid when moist ; epidermis smooth, tough, feeling like fine kid leather, turning yellow when bruised ; stem three to four inches high, one third of an inch thick, white, smooth, with the exception of a few fibrilla, equal except at the base ; veil large, at first covering the gills and connecting the margin with the stem, white, externally flocose ; gills crowded, very thin, not ventricose, free, brown when young, then darker brown, at length almost black like the dark part of a bean flower.—A fine species allied to *A. arvensis.* When young it has a peculiar, but not unpleasant smell.

PAXILLUS POROSUS, n. sp.—In moist woods. Waynesville, Aug. 23, 1844.

Pileo excentrico, carnoso, nitido ; stipite lento, sursum reticulato ; hymenio toto poroso, flavo.

Pileus two to five inches broad, one quarter to three quarters of an inch thick, fleshy, viscid when moist, reddish-brown, rather shining ; margin thin and even ; stem lateral, one inch or more high, one third of an inch thick, tough, diffused into the pileus, reticulated above by the decurrent hymenium ; hymenium yellow, porous, formed by radiating thin folds from a line to half a line distant, branching and connected by numerous irregular veins, so as to form large angular pores, the radiating folds being broader than those which connect them ; spores semi-ovate ; smell very strong and unpleasant. Nearly allied to *Paxillus involutus*, but apparently distinct. The spores are of the same form but larger than in that species. Without examining the fructification it might be taken for a *Boletus.*

PAXILLUS FLAVIDUS, n. sp.—On the ground amongst grass, in dry open woods. Waynesville, Sept. 20, 1844.

* Six days after the specimens were collected and put to dry, on opening the paper they had the smell, and produced the sensation on the eyes and nose, of hartshorn. This vanished in a short time on exposure to air.

Pileo alutaceo-fusco, depresso; stipite lento, flavo, squamulis glutinosis aspero; lamellis párce ramosis, postice furcatis, vivide flavis.

Pileus two to four inches across, depressed sometimes subinfundibuliform, smooth to the touch like kid leather, buffish brown, or pale snuff color, viscid when moist: flesh rather thin, spongy; gills close, thin slightly branched, connected by veins, decurrent, forked at the base, bright yellow; stem one to two inches high, one third to a half inch thick, tough; yellow, rough with glutinous scales. Distinguished by its bright yellow, very decurrent gills, which are forked behind, but do not anastomose.

Lactarius calceolus, n. sp.—On the ground in woods. Waynesville, Aug. 31, and Sept. 10, 1844.

Pileo tenui, centro depresso, margine repando, alutaceo, fusco, epidermide rimosa; stipite curto, concolori; lamellis perpaucis, distantibus, venoso-connexis, decurrentibus, albis.

Pileus three inches across, thin, arched, so as to present a half ovate form, brown buff, smooth, not viscid, epidermis cracked; flesh white; stem short, half an inch in height and thickness, brown buff, like the pileus; gills white decurrent, half an inch broad, extremely distant, not exceeding twenty, more or less connected by transverse veins or plates, forked near the edge, exuding a mild milky juice. An extremely curious species, remarkable for its few distant gills, and the contrast between the brown buff stems and white gills. The pilei in all the specimens found at present are laterally confluent. It can not be confounded with any known species.

Marasmius pyrrhocephalus, n. sp.—On the ground in damp woods Waynesville, Aug. 23, 31, 1844.

Pileo convexo, umbilicato, striato-plicato, rufo; stipite gracili, brunneo, piloso, sursum pallescente; lamellis ventricosis, breviter adnatis, ex albo alutaceis.

Pileus two lines across, hemispherical, umbilicate, membranaceous, red brown, smooth, striate; stem one and a half to two inches high, slender, brown, closely velvety below, generally rooting, paler above, more or less densely covered with short pale hairs and meal; mycelium arachnoid white; gills white, at length pale, tancolored, ventricose, shortly adnate. Allied to *Marasmius hæmatocephalus*, Mont. Two forms occur, the one smaller and more delicate than the other.

Marasmius clavæformis, n. sp.—On dead sticks. Waynesville, May 31, 1844.

Pileo convexo, albo; stipite gracili, deorsum attenuato, depresso-velutino, fusco, sursum albo, furfuraceo; lamellis carneo-albis, antice latis, postice longe decurrentibus.

Pileus two lines broad, convex, tough, white; stem one inch high, attenuated below, attached by a minute bulb, brown and clothed for three quarters of its height with depressed velvety pubescence, incrassated above where it passes into the pileus, white sprinkled with furfuraceous particles; gills distant, broad in front, very decurrent behind, whitish inclining to flesh color; interstices more or less reticulate. Allied to *Marasmius insititius.* Remarkable for its very decurrent gills.

Lentinus tigrinus, Fr.—On dry stumps. Cincinnati, Nov., 1842.*

Lentinus cæspitosus, n. sp.—In woods, on the ground. Waynesville, Sept. 8, 1844.

Eximie cæspitosus; pileo plano, alutaceo, fibrillis brunneis adpressis sparsis ornato, margine incurvo; stipite elongato, striato, griseo-albo, fibrilloso; lamellis integris, albis, longe decurrentibus.

Pilei forming tufts of thirty or more individuals, one and a half to two inches across, plane tough, yellowish-buff, clothed with close-pressed, brownish-red fibrillæ; margin incurved; stems three inches high, two lines thick, flexuous, tough, striate, grayish-white, fibrillose, solid formed of fibres; gills white, very decurrent and attenuated behind, quite entire. A very curious species with the habit of *Agaricus contortus*, Bull. It is easily distinguished from *L. sitaneus* and its allies by its entire gills.

Lentinus sulcatus, Berk.—In the cracks of dry fence rails. Cincinnati, May 28, 1842.

Parvus; pileo primum subconico, demum hemispherico, carnosulo, diffracto squamoso, sericeo-virgato, rufescente, margine sulcato; stipite centrali, brevi, solido, subconcolore, furfuraceo; lamellis distantibus, latiusculis, subcrassis, postice emarginatis, pallidis.—*Berk. in Hook. Lond. Journ.*, v. iv., p. 301.

Pileus not three quarters of an inch broad, hemispherical or nearly so, at first slightly conical, of a more or less rufous tint, broken up into irregular scales, sericeo virgate (sometimes the scales are more or less

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* The gills have anastomosed in these specimens to such an extent as to form a solid wood mass.

indistinct); fleshy; margin deeply sulcate, with the interstices darker, which gives the pileus a very neat appearance; stem about three quarters of an inch high, one and a half lines thick, often slightly attenuated downward, solid, of the same color as the pileus furfuraceous, sometimes confluent; gills distant, broad, subventricose, emarginate behind, very slightly annexed, pallid, rather thick, indistinctly toothed. Allied to *L. scleropus*, etc.

PANUS DEALBATUS, n. sp.—On a dry dead branch. Waynesville, Aug. 26, 1844.

Pileo coriaceo-molli, flabelliformi, umbrino, striato; stipiteque laterali, longiusculo, compresso, vel canaliculato, sursum dilatato, strato albo, subtiliter rimoso vestitis; lamellis decurrentibus, distinctis, umbrinis.

Pileus three quarters of an inch broad, flabelliform sometimes lobed; when moist tough and pliable, umbro-brown, striate; when dry, white and minutely cracked, as if whitewashed, with a dark border; stem quarter of an inch or more high, dilated upwards, compressed and often canaliculate, perfectly lateral, of the same color and texture as the pileus; gills narrow, umber brown, distinct, without any veins in the interstices, decurrent and clothed below with a white stratum; when dry, brown with a white edge. Allied to *A. farinaceus*, Schum., but at once distinguished by its very decurrent gills. There are few prettier fungi than this when dry. Sometimes the stem is forked, and each division produces a distinct pileus.

PANUS ANGUSTATUS, n. sp.—On a dead log. Waynesville, Sept. 10, 1844.

Parvus, tenuis; pileo spathulato, subtiliter pubescente, postice angustato, farinaceo; strato superiore gelatinoso; stipite brevissimo; lamellis angustis, decurrentibus.

Pileus about one inch long, coriaceo-submembranaceous, spathellate or flabelliform, narrowed behind, white, dirty white or yellowish, most minutely pubescent; upper stratum gelatinous; stem extremely short, being in fact little more than a continuation of the pileus; gills very narrow, close, decurrent, white, very minutely pubescent, yellowish when dry. Somewhat resembling *Panus copulatus*. Mr. Lea describes it as tough when fresh, and it is therefore placed in the genus *Panus*.

Boletus strobilaceus, Scop.—On the ground, and on rotten trunks of trees. Cincinnati, July, August; Waynesville, Aug. 4, 1844.*

Polyporus radicatus, Schwein.—Waynesville, Sept., 1844.†

Polyporus arcularius, Fr.—Cincinnati, May 8, 1841, April 30, May 7, 1842.‡

Polyporus connatus, Schwein.—On ground where wood had been burnt, amongst *Funaria hygrometrica.* Cincinnati, June 4, 1842.§

Polyporus fissus, n. sp.—On a decaying stick. Waynesville, Sept. 5, 1844.

Pileo primum infundibuliformi, demum fisso, lobis flabelliformibus, tenuissimo, luteo-fusco; stipite brevi, deorsum nigro; hymenio albo; poris minimis.

Pileus one and a half to two inches across, at first infundibuliform, at length split once or twice behind into flabellate lobes, extremely thin, quite smooth, minutely striate, yellow brown; stem scarce half an inch, very minutely velvety, black below; pores white, invisible to the naked eye, punctiform. Closely allied to *P. varius*, but a much more delicate species than any of its allies. The pores are as minute as in *P. xanthopus*, so that it was sent as a *Thelephora.*

Polyporus rhipidium, n. sp.—On rotten trunks, in woods. Waynesville, Aug. 21, 1844.

Cæspitosus; pileo coriaceo, reniformi, concentrice sulcato, alutaceo-albo, cute in areolas furfuraceas secedente; stipite laterali, brevi, sursum dilato, pruinoso; poris parvis, albidis, angulatis, denticulatis, quandoque elongatis.

Pilei gregarious, cæspitoso-imbricate, coriaceous, three quarters of an inch long and broad, deeply, concentrically sulcate, yellowish,

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* The spores in this species are subglobose or obliquely ovate, and by no means elongated as in other Boleti In the Ohio specimens I find them minutely granulato-echinulate. The tubes, too, do not separate from the pileus. It will probably form, some day, the type of a distinct genus.

† Specimens of this occur of various sizes, from what Schweinitz describes, to five inches across, with the stem eight inches or more high, and an inch thick.

‡ The specimens agree exactly with one from the Pyrenees, given me by Dr. Montagne. Fries describes the pores as entire, but this character is probably taken from Micheli's figure.

§ With this is a variety of *Polyporus perennis*, which Mr. Lea considered a form of *P. connatus*. There is, however, such an immense difference in the pores, that I can scarcely credit it, though the external resemblance is very strong.

cracked into minute, furfuraceous areolæ ; stem quarter of an inch high, lateral, dilated above, pruinose, yellowish when dry ; pores one hundredth of an inch in diameter, dirty white, angular, often elongated, edge of dissepiments uneven and toothed. This curious species exactly resembles *Panus stypticus*, with the exception of the hymenium. I know of no species to which it has a close affinity.

POLYPORUS SULPHUREUS, Fr.—Waynesville.*

POLYPORUS HYPOCOCCINUS, n. sp.—On rotten trunks. Waynesville, Sept. 7, 1844.

Pileo subungulato, carnoso-suberoso, intus fibroso zonatoque, inequabile, exalutaceo-aurantiaco, incano, subtiliter tomentoso ; poris parvis, longis, e pileo secernibilibus, aurantiis, intus coccineis.

Pileus several inches across, subungulate or expanded, of a soft coriaceous or corky substance, uneven, buff and orange, becoming whitish when dry, very minutely tomentose ; substance pale buff (sometimes pink when dry), consisting of fibres which radiate from the base and are crossed by concentric zones: hymenium bright crimson orange ; pores one seventieth of an inch broad, an inch long, crimson within ; edge of dissepiments orange, slightly thickened and flexous, separable from the flesh, and partially from each other. This magnificent species approaches, in some respects, the genus *Fistulina*, but the pores, though partially separable, are those of a *Polyporus*. Its situation is amongst the *Anodermei*.

POLYPORUS MOLLIUSCULUS, n. sp.—Cincinnati.

Imbricatus ; pileis effuso-reflexis, sublobatis, leviter zonatis, albis zonis strigis mollibus sparsis ornatis ; contextu albo ; poris mediis, pallidis.

Imbricated, thin, four inches or more long, three inches broad, sometimes perfectly resupinate, more generally with the border, broadly reflected and slightly lobed, white finely silky, or nearly smooth, with zones of soft strigæ, which, in the dried plant are perfectly innate ; substance white, thin corky when dry ; pores one forty-eighth of an inch broad, at first entire with thick dissepiments, at length lacerated and elongated, wood colored. Resembling in general appearance *Polyporus alutaceus*, as figured by Rostkovius, but much thinner. I can not refer it to any described species. Its position is amongst the white *Anodermei*.

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* The specimens are very thin and extremely beautiful.

Polyporus Isidioides, Berk.—On a large dead beech. Cincinnati, Sept. 17, 1842.*

Polyporus adustus, Fr.—On a mulberry stump. Cincinnati, Oct. 14, 1841, Sept. 15, 1842.

Were not *Pol. adustus* so very variable this would doubtless be considered a distinct species. It is of a yellow brown tint, velvety, with a few distant zones, the margin white, rigid when dry, substance zoned: the pores are white and very shallow. It has a fetid odor when drying. The common form also occurs.

Polyporus nigro-purpurascens, Schwein.—On dead trunks. Waynesville, Aug. 31, 1844.

Pores at first salmon colored or brownish, in older specimens yellowish white. This, if my specimen from the south of Europe is properly named is *P. dichrous*, Fries.

Polyporus endocrocinus, n. sp.—On the decayed part of the trunk of a yellow hickory. Waynesville, Aug. 29, 1844.

Pileo crasso, carnoso-fibroso, setis strigoso-horrido, brunneo; contextu croceo-rhubarbarino; stipite brevi vel obsoleto; hymenio aureo-fusco; poris mediis, laceratis; dissepimentis tenuibus.

Pileus thick, four to six inches across, of a fleshy fibrous consistence, absorbing much moisture, dark brown, clothed with strigose, flat, lacerated setæ or scales; substance of a rich saffron; hymenium golden brown; pores one sixtieth of an inch broad, angular, with the edge of the thin dissepiments torn or fringed. This species shrinks much in drying. It is allied to *Pol. Schweintzii*, but is distinguished by its saffron colored substance, and its strigoso-squamose pileus, Two specimens only were found.

Polyporus galactinus, n. sp.—On rotten trunks. Waynesville, Aug. 29, Sept. 10, 1844.

Pileo dimidiato, carnoso, molli, inæquabili strigoso-tomentoso, lacteo, intus zonato, fibroso, margine tenui; poris parvis, albis.

Pileus two to three inches broad, one and a half inches long, dimidiate or uniform and elongated behind, convex, uneven, milk white, clothed with strigose down, of a soft fleshy substance, zoned within and consisting of radiating fibres; hymenium flat, or slightly

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* Berk. in Zeyher's Fungi, from Uitenhage.—*Hook. Lond. Journ.* This species is perhaps too near *Pol. gilvus*.

concave; pores one hundredth of an inch broad, scarcely visible to the naked eye, but giving to the hymenium a silky lustre, white; dissepiments very thin, slightly uneven. Nearly allied to *P. undulatus*, Schwein., and *P. symphyton*, Schwein. The dried specimens are rigid, and sometimes have the margin dark brown.

Polyporus dryophilus, n. sp.—On living red oak. Waynesville, Sept. 5, 1844.

Pileo crasso, rigido, ungulato, scabroso, inæquabili, incano-ferrugineo-flavo; contextu cinnamomeo; hymenio cinnamomeo-fusco; poris parvis, intus rhubarbarinis.

Pilei subimbricate, four inches broad, three inches long, ungulate, unequal, rough with scabrous points formed by innate pubescence of a ferruginous yellow, but subdued by a thin white film; substance fibrous, hard, cinnamon; pores externally cinnamon brown, within ferruginous yellow, about one eightieth of an inch broad, angular, with thin dissepiments. Nearly allied to *P. dryadeus*, but a smaller, more rigid species, with larger, differently colored pores. It has also much resemblance to *P. gilvus*.

Polyporus pubescens, Fr.—On rotten trunks and dry fence rails. Waynesville, Aug. 26, Sept. 9, 1844.*

Polyporus conchifer, Schwein—Waynesville, Sept. 9, 1844.†

Polyporus conglobatus, n. sp.—On beech, bursting through the bark. Cincinnati, July 11, 1837. On a hickory stump, June, 1844.

Pileis suberosis, erumpentibus, arctissime imbricatis, massam globosam efformantibus, arcuatis, rugosis, fusco-purpureis, margine pallide, postice leviter laccatis; hymenio brunneolo; poris punctiformibus; dissepimentis obtusissimis.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 303.

Forming a compact, globular mass, four or five inches in diameter, consisting of closely pressed, curved, imbricating pilei, united at the base into a mottled mass, consisting of bark highly impregnated with mycelium, purplish brown behind, where it is laccate with a dark bloom, pallid in front; substance, corky, rather soft, ferruginous; hymenium concave, scarcely conspicuous without dividing the pilei, brown; pores minute, punctiform, pale within; interstices even, obtuse.

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* A small variety not exceeding an inch in breadth, and the third of an inch in length.

† Nothing can well be more different than the pure white, adult individuals, and the elegantly brown-zoned plant, looking like some states of *Thelephora evolvens*, before the pores are formed. Occasionally the whole upper surface is clothed with a cracked brown stratum, not disposed at all in zones.

The mass behind is sometimes perforated by the larva of some insect, which makes large channels through it. Very fragrant when fresh; odor a combination of pine apple and strawberry very perceptible, at a distance of twenty yards from the tree. The specimen on hickory was of a fine ochre red, and the hymenium purplish. Allied to *Polyporus graveolens*, Schwein., which grows on oak. The pilei in that species are spathulate, the pores invisible to the naked eye, and the substance very hard.

POLYPORUS NIGER, n. sp.—On rotten trunks. Cincinnati, March 14, 1842.

Resupinatus, crassiusculus; pileo vix ullo; hymenio nigro; poris minimis punctiformibus, intus umbrinis; dissepimentis tenuibus.—*Berk. in Lond. Journ. Botany*, vol. iv., p. 104.

Elongated, altogether resupinate, except at the very edge, where it is slightly raised, dark brown, and pubescent; substance, where it is not quite obsolete, dark brown; hymeium black; pores very minute, punctiform, two lines deep; edge very minutely tomentose with black down, umber within; dissepiments thin. Nearly allied to *P. tephroporus* (formerly *P. Surinamensis*, Mont.), with which it agree in many respects. The hymenium, however, is jet black, instead of cinereous, and the inside of the tubes is umber. Like it, it is slightly raised at the edge, and the substance and exposed portion of the pileus are dark brown. The dissepiments also in Dr. Montagne's fungus are thicker.

POLYPORUS OBLIQUUS, Fr.—Waynesville, August, 1844.*

TRAMETES LACTEA, Berk.—On dead trunks. Cincinnati.

Pileo laterali, duro, suberoso, explanato, dealbato, glabro; contextu albo; stipite brevissimo disciformi; hymenio albido; poris parvis, subrotundis, acie obtusa. *T. incana.—Berk. in Hook. Lond. Journ.*, vol. iv., p. 305.

Pileus eight inches broad, four and a half inches long, attached by a very short, lateral, disciform stem, flabelliform, smooth, opaque white, zoneless, or with a few obscure depressions and short radiating grooves; substance hard, corky, white, one and a half inches thick, margin subacute; hymenium even of a very pale ochre; pores small, one hundred and sixtieth of an inch in diameter, mostly roundish, here

* On a dead limb of Ostrya Virginica, throwing off the bark exactly as in *Corticium comedens*.

and there forming linear or curved sinuses. Sometimes the stem is accidentally elongated. Resembling somewhat, *Dædalea ambigua*, and certain states of *Lenzites repanda*, but distinct from either. I am obliged to alter the name, as while my paper was in the press, M. Leveille published a species under the name of *Trametes incana*.

DÆDALEA AMBIGUA, Berk.—On dead trunks. Cincinnati.

Pileo suberoso, crasso, convexo, azonato, dealbato, glabro; hymenio, subalutaceo; poris parvis simuosis, acie obtusa.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 305.

Pileus sessile dimidiate, six inches broad, three inches long, one and a half inches thick, venose, zoneless, opaque white, as if whitewashed, smooth, or most minutely pubescent, in the younger parts only of a hard corky texture; white within, margin at first very obtuse; hymenium rather concave; of a pale tan color, pores small, narrow, sinuated moderately deep; dissepiments obtuse.

Other specimens gathered at Waynesville, Aug. 8, 1844, after the above characters were published, approach nearer to *Lenzites repanda* and *L. applanata*, combining the characters of both. They are flat and thinner, with the pores less sinuous, and in one specimen not altogether unlike those of *L. applanata*. The species is, however, more nearly allied to *L. repanda*. Even in the thinnest specimens, the margin is not acute as in that species.

DÆDALEA UNICOLOR, Fr.—Under side of a rotten log. Waynesville, Aug. 28, 1844.*

DÆDALEA PALLIDO-FULVA, n. sp.—On a dead log in a log-fence. Cincinnati, March 19, 1842.

Coriaceo-suberosa, pileo dimidiato, subnitido, azono, pallido; hymenio pallido-fulvo, poris angustis, parce sinuosis rectis.

Pileus one and a half inches long, three inches or more broad; stem less dimidiate, even or rather rugged, zoneless, rather shining, at first most minutely pubescent; substance hard, wood colored; hymenium pale, tawny; pores mostly straight, one sixtieth of an inch broad. A very distinct species, just intermediate between *Dædalea* and *Lenzites*.

DÆDALEA SEPIUM, n. sp.—On dry fence rails. Waynesville, Sept. 9, 1844.

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* A resupinate form, differing from the ordinary state in its paler hymenium.

Pileo tenui, reflexo, basi effuso, subtiliter tomentoso, pallido-ligneo, zonis saturationibus; contextu albo; hymenio poroso sinuoso, pallido.

Pilei effused at the base, reflexed above, laterally connate, at first often attached by the vertex, or triquetrous, pale wood color, finely tomentose, marked with numerous zones which are darker; hymenium pallid, consisting of slightly sinuous pores, about one thirtieth of an inch in diameter. Its nearest ally is apparently *Dædalea zonata*, Schwein.

LENZITES CRATÆGI, n. sp.—On a dead branch of a Cratægus. Cincinnati, Oct. 12, 1840.

Pileo coriaceo-rigido, glaberrimo, nitido, cervino, concentrice sulcato et fasciato, quandoque radiato-ruguloso; poris flexuosis, demum elongatis; dissepimentis molliusculis, hic illic lamellæformibus.

Pileus orbicular, one and a half inches broad, fixed by the vertex, rigid, coriaceous, quite smooth and shining, repeatedly zoned and sulcate; hymenium brownish; pores one sixtieth of an inch in diameter, slightly sinuous, much elongated toward the centre; dissepiments thin, soft. This beautiful species has exactly the habit of *Hexagona tenuis*, but the pores are very different. It was gathered at Isle aux Noix, Canada, by Dr. Maclagan, by whom it was sent. The specimen is ungulate, and marked with little radiating lines, which are wanting in Mr. Lea's plant.

HYDNUM DIFFRACTUM, n. sp.—On the ground, in dry woods. Waynesville, Aug. 26, 1844.

Pileo carnoso-lento, crasso, glabro, alutaceo, margine incurvo; stipiteque obeso, concolori, diffractis; aculeis subulatis, integris, mollibus, alutaceo-pallidis.

Pileus three inches broad, convex, smooth, of a tough fleshy substance, at length much cracked and split; margin involute; stem one and a half or two inches high, three quarters of an inch or more thick, buff and split like the pileus; tender when fresh; spines even, subulate, entire, soft, of a pale buff; smell vinous. A remarkably rigid species when dry; allied to *H. candidum* and *H. repandum*.

HYDNUM FLABELLIFORME, Berk.—On a dead oak trunk. Cincinnati, Jan. 14, 1842.

Imbricatum, coriaceum; pileis spathulato-flabelliformibus, zonatis, hirsutis; hymenio ochraceo; aculeis longiusculis, acutis, carneis, siccis, ochraceis.—*Berk. in Hook. Lond. Journ. Bot.*, vol. iv., p. 306.

Pilei imbricated, laterally confluent, half an inch broad, three

quarters of an inch long, spathulato-flabelliform, fixed by a narrow base, which is mostly more or less distinct, coriaceous, clothed with white or slightly tawny short woolly hairs; hymenium, bordered; aculei acute, sometimes compressed above, flesh colored, ochraceous when dry. Allied to *H. ochraceum.*

HYDNUM STRATOSUM, n. sp.—On a dead trunk. Cincinnati, June 1, 1844.

Pileis resupinatis, margine libero, demum stratosis, e processibus rigidis ramosis extus stuppeis formatis; aculeis longis, rigidis, acuminatis, spadiceis, hic illic cinereis.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 307.

Pilei resupinate, with a narrow lobed border, spreading for three or four inches over the matrix, consisting of repeatedly branched, rigid, brown processes, resembling some cornicularia, which are clothed above with gray, or ferruginous tow-like fibres. Aculei rather long, rigid, sharply acuminate, brown, varying to cinereous, at length stratose. This is one of the most remarkable species with which I am acquainted. It resembles in many respects *H. parasiticum*, but has not, like that a coriaceous pileus. The whole substance, indeed, consists merely of rigid branched processes, which are partially over above with coarse pubescence, so that the pileus might perhaps be described as repeatedly branched. These processes, however, are combined into a lobed stratum. I do not know any other species with which it can be compared, except, perhaps, as Dr. Montagne suggests, his *H. pteruloides*, but that he is now inclined to consider as nearly a state of *Trametes hydroides*, whereas the present is a perfect fungus.

HYDNUM OHIENSE, Berk.—On the underside of a decayed log. Cincinnati, March 19, 1842.

Resupinatum, membranaceum, a matrice hic illic secernibile, pallide flavum; aculeis longis, acutissimis, aquoso pallido-fuscis, subfasciculatis.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 307.

Spreading for several inches, entirely resupinate, membranaceous, partially separable from the matrix: aculei somewhat fasciculate, one to two lines long, of a watery pale brown, very slender at the apex. Resembling *Hydnum Fernandesium*, Mont., from which it differs in its shorter, less crowded aculei. The margin. too, in the Juan Fernandez species is more distinct, and the whole fungus more luxuriant.

THELEPHORA CUTICULARIS, n. sp.—In moist cavity of a dead tree, attached to the wood, twigs, etc. Waynesville, Aug. 23, 1844.

Imbricata, coriaceo mollis, brunneo-purpurascens; pileolis inæquabilibus, rugosis, depresso-sericeis; hymenio sublævi, pulverulento.

Imbricated; pilei three quarters of an inch long, laterally confluent, uneven, rugged, brown inclining to purple, with a pale margin, of a soft coriaceous consistence; surface soft clothed with matted down, not distinctly pubescent; zoneless; hymenium concave, nearly even, not setulose; smell strong and unpleasant. One specimen, gathered apparently in a different locality, consists of a mass of pilei running one into the other with but little distinct hymenium. Allied to *T. terrestris.*

Thelephora albo-marginata, Schwein. Mss.—On bark of dead buttonwood. Cincinnati, March 19, 1842.

Latissime confluenti-effusa, rarius breviter reflexa, umbrina, centro pruinosa, margine albo-tomentoso.

At first consisting of distinct, orbicular patches, which soon become confluent; umber, velvety, but by no means bristly, clothed with a white bloom, in the centre quite even, or irregularly rugose, sometimes reflexed, in which case the pileus is brown and silky; margin white, tomentose, not fimbriate. This was distributed under the name of *T. arida*, but more perfect specimens show that it is a fine and very distinct species. It is possible that *T. albo-badia* may be a synonym, for I do not find the name adopted above from Sir W. J. Hooker's Herbarium, in Schweinitz's list.

Stereum rugosum, Fr. Epic.—On dead logs. Cincinnati, April 30, 1842.*

Didymium regulosum, n. sp.—On bark of honey locust. Cincinnati, June 27, 1842.

Gregarium; peridio lenticulari, subtus late umbilicato, albo, ruguloso; stipite tenui costato, stramineo, apice attenuato, capillitio, parco, albo; sporis nigris, sub lente fusco-purpureis. Columella nulla.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 308.

A minute species, one third of a line in diameter, with the stem two thirds of a line high. The appearance of the surface of the peridium is like that of a little globule of the mother of vinegar, white and curdled.

Stemonitis fusca, Roth.—On dead poplar. Cincinnati, June 23, 1840.†

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* The specimens are remarkably fine, spreading for several feet over the under side of dead logs. The pileus is concentrically zoned, of a rich brown, and decidedly tomentose. The general appearance is somewhat different from European specimens, but I do not consider it a distinct species.

† Spores larger than in British specimens.

SPHÆRONEMA OXYSPORUM, n. sp. Waynesville, Aug. 3, 1844.

Peritheciis subulatis, flavis, apice nudis; sporis ellipticis, utrique appendiculatis.

Externally resembling *Sphæronema subulatum*, but distinguished by its spores having an elongated filament at either extremity, and by the naked tip of the perithecium, which has a more compact structure.

DIPLODIA MORI, n. sp.—On twigs of Morus multicaulis. Cincinnati, June 25, 1840.

Peritheciis globosis, dispersis, siccitate collapsis; sporis obovato-oblongis, pallidis, simplicibus.

Sometimes aggregate and oblong from the confluence of several individuals; more frequently solitary; occasionally the contents of the spores are attracted to either end, but I do not find a septum even in decaying specimens.

SEPTONEMA SPILOMEUM, Berk.—On fence rails. Cincinnati, March 3. 1842; Waynesville, Aug. 27, 1844.

Soris parvis, punctiformibus, atro-purpureis; filis ramosis; articulis oblongo-ellipticis, scabriusculis, triseptatis.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 310, tab. 12, fig. 5.

Forming little scattered, purplish-black sori, about the size of a poppy seed; threads branched; articulations oblongo-elliptic, triseptate, one or more of the septa containing occasionally an oil globule; border of articulations pellucid, rough with little scabrous prominences. Very distinct from the other species in its punctiform habit, and the nature of the articulations. These are not represented sufficiently irregular in the figure. If is very difficult to get a clear view, as they are so opaque.

SPORIDESMIUM CONCINNUM, Berk.—On a rotten trunk. Cincinnati, March 31, 1841.

Sporis primum brevissme pedicellatis, oblongis, obtusis, nitidis, fenestratis.—*Berk. in Lond. Journ. Bot.*, vol. iv., p. 309, tab. 12, fig. 3.

Forming minute, jet-black, crowded sori, which are at length almost confluent; stroma consisting of decumbent, branched threads; spores at first simple, obovate, pellucid, then oblong (the peduncle being entirely obliterated), and divided by numerous transverse and vertical, or more rarely oblique septa.

PUCCINIA ACULEATA, Schwein.—On the under side of the leaves of Podophyllum peltatum.*

* Corda Fasc 6, ined. cum optima icone.

Uredo rubigo-vera, DC.—On rye. Cincinnati, May 3, 1840.*

Cronartium asclepiadeum, Kze., var. Thesii, Berk.—Cincinnati.

Maculis obliteratis; tuberculis parvis sparsis; sporis subglobosis; peridiis elongatis, incurvatis, extus minutissime ramentaceis.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 311.

On Thesium umbellatum, generally scattered, not aggregate, as in the original species, where they seem to be usually confined to a determinate spot. Peridia more minute; cells of the peridium longer; spores not so much elongated.

Macrosporium pinguedinis, Berk.—On grass soiled with fat. Cincinnati, June 19, 1841.

Latissime effusum, floccis tenuibus, erectis, simplicibus, septatis; sporis lanceolatis, quandoque obovato-oblongis.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 309, tab. 12, fig. 2.

Completely investing the culms and leaves on which it grows. Flocci erect, flexuous, septate; spores brown, lanceolate, obtuse, transversely septate, with occasionally a vertical septum; sometimes obovate-oblong.

Macrosporium punctiforme, Berk.—On dead stems of Rubus occidentalis. Cincinnati.

Soris minutis, sparsis, punctiformibus; sporis obovatis; filis simplicibus, obtusis, subflexuosis.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 309, table 12, fig. 1.

Forming minute, black, scattered dots; stroma reticulate; flocci erect, simple, slightly flexuous, sparingly septate, sometimes decumbent and then proliferous; spores obovate, at first simple and pellucid, then furnished with one or two transverse septa, at length acquiring a darker tinge, and a few oblique or vertical septa.

Oidium simile, Berk.—On decayed wood. Cincinnati, Jan. 18, 1842.

Effusum, submembranaceum, fulvum; filis ramosiusculis; articulis ultimis subglobosis.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 310, tab. 12, fig. 4.

Forming a deep, tawny, pulverulent, but somewhat membranaceous stratum, which to the outward eye exactly resembles *Oidium fulvum*, but distinguished by its subglobose, not oblong articulations. The fructifying bodies arise, either from a direct transformation of the ultimate joints, or from the central constriction of the subterminal.

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* An imperfect state of Puccinia graminis.

Peziza acetabulum, L.—On the ground. Cincinnati, April 30, 1842.*

Psilopezia, nov. gen.

Hymenium planum, ascigerum, omnino immarginatum, strato tomentoso, innatum, asci ampli: sporidia elliptica, binucleata.

Psilopezia nummularia, n. sp.—On a decayed log in a wet place. Cincinnati, July 16, 1842.

Orbicular, one third of an inch broad, flat, purple brown, growing on a white, tomentose stratum, which forms a narrow border; asci large, containing eight large, elliptic binucleate sporidia. The characters of this genus are precisely those of *Pyronema*, which was founded on the old confluent state of *Peziza omphalodes*. It has the habit of Corticum with the hymenium of a *Peziza*, from which it is distinguished by the total absence of any true margin. The name of *Pyronema* is evidently inapplicable to the present species.

Patellaria carpinea, Berk., *Peziza carpinea*, Pers.—On Hornbeam. Cincinnati, Oct. 31, 1839.

This is not a good *Peziza*, though it certainly has asci and sporidia. The former are clavate, the latter subrymbiform. *Ditiola*, to which Fries is inclined to refer it has no asci. It appears to me evidently congeneric with *P. rhabarbarine*, Berk.

Sphæria multiformis, Fr.—Kentucky hills, four miles from the Ohio.†

Sphæria deusta, Hoffm.—On dead logs. Cincinnati, Apr. 21, 1842.‡

Sphæria (Lignosæ) tinctor, Berk.—On dead buttonwood (Platanus occidentalis. Cincinnati, March 14, 1842.

Effusus, innatus, planus, sculpturam matricis e mycelio miniatæ superficie referens, intus extusque ater; peritheciis elongatis, collo brevi, ostiolo inconspicuo.—*Berk. in Hook. Lond. Journ. Bot.*, vol. iv., p. 311.

Forming a black, widely effused stratum, exhibiting all the markings of the matrix, which is tinged to the depth of a quarter of an inch, orange red, black both within and without; stroma hard, half a line or more thick; perithecia vertical, elongated, with a very short neck; ostiola not visible externally even under a lens. Analogous to *S. hypomilta*, Mont., related to *S. stigma*. The stroma is quite distinct from the wood, though it exhibits on its surface all its markings. It has the habit of the tribe *Concrescentes*.

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* This species, it will be observed, retains its early appearance in America.

† The effused variety.

‡ The young Thelephoroid state.

Sphæria (Circumscriptæ) fulvo-pruinata, Berk.—On dead Platanus occidentalis. Cincinnati, January 14, 1842.

Pustulata, subangulata, basi effusa, peritheciis oblongis, collo elongato; stromate discoque ostiolis punctato fulvis; sporidiis ellipticis, uniseptatis.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 312.

Forming somewhat angular pustules, about a line broad, rather effused at the base, as seen through the thin cuticle; disc angular, tawny, pulverulent, pierced by the black punctiform ostiola; stroma tawny like the disc: perithecia globose; asci linear; sporidia elliptic, uniseptate, with a single globose nucleus in each cell.

Sphæria (Circumscriptæ) Leaiana, Berk.—On bark of dead Hornbeam. Cincinnati, June 20, 1839.

Innata; stromate pallido, laxo, e cortice et ligno linea circumscripto; peritheciis ellipticis, ostiolis subconfertis, elongatis, lineolatis, granulatis, sporidiis minimis curvulis.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 311.

About half a line in diameter. Perithecia not numerous, circinate, elliptic, seated on a pale stroma of rather a loose texture; ostiola forming a little tuft rather elongated, umbilicate, finely grooved, granulated; asci lanceolate; sporidia minute, curved like those of *S. verrucœformis.* Distinguished from *S. carpini* by its pretty, granulated ostiola; but above all by its minute, curved, not lanceolate sporidia. In *S. dicipiens* the sporidia are dark and elliptic with one side flattened.

Sphæria (Confluentes) rhizogena, Berk.—On the roots of Gleditschia triacanthos, washed bare by the Ohio freshets. Cincinnati, Dec., 1840.

Suborbicularis, atro-fusca; stromate pallido, peritheciis globosis, primum cervino-pruinosis, demum supra atro-fuscis, subtus pallido-fuscis; papilla subtili abrupta quandoque depressa, intus pallido-fuscis. —*Berk. in Hook. Lond. Journ.*, vol. iv., p. 312.

Patches nearly orbicular, two lines or more broad, with their surface rather irregular, here and there depressed; stroma pale, yellowish-brown; perithecia minute, dull, not shining, partially immersed, pale brown when shaded from the light, nearly black above, at first pruinose, globose with a minute and sometimes depressed papilla, filled with pale brownish jelly; asci linear, sporidia, elliptic. Habit that of *S. laburni.* Its nearest ally appears to be *S. gleditschiæ. S. melogramma* as published by Mouegeot differs in its fusiform sporidia. Fries, No. 441 has curved sporidia.

Sphæria (Seriatæ) maydis, n. sp.—On dead culms of Zea Mays. Cincinnati, May 1, 1841.

Masculis parvis, subellipticis, elevatis; peritheciis paucis, ostiolo, unico, conico; sporidiis oblongiis, curvulis, uniseptatis.

Habit that of *S. arundinacea.* Spots minute, often purple-brown, punctiform or subelliptic, rarely linear, containing very few perithecia, with a single broad conical ostiolum; sporidia oblong, slightly curved, uniseptate. Very different from *Sphæria Zeæ*, Schwein., as appears from an authentic specimen in Sir W. J. Hooker's Herbarium.

Sphæria (Byssisedæ) rhodomphala, Berk.—On rotten wood. Cincinnati, Dec. 9, 1841.

Peritheciis demum confertis, minutis globosis umbilicatis, atris, plus minus, præsertim circa ostiolum, obsoletum, miniato-pruinatis, sub lente scabriusculis subiculio fusco insidentibus.—*Berk. in Hook. Lond. Journ.*, vol. iv., p. 313.

Scattered, at length much crowded, either free or seated on a matted brown subiculum; perithecia globose, at first powdered with vermilion, which is more or less persistent in the center; ostiolum simple, umbilicate; asci somewhat lanceolate, pedicellate; sporidia lanceolate, constricted in the center with a single septum. and containing one or sometimes two nuclei. A pretty species, but rather difficult to place, as the subiculum is sometimes entirely wanting, and the perithecia are rather pulverulent than villous. It has almost equal claims to take its place amongst *Denudatæ*, *Villosæ*, and *Byssisedæ*.

Sphæria (Subtectæ) argyrostigma, n. sp.—On dead leaves of Yucca filamentosa. Cincinnati, Feb. 8, 1842.

Epiphylla, ethypophylla, late dispersa; peritheciis minoribus depresso-globosis, epidermis tectis astomio; maculis epidermalibus, punctiformibus, nigris, centro, candidis; sporidiis cymbiformibus, pallidis. Appearing like scattered Phoma, but it has distinct asci.

Antennaria pinophila, Nees.—On sugar maple. Cincinnati, April 30, 1842.*

OMISSION.

Agaricus vaginatus, Bull.—Cincinnati.

A distinct form, if not species, occurred in Banklick woods, Ohio, at the root of a beech tree, growing in a bunch, with the gills attached to the stem, but easily breaking away. The pileus was viscid. brownish yellow; the stem also brownish and viscid, especially within.

* I can not distinguish the specimens from Nees von Esenbeck's species.

COLEOPTERA OF THE VICINITY OF CINCINNATI.

By Charles Dury.

Since the publication of the list of Coleoptera (*this Journal*, Oct., 1879), these additional species have been taken. This list enumerates 167 species, the former list, 1419,—making a total of 1586, belonging to 712 Genera, and 71 Families. I am indebted to the late Mr. Chas. G. Siewers, of Newport, Ky., for notes on the capture of several species not observed by myself.

CICINDELIDÆ.

Cicindela punctulata, Fab. Ohio.

CARABIDÆ.

Clivina postica, Lec. "
Schizogenius ferrugineus, Putz. "
Lebia lobulata, Lec. "
    pumilla, Dej. "
Perigona nigriceps, Dej. Ky.
Evarthrus acutus, Lec. "
Bradycellus atrimedius, Say. Ohio.
Chlænius impunctifrons, Say. "

HYDROPHILIDÆ.

Megasternum costatum, Lec. "
Cercyon pubescens, Lec. "
Cryptopleurum vagans, Lec. "

TRICHOPTERYGIDÆ.

Nossidium americanum, Mots. "

STAPHYLINIDÆ.

Philotermes pilosus, Kraatz. "
Bledius analis, Lec. "
Apolocellus sphæricollis, say. "

PSLAPHIDÆ.

Batrisus riparius, Say. "
    globosus, Lec. "
    nigricans, Lec. "
Decarthron abnorme, Lec. "

SILPHIDÆ.

Ptomaphagus pusio, Lec. "
Catops bassilaris, Say. "
Catops clavicornis, Lec. "
Liodes obsoleta, Horn. Ky.
    blanchardi, Horn. "
    basilis var. dichroa, Lec. "
Agathidium pulchrum, Lec. "

SCYDMÆNIDÆ.

Scydmænus motschulskii, Lec. Ohio.

CORYLOPHIDÆ.

Sericoderus subtilis, Lec. "
Sacium fasciatum, Say. "

SCAPHIDIIDÆ.

Cyparium flavipes, Lec. Ky.

LATHRIDIIDÆ.

Lathridius lirata, Lec. Ohio.
Corticaria serratus, Payk. "
    pictus, Lec. "

ENDOMYCHIDÆ.

Alexia minor, Cr. Ky. Ohio.

TRITOMIDÆ.

Mycetophagus obsoletus, Mels. Ky.
Litargus infulatus, Lec. "

SPHINDIDÆ.

Sphindus americanus, Lec. Ohio.

CIOIDÆ.

Ennearthron Mellyi, Mell. "

ATOMARIIDÆ.

Atomaria ferruginea, Sahlb. Ky.
Loberus impressus, Lec. Ohio.
Marginus sp. "

CUCUJIDÆ.

Lathropus vernalis, Lec. Ohio.
Læmophlæus adustus, Lec. "

COLYDIIDÆ.

Penthelispa reflexa, Say. Ky.
Pycnomerus sulcicollis, Lec. "
Cerylon castaneum, Say. Ohio.

RHIZOPHAGIDÆ.

Nemophlœus pallipennis, Lec. "
Monotoma producta, Lec. "

TROGOSITIDÆ.

Nemosoma cylindricum, Lec. "

NITIDULIDÆ.

Stelidota geminata, Say. "
Cybocephalus nigritulus, Lec. Ky.

COCCINELLIDÆ.

Exochomus marginipennis Lec. Ohio
pilatii, Muls. "
Œneis pusilla, Lec. "
Scymnus punctulata, Mels. "

GEORYSSIDÆ.

Georyssus pusillus, Lec. "

HISTERIDÆ.

Hister harrisii, Kby. "
Saprinus fitchii, Mars. "
fraternus, Say. "
Aeletes, n. sp. "

SCARABÆIDÆ.

Canthon chalcites, Hald. "
Atænius, n. sp. Ky.
Odontæus fillicornis, Say. Ohio.
Cleotus globosus, Say. "
Trox capillaris, Say. "
foveicollis, Harold. "
Hoplia debilis, Lec. Ky.
Dichelonycha subvittata, Lec. "
linearis, Gyll. Ohio.
Lachnosterna hirticula, Knoch. Ky.
Cremastochilus variolosus, Kby. O.
canaliculatus, Kby. Ohio.

BUPRESTIDÆ.

Anthaxia quercata, Fab. Ohio.
Chrysobothris, n. sp. Ky.
Agrilus subcinctus, Gory. Ohio.

ELATERIDÆ.

Tharops ruficornis, Say. "
Fornax, n. sp. "
Microrrhagus impressicollis, Bv. Ky.
Elater socer, Lec. "
Megapenthes limbalis, Hbst. "
Limonius auripillis, Say. "
aurifer, Lec. "
Athous equestris, Lec. "
opalinus, Cand. "
Corymbites rotundicollis, Lec. "
Asaphes æreus, Mels. "
indistinctus, Lec. Ohio.

RHIPICERIDÆ.

Sandalus petrophya, Knoch. "

DASCYLLIDÆ.

Eurypogon niger, Mels. "
Cyphon obscurus, Guer. "
Eucinetus morio, Lec. Ky.
Philodactyla serricollis, Say. Ohio.

LAMPYRIDÆ.

Phengodes plumosa, Oliv. "
Eros fraternus, Rand. Ky.

MALACHIDÆ.

Anthocomus erichsonii, Lec. Ohio.
Attalus, sp. "

CLERIDÆ.

Clerus quadrisignatus, Say. "

PTINIDÆ.

Ernobius mollis, Linn. "
Petalium bistriatum, Say. "
Eupactus nitidus, Lec. "
Xyletinus fucatus, Lec. "
Cænocara oculata, Say. "
Sinoxylon bidentatum, Horn. Ky.
basilare, Say. Ohio.
Euceratocerus hornii, Lec. "

CERAMBYCIDÆ.

Phymatodes variabilis, Fab.	Ohio.
varius, Fab.	Ky.
Elaphidion incertum, Newm.	"
Heterachthes quadrimaculatus, N.	"
Obrium rubrum, Newm.	"
rubidum, Lec.	"
Neoclytus nitidus, Horn.	"
Clytanthus albofasciatus, Lap.	Ohio.
Encyclops cæruleus, Say.	"
Monohammus titillator, Oliv.	"
Goes pulverulentus, Hald.	Ky.
Urographis triangulifer, Hald.	"
Lepterges regularis, Lec.	Ohio.
Saperda lateralis, Fab.	"

CHRYSOMELIDÆ.

Cryptocephalus lautus, Lec.	Ky.
Pachybrachys pubescens, Oliv.	Ohio.
Trirhabda canadensis, Kby.	"

TENEBRIONIDÆ.

Alphitobius diaperinus, Pz.	"
Tharsus seditiosus, Lec.	Ky.
Paratenetus fuscus, Lec.	Ohio.
Platydema picilabrum, Mels.	Ky.
Phylethes bifasciatus, Say.	"

ALLECULIDÆ.

Hymenorus pilosus, Mels.	"
Mycetochares binotata, Say.	Ohio.
bicolor, Coup.	"
Strongylium crenatum, Mäkl.	Ky.

ANTHICIDÆ.

Xylophilus signatus, Hald.	"
Corphyra pulchra, Lec.	Ohio.

MELANDRYIDÆ.

Canifa pusilla, Hald.	"
Orchesia gracilis, Mels.	"

MYCTERIDÆ.

Lacconotus punctatus, Lec.	Ky.

MORDELLIDÆ.

Mordellistena semiusta, Lec.	Ohio.
nigricans, Mels.	"
millitaris, Lec.	"
æmula, Lec.	"
lepidula, Lec.	"
morula, Lec.	"

ŒDEMERIDÆ.

Nacerdes melanura, Linn.	"

OTIORHYNCHIDÆ.

Pandeletejus hilaris, Hbst.	Ohio.

CURCULIONIDÆ.

Listronotus squamiger, Say.	"
Lixus læsicollis, Lec.	Ky.
Magdalus barbita, Say.	"
Anthonomus signatus, Say.	Ohio
Prionomerus calceatus, Say.	Ky.
Thysanocuemis fraxini, Lec.	Ohio.
helveolus, Lec.	Ky.
Zaglyptus sulcatus, Lec.	"
striatus, Lec.	"
Acalles carinatus, Lec.	Ohio.
Acoptus suturalis, Lec.	"
Cœliodes asper, Lec.	"
Centorhynchus zimmermanni,	"
Cossonus corticola, Say.	"
Centrinus picumnus, Hbst.	"

CALANDRIDÆ.

Dryophthorus corticalis, Say.	Ky.

SCOLYTIDÆ.

Xleborus cælatus, Eich.	Ohio.
celsus, Eich.	Ky.
Chramesus icoriæ, Lec.	"
Phlœotribus, sp.	Ohio.
Scolytus quadrispinosus, Say.	"
rugulosus, Ratz.	"

DESCRIPTION OF THREE NEW ORDERS AND FOUR NEW FAMILIES, IN THE CLASS ECHINODERMATA, AND EIGHT NEW SPECIES FROM THE SILURIAN AND DEVONIAN FORMATIONS.

By S. A. Miller.

Order Agelacrinoidea, n. ord. and n. fam.

This order is proposed to include, so far as known, only the family Agelacrinidæ, and each may, therefore, be defined as follows:

Body thin, circular and parasitic upon other objects. The lower side consists of a thin, smooth, attaching membrane or plate. The upper side is more or less convex, and composed of thin, squamiform or imbricating plates, usually much smaller at the periphery than toward the center. Ambulacra constituting part of the convex surface furrowed on the interior, and composed of a double series of transverse alternating plates, sometimes having smaller, middle, intercalated ones. Two or more rows of ambulacral pores connect the exterior with the interior of each ambulacrum. The so-called ovarian or anal aperture is situated in one of the inter-ambulacral areas, and is usually surrounded by cuneiform plates forming a depressed circular prominence. The genera belonging to this order and family are Agelacrinus, Edrioaster and Hemicystites.

Order Lichenocrinoidea, n. ord. and n. fam.

This division of the fossil Echinodermata, and the family Lichenocrinidæ, are established upon the genus Lichenocrinus.

The definition of the order and family will be the same, as both are founded on a single genus.

The body attached during part or all of its life to foreign objects. It is circular, convex upon the upper side, and more or less crateriform surrounding the central stalk-like appendage. The lower side at some period of life possessed a thin attaching plate. The upper side is covered with numerous polygonal plates, without any evidence of the presence of ambulacra, arms, mouth, pectinated rhombs or pores connecting the exterior with the internal cavity. The interior of the visceral cavity contains numerous radiating upright lamellæ that support the polygonal plates of the upper side, and often leave their impression, like the radiations of a star, upon the object to which it

was attached. The stalk rises from the central depressed area, and consists, at first, of interlocking plates, but afterward, of circular ones, like those of a crinoid column, and finally tapers to a point. It was flexible and perforated with a longitudinal channel, though the perforation has not been satisfactorily ascertained, at the upper terminating point.

Order Myelodactyloidea, n. ord.

This division of the fossil Echinodermata is established as follows:

Body free, discoidal, and possessed of an internal radiating system of pores, which increase, by division, from the center to a tubular channel in the circular margin or surrounding coil. There are two families referred to this order, the Myelodactylidæ and the Cyclocystoididæ. In the former, the radiating and circular systems become complicated by the connection, between succeeding coils and through the flattened connecting finger-like processes; in the latter, the arrangement is more simple, as the interior radiations connect with a single marginal circular system. The external form and internal structure are so essentially distinct from other well defined orders, that the technical names, used in description, have no ascertained application. That is, we can not intelligently apply the words calyx, ambulacra, arm, etc., to any part of these peculiar organisms. This order has been suggested with hesitation, because there still exists a possibility that Myelodactylus belongs, in some manner, to the vault of a crinoid, but the author thinks there is not much probability of such connection.

Family Myelodactylidæ, n. fam.

This family is founded upon the single genus Myelodactylus, and defined as follows:

Body free, discoidal, and resembling a coil rolled in the same plane, and covered upon either side by finger-like processes from each succeeding turn overlapping the next inner one. The whorls are composed of a series of plates, having a tubular channel within, and perforated and finger-like processes upon the exterior, directed toward the center, and flattened down upon the next inner whorl to which they are attached, and form a porous connection from the tubular channel of one whorl to the next inner one. The cast of the pores of the inner whorl resemble the radiating spokes of a wheel: they are multiplied in connecting the tubular channels of each succeeding whorl, thus making the internal radiating system doubly complicated. The

central aperture, if one exists, has not been discovered, and the structure of the terminal end of the anomalous coil is wholly unknown. The internal radiating system of pores may be compared with that of the family Cyclocystoididæ, and here the analogy in structure, with other families in the class Echinodermata, so far as known, ceases. The terminal end of the coil being unknown has led to the suggestion of the possibility of its having been connected with the vault of a crinoid, but as no genus is known having any such appendage, and some classification seeming desirable, this family has been proposed.

Family CYCLOCYSTOIDIDÆ, n. fam.

This family is founded upon the single genus Cyclocystoides, and defined as follows:-

Body free, consisting of a circular disk, and having a margin composed of a series of perforated plates. Within this marginal series the disk is covered with an integument of small plates, except, possibly, a small central aperture. The rim or marginal series contains a tubular channel, making the complete circle, which is connected with the interior, by numerous pores, that radiate from the center, and repeatedly bifurcate before reaching it. The inner side of the rim is grooved. for the reception of the internal part of the disk, and the outer side depressed and scarred, either by mammillary elevations or concave depressions, as if for the attachment of ossicular or other processes. The tubular channel is connected with the exterior by minute circular pores, which were probably analagous, in their purpose, to the calycine pores in the Cystideæ.

HOLOCYSTITES JOLIETENSIS, n. sp.

[Plate IX., figs. 1 and 1*a*, natural size.]

The body is rather above the medium size, and almost completely obovate in outline. It is covered by numerous irregularly disposed convex plates, differing much in size and form, and not susceptible of being thrown into circular ranges, as is usual in this genus.

The species is founded upon casts, but these preserve the form of the convexity of the plates, and one of them, as shown in fig. 1, preserves the cast of some of the pores with which the plates were perforated, which draw this species in near relationship with *H. pustulosus*, described in vol. 1, p. 134, pl. 6, figs. 1 and 1*a*, of this JOURNAL. Both species were covered with irregular, convex, pustulous, porous plates,

and each has a general obovate outline. This species, however, is distinguished, readily, by the numerous, smaller, intercalated plates, upon the surface, which do not characterize *H. pustulosus.*

Farther defining it, we may say, that it appears to have possessed a small column. The lower range of plates consists of eight, which are slightly longer than wide These are succeeded by a range of eight plates, which are a little larger than those in the first range, and each of which is longer than wide. This range is succeeded by a number of small intercalated plates, which, in fig. 1, indicate about eighteen plates in the circumference of the specimen, but one side of the specimen is injured, so that only one half of them can be distinguished, and if fig. 1*a*, as supposed, belongs to the same species, and shows the opposite side, then some larger plates occur, and there are less than eighteen thrown into an irregular range. Above this, large plates may be described as surrounded with smaller ones, rather than saying that they form ranges surrounding the body, though some of the larger plates rest upon each other, and form a line of plates of irregular size, extending from the base to the summit, but not in the opposite direction.

The summit of each specimen is too much injured to allow any certainty in the determination of the mouth and ambulacral opening, though the latter appears to have been quite central.

The species is founded upon two specimens, each of which preserves only one side. They are from the magnesian limestone, of the age of the Niagara Group, at Joliet, Illinois, and belong to the collection of W. C. Egan, of Chicago. Another specimen, in the same collection, indicates a distinct species, with remarkably porous plates, but the specimen is not in such a state of preservation as to justify giving to it a specific name.

Eucalyptocrinus proboscidalis, n. sp.

[Plate IX., fig. 2, natural size, as drawn from a plaster cast of the original.]

The calyx of this species is elongated, and even when covered with plates is longer than wide. With the brachials and interbrachial plates attached, it is elongate-cylindrical, or possesses a length over two and a half times its diameter, and above this the species bore a huge proboscis, having a length almost equal to all the other parts of the body.

The calyx, in the form and arrangement of the plates, is much like *E. egani*, but is proportionally a little more elongated, and a little less truncated at the base.

The cast of the dome, that covered the calyx, has a height, above the connection between the arm furrows and the interior of the body, nearly equal to its diameter. The cast of the canal leading from the dome to the proboscis is near the size of the column, for a distance about equaling the diameter of the body, when it suddenly and rapidly expands over the top of the interbrachials, to three times its diameter within, or about two thirds the diameter of the calyx, and represents the base of the proboscis. The proboscis is here covered with large hexagonal plates, each of which is a little longer than wide, and which seem to form regular, continuing, upright series, toward the apex of the prolonged proboscis, gradually diminishing in size as the latter contracts.

The length of the specimen, from the bottom of the calyx to the apex of the proboscis, is 4 25-100 inches; to the top of the interbrachials, 2 40-100 inches; to the top of the dome, 1 40-100 inches; and to the top of the calyx, 90-100 inch. The diameter of the cast of the calyx at the top is 75-100 inch; the greatest diameter through the interbrachials is 90-100 inch, which shows a slight expansion above the top of the calyx, and the diameter of the cast of the base of the proboscis is a full half inch.

This remarkable specimen was found in the magnesian limestone of the age of the lower part of the Niagara Group, at Pontiac, O. D. A. McCord, of Oxford, in Butler county, made several plaster casts of it, from one of which I have illustrated and described the species. It would have been a little more satisfactory to have had the original, but the workman who discovered it seemed to value its possession, and as I have had no opportunity to communicate with him, or borrow it, I have ventured upon the opportunities presented for laying the interesting species before the public.

Murchisonia worthenana, n. sp.

[Plate IX., fig. 3, natural size.]

Shell rather below medium size, in this genus, and very wide, the apical angle being about 90 deg. It consists of six or seven whorls, very extremely and sharply angular at the lower edge, and the last one, at half the distance from the angle to the columella, commences, with a gentle slope, to ascend to the suture, which is close up under the keel of the volution above. The angularity increases with each descending whorl from the apex, until the keel may be called a flange, and then an extended flange, slightly curving upward, which, on the

last whorl, extends nearly half the distance from the periphery to the columella. The suture is sharp and distinct, and close up under the keel above. Aperture unknown. The last volution appears to have expanded below for the aperture, but enough is not preserved for definition.

Surface ornamented by numerous distinct round striæ or lines, extending from the sutures a little obliquely backward to the periphery of the angular keel. These striæ increase in width toward the keel, and in two instances on our specimen there is an increase by implantation.

The peculiar keel or flange, and the surface ornamentation, will distinguish this species from any hitherto described.

It was collected by W. C. Egan, at Bridgeport, Chicago, in the magnesian limestone of the age of the Niagara Group, and by him presented to the author. Instead of being a cast of the interior of a shell, as is usual in such limestone, it is a cast of the exterior of the shell, and is, therefore, remarkable and unique. The specific name is in honor of A. H. Worthen, the distinguished State Geologist of Illinois.

POTERIOCRINUS DAVISANUS, n. sp.

[Plate IX., fig. 4, natural size ; fig. 4*a*, enlarged view of the calyx and brachials ; fig. 4*b*, enlarged view of the azygos side of another specimen ; fig. 4*c*, an enlarged view of a fragment of an arm.]

This species is rather below the medium size, the calyx truncated obconoidal, the arms strong, and the column fairly proportioned to the size of the body.

Column.—The column is long, round, smooth, or with very slightly projecting plates, and very gently expanding to unite with the calyx. The plates are of nearly uniform thickness, and where the column is weathered, the serrated union of the plates discloses the radiations upon their uniting faces.

Body.—The length and breadth of the calyx are nearly equal ; the plates are smooth, and the sutures moderately distinct. The basal plates are pentagonal, slightly wider than high, the two upper sloping sides are the shorter ones, and the side articulating with the column has about the same length as the uniting sides between the basals. The subradials are about as wide as high, and quite regularly hexagonal, except the two on the azygous side, which support the plates at the base of the proboscis, which are heptagonal. The first radials are pentagonal, three of them wider than long, and the other two about as long as wide. The upper or articulating surface is truncated the entire width of the plate, for the support of the brachials.

Brachials.—There are three brachials, or free radial plates, supporting arms, in each of the five series. The first plate is longer than wide ; it is longer than any plate in the calyx ; it tapers very gradually, and being round upon the outer face presents the appearance of a truncated cone. The second plate is rather wider than long, and tapers less, proportionally, than the first. The third plate is pentagonal, rounded, expanded at the upper third, where its width is about equal to the greatest length, and supports the arms upon its upper sloping sides. This description will apply to three of the series, but the two series upon the azygous side are a little narrower at the base of the first brachials, and therefore taper less in the first and second plates.

Arms.—There are ten arms, rather stout, and of medium length. They are composed of elongated, somewhat wedge-shaped, plates, that project slightly at the upper margin of the longer sides from which the pinnules arise, giving the arms a serrated or roughened aspect upon either side. The pinnules are long and strong. None of them in the illustrations are drawn to their full length, and the plates are longer than they are indicated in fig. 4*c*, which was drawn rather to indicate a magnified piece of an arm than to show the appearance of the pinnules.

Interradials and proboscis.—There are two or three small plates upon the azygous side, within the calyx, which seem to belong to the ventral tube or proboscis, which are succeeded by small plates that cover the proboscis, as shown in the magnified view, fig 4*b*. The proboscis is large, separates widely the two anterior arms, and gently curves inward between the arms and pinnules. It is shown broken off in fig. 4. It appears that it extended, in height, beyond the arms.

This is a marked and beautiful species, that will not be confounded with any other known to the author, who collected it, in rocks of the age of the Upper Helderberg Group, at Deputy, Indiana.

The specific name is in honor of William J. Davis, author of the "Fossil Corals of Kentucky," in the forthcoming volume of the Palæontology of that State, who has been making his home, for many years, in the special interest of palæontological science, among the Devonian fossils in the vicinity in which this species was collected.

POTERIOCRINUS NETTELROTHANUS, n. sp.

[Plate IX., fig. 5, enlarged two diameters ; fig. 5*a*, magnified view of two arms as they appear from the fourth brachial.]

This species is very small, column comparatively large, and arms remarkable for unequal bifurcations.

Column.—The column is round, smooth, very gently expanding to unite with the calyx, and seems to have tapered to a point at no great distance from the calyx, after throwing off numerous floating rootlets. This latter supposition is based upon the two facts, that the column, over an inch in length, attached to a head, has materially diminished in size, and upon the same slab, near by, there occurs a yet smaller tapering column throwing off small rootlets, at irregular distances from each other, which are about the size of what we may suppose pinnules would be in a species in this genus of the size of the one under consideration. The length of these little rootlets is about one fourth of an inch, and the length of the fragment of the column so preserved is about one and a half inches. The plates are of nearly uniform thickness.

Body.—The calyx is like a smooth, reversed, truncated, slowly tapering cone, having a length more than one and a half times its greatest diameter. The basal plates are pentagonal, higher than wide, the two uniting sides being the longer, and the two upper sloping sides being the shorter ones. The subradials are hexagonal, longer than wide, the upper sloping sides being a little longer than the under ones. The first radials are pentagonal, longer than wide, and the upper or articulating surface is truncated the entire width for the support of the brachials.

Brachials.—There are four brachials or free radial plates supporting arms in each of the five series. These are round or subcylindrical on the outer face, tapering very slightly only, up to the middle of the fourth plate, where there is a little expansion, at the lower part of the sloping sides, which support the arms. The first plate is the longer one, but they decrease in length, very slowly, so that the fourth plate is fully two thirds as long as the first one.

Arms.—The arms are remarkable in their manner of division. Every third plate from the last brachial throws off an armlet or little arm, which occurs in every instance observed, and is shown upon three arms on one specimen to the sixth bifurcation. The armlets do not possess the character of pinnules, but in no instance do they bifurcate. This character is quite well shown in the magnified view of part of two arms shown in fig. 5*a*. There are ten specimens of this species on a large slab, more or less perfect, and one of them shows part of eight arms, another part of six, and two others each preserve a considerable part of four, and others have some in a greater or less state of preservation. From an examination of these

I would say each arm possessed six or more armlets. Notwithstanding the specimens are in a good state of preservation, there is no evidence of the existence of pinnules, beyond a finely serrated edge, as if the ambulacral furrow had been protected by very short, fine cilia.

The azygous side is not shown by any specimen, in such condition as to justify a definition, and but one specimen shows any part of the proboscis, and it exposes only enough to prove the existence of that part.

I collected this species in rocks of the age of the Upper Helderberg Group, at Deputy, Indiana.

The specific name is in honor of Henry Nettleroth, of Louisville, who has done so much to make known the fossils of the Devonian rocks of that locality, and who is the author of the "Fossil Mollusca of Kentucky," in volume 1 of the Palæontology of that State, which is now in press.

Lichenocrinus tuberculatus, S. A. Miller.

[Plate IX., fig. 6, three specimens on a shell, natural size; fig. 6*a*, a magnified view of one of these, showing the upright lamellæ in the body cavity.]

[Lichenocrinus tuberculatus, S. A. Miller, 1874, Cincinnati Quarterly Journal of Science, vol. 1, p. 346.]

The specimens illustrated, I collected at an exposure of the extreme upper part of the Hudson River Group, about three miles south of Osgood, Indiana. They are large, and show the interior better than any I have hitherto seen. The crenulations on the upright lamellæ, shown in the magnified view, fig. 6*a*, are due, probably, to mineralization, and do not represent a character of the genus. The upright lamellæ radiate from a central apex, or little sharp node, which has an appearance something like the apex of a *Crania lœlia*. This is placed immediately below the perforation of the column, and seems to set at rest the question as to a central opening on the under side. There is no such opening. The specimen which Prof. Meek examined, and which caused him to suggest the possibility of such an opening, evidently presented some defect instead of an opening.

Lichenocrinus affinis, n. sp.

[Plate IX., fig. 7, natural size; fig. 7*a*, magnified view.]

This species is small, and very much resembles *L. crateriformis*. It is circular, discoid, crateriform, and composed of irregular, polygonal, slightly convex plates. These are smaller at the periphery, and

near the column, than on other parts of the body. There is no alternation in the arrangement of the plates, nor any regular circular series, such as the larger circle of plates that covers the greatest convexity of *L. crateriformis.* It is distinguished from the latter species by this want of any order in the arrangement of the plates, the absence of the large circular series, and the slight convexity of the plates. It has a column which is pentagonal near the head.

It is found in the upper part of the Hudson River Group, in Warren and Clinton counties. The specimens illustrated were presented to the author by Dr. Dyke, of Lebanon, O., who found them in that vicinity, and I collected it several years ago near Clarksville, associated with *Glyptocrinus oneali* and *Megalograptus welchi.* It is found in the rocks a little below the range of *L. tuberculatus*, but considerably above any known specimens of *L. crateriformis.*

CYCLONEMA CINCINATENSE, n. sp.

[Plate IX., fig. 8, natural size ; fig. 8*a*, natural size, showing aperture with a little of the outer lip broken away ; fig. 8*b*, natural size of a specimen, with much of the outer lip broken off ; fig. 8c, magnified view of a part of the surface of the upper part of the last whorl.]

Shell rather below the medium size in this genus, and usually wider than high. It consists of four or five rounded volutions, which increase rather rapidly in size, and become more depressed upon the upper side as they approach the last whorl, which is also flattened upon the lower side, from the outer lip to the columella, and forms a slight concavity, as it passes the straightened lip of the latter; suture usually well defined; aperture higher than wide, somewhat ovate in outline, and straightened upon the inner side; inner lip slightly thickened at the columella.

Surface ornamented by revolving lines or ridges, which are beautifully crenated or delicately cancellated by the crossing of more numerous and finer oblique lines of more uniform size. About six or seven revolving ridges, or strong lines, occur on the upper and outer part of the last volution, those on the upper part being most distant from each other, and between each of which there is a single fine revolving line ; on the volution preceding the last, only four or five of the stronger revolving lines occur, with a corresponding decrease in the number of the finer ones; while on the first and second volutions the revolving lines are more uniform in size and less numerous. The revolving lines on the under side of the last volution become gradually finer toward the columella, until they correspond in size with the crossing oblique lines, and furnish an evenly cancellated ornamentation.

This species is distinguished from *Cyclonema varicosum* by the form of the aperture, which is higher than wide, and longitudinally ovoid instead of as wide as high and transversely semioval; the columella is not so much lengthened, and is entirely destitute of the flattening near the upper part, which is so striking a feature in the illustration of Hall's species, in the 24th Rep. N. Y. St. Mus. of Nat. Hist. It is, too, a much smaller species, and ornamented by more numerous and more uniform revolving lines. It will be readily distinguished from all forms figured by Prof. Meek, in the Ohio Palæontology, vol. 1, pl. 13, under the name of *Cyclonema bilix*, by the general form of the shell and the character of ornamentation.

I collected numerous specimens of this species in the shales of the age of the Utica Slate Group, in the bank of the Ohio river, in the 1st ward of the city of Cincinnati, and five miles above the latter place on the Kentucky shore. Dr. R. M. Byrnes found it in the rocks of the same age opposite the 5th street ferry, and E. O. Ulrich has collected it in rocks of the same age at several places in the vicinity. Those in my own collection vary in width from $\frac{20}{100}$ to $\frac{55}{100}$ inch, and in height from $\frac{20}{100}$ to $\frac{65}{100}$ inch; but the ornamentation and shape present a striking uniformity throughout. The specimens illustrated are from my own collection. I am not aware of the existence of the species higher than rocks of the age of the Utica Slate.

Cyclora pulcella, n. sp.

[Plate IX., figs. 9, *9a* and *9b*, magnified views, the natural size being shown by the line in the center between the three figures.]

Shell small, rather wider than high, whorls three, which increase rapidly in size, suture well defined, aperture somewhat circular, umbilicus moderately large. Surface ornamented with numerous fine lines, extending from the suture a little obliquely backward. The cast of this species bears a resemblance to *Cyclora minuta*, from which it is distinguished by its larger size and more rapidly swelling volutions. The shell is distinguished by these differences, and also by the surface ornamentation.

Shell about a line in height, and about a line and a half wide.

The author collected this species in the upper part of the Hudson River Group, near Versailles, Indiana.

AMERICAN PALÆOZOIC BRYOZOA.

By E. O. Ulrich.

[*Continued from Vol. 5, page 175.*]

Monticulipora, D'Orbigny (Restricted).

Monticulipora. D'Orbigny, Prodr. de Pal., vol. 1, p. 25, 1850.

External characters.—Zoarium massive, lobate, laminar, incrusting, and sometimes irregularly frondescent. Surface sometimes smooth, usually tuberculated. Monticules closely approximated, usually conical, often elongated or compressed. Cells small, their diameter varying in different species from $\frac{1}{80}$th to $\frac{1}{130}$th of an inch, polygonal, and with thin walls; generally groups of cells slightly larger than the average, are distributed at regular intervals among those of the ordinary size. Not infrequently a few smaller (young ?) cells occupy the summits of the monticules, and they may occasionally be detected between the cells occupying the hollow interspaces.

Internal characters.—Tubes in the "immature" zones, with very thin walls, and crossed by straight or oblique diaphragms; and often there are large cystoid diaphragms present. In the mature zones the walls become very slightly thickened, and small spiniform tubuli can usually be detected; while numerous cystoid diaphragms are always developed in the greater number of the tubes. Immediately above the point of gemmation, the young tube is crossed by numerous straight diaphragms, giving it the appearance of an interstitial tube. Subsequently the diaphragms become less crowded, and the young tube assumes the characters of an ordinary cell. The process of gemmation seems to have taken place more especially at certain levels, since tangential sections taken at different heights, may show in one comparatively numerous small tubes intercalated among the ordinary cells, while another may show but few or none of them.

The genus *Monticulipora* as above defined and restricted, includes, so far as I have been able to ascertain, no less than ten distinct species, nine of which belong to the Cincinnati Group of Ohio and Kentucky, and the tenth to the Trenton Group of the latter State. Of these, two have been already published, the type species, *M. mammulata*, D'Orb., and the *M. cincinnatiensis*, James (as fig. and described by Nicholson), four I now publish for the first time, *M. lævis*, *M. con-*

similis, *M. parasitica*, and *M. wetherbyi*, and four others, which for the present must remain unpublished.

Under my definition of the genus *Monticulipora*, on p. 153 of this volume, I reduced Hall's *Trematopora* to the rank of a subgenus. That reference I now wish to retract, my opinion of *Trematopora* having undergone a change, since making the discovery that I had committed an unfortunate error, by transposing the labels on the sections cut from two, externally similar, though internally widely different species of bryozoans. About one year ago, Prof. R. P. Whitfield, the curator of Geology at the American Museum of Natural History, New York, very kindly presented me with an authentic fragment of *Trematopora tuberculosa*, Hall, which, being the first species described under the genus, *Trematopora* must therefore be regarded as its type. Of this fragment I made three sections, a longitudinal, a transverse, and one tangential. At the same time I also prepared three similar sections from an example of the species I subsequently described under the name of *Homotrypa obliqua*, n. sp. In labeling the sections of these two forms, I erroneously wrote *Trematopora tuberculosa* on the slides which I know contained sections cut from the fragment of *H. obliqua*. After an examination, I came to the conclusion that *Trematopora tuberculosa* could not be considered to differ generically from the species described further on under the name of *Homotrypa curvata*. Although I now regard the latter as differing in a generic sense from *Monticulipora*, D'Orb. (as restricted by me), two months ago I was uncertain, and preferred to arrange *Trematopora* as a subgenus under *Monticulipora*, rather than either to give the name the rank of a distinct genus, or to discard it altogether. The mistake was discovered after making another series of sections of the species *obliqua*, which of course were found to be identical with those at first labeled *Trematopora tuberculosa*. To insure certainty, I begged Prof. James Hall, the accomplished palæontologist of Albany, New York, to send me a fragment of his *T. tuberculosa*, which I might consider typical and authentic. He obligingly sent me two specimens, from which I prepared a series of sections that agreed in all respects with those formerly made and supposed to belong to *obliqua*. Having now found that my definition of *Trematopora* (*ante* p. 153) does not apply to the type species of that genus, and having also come to the conclusion that the group of species which I had intended to arrange under that name, is generically differentiated from *Monticulipora*, it becomes necessary to propose a new genus for their reception. I therefore beg

that the name *Homotrypa* (as defined further on) be accepted for the group of species which my unfortunate mistake led me to believe to be congeneric with Hall's *Trematopora tuberculosa.*

MONTICULIPORA MAMMULATA, D'Orb. (Plate X., figs. 5, 5*a.*)

Monticulipora mammulata, D'Orbigny. Prodr. de Paléont., vol. 1, p. 25, 1850.

Chætetes mammulata, Edwards and Haime. Pol. Foss. des Terr. Pal., p. 267, Plate XIX., fig. 1, 1851.

Monticulipora mammulata, Edwards and Haime, Brit. Foss. Cor., p. 265, 1854.

Monticulipora (Peronopora) molesta, Nicholson. The Genus Monticulipora, p. 224, Plate VI., figs. 2, 2*d.* Not *Monticulipora mammulata*, Nicholson.

Zoarium occurring as irregularly lobate masses, often of considerable size, that usually tend to throw off compressed processes, which in many specimens become frondescent; or, it may take the form of extended and undulated, often palmate, expansions, varying in thickness from 2 inch to .4 or .5 inch. Surface covered with numerous prominent, typically conical, often elongated monticules. The last feature is produced by the fusion of two or three of them. They are quite regularly arranged in series, in which sometimes five, usually, however, six, may be counted in the space of .5 inch. Cells polygonal, thin-walled, subequal, from $\frac{1}{120}$th to $\frac{1}{130}$th inch in diameter,* those occupying the summits of the monticules, being scarcely larger than those in the intervening spaces. Smaller or interstitial (?) cells may occasionally be observed, more frequently on the monticules where they are wedged in between the ordinary cells. When the cell-walls are perfectly preserved, they show the spiniform tubuli as minute granules.

Longitudinal sections show conclusively that the zoarium is divided into successive "immature" and "mature" zones. In the first, the cell-walls are very thin, and the tubes are almost invariably crossed only by straight or somewhat obliquely directed diaphragms, at distances apart of about one tube-diameter. This zone is very narrow, and soon a "mature" zone is entered when the walls are slightly

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* In all cases where the diameter of a *cell* is given, the measurement includes the wall. The dimensions given were obtained by calculating the number of cells in a given space. For instance, if the diameter of the cells of a species is stated to be 1-100th of an inch, it is equivalent to saying that ten cells may be counted in the space of one tenth of an inch.

thickened, the diaphragms more crowded, and the greater number of the ordinary tubes have along one or both sides a series of cystoid diaphragms; now there is also developed a limited number of much smaller tubes, which differ, at least near their point of origin, from the ordinary tubes in having more closely arranged diaphragms. In consequence, they have there the usual appearance of interstitial tubes. This character they may retain throughout the zone, but as they enter the next succeeding "immature" zone, their character has changed to that of an ordinary tube. The spiniform tubuli can not often be detected in a section of this kind.

A tangential or rather transverse section may present three different phases, according as it may pass either through the "immature" (1st), or fully "mature" (3d) stage; or (the 2d) if it cut the tubes just as they enter into the last stage. In the first, the tubes have excessively thin walls, are always apparently of one kind only, and thoroughly simple. In the second the walls are still very thin, and the appearance is like that of the preceding stage, excepting that we now observe quite a large number of smaller cells, wedged in among the ordinary tubes. In the third stage (Pl. X., fig. 5), the walls have become appreciably thickened, the smaller tubes, noticed in the second stage, have all, excepting a few among the cells occupying the monticules, changed their character, so that they can no longer be distinguished from the ordinary cells. This stage is further marked by the development of a large number of very small spiniform tubuli. Of the different phases above described, a single section may show only one, or, if large, all three.

The normal mode of growth of *M. mammulata*, is unquestionably the same as in other massive or discoidal forms of the *Monticuliporidæ.* The frondescent examples of the species have an entirely different structure from such truly frondescent forms as *Heterotrypa frondosa*, D'Orb. (not Nicholson),or *Homotrypa dawsoni* (*M.*(*Heterotrypa*) *dawsoni*, Nicholson). In the latter, as well as in all the ramose species, the frond or branch is divided into an axial and a peripheral region, and the structure of the tubes in these two regions, as is shown on page 125 of this JOURNAL, is widely different. No such difference can be shown to exist between the axial and peripheral portions of any frondescent specimen of *M. mammulata.* What we do find is precisely similar to the structure and mode of growth observed in the massive or lobate examples of the species, viz.: the "immature" and "mature" zones (respectively equivalent to the axial and peripheral regions of the ramose and truly frondescent forms), are reproduced at successive

levels, one above the other, and it can not be said that the fronds are ever divided into dissimilar axial and peripheral regions.

Dr. Nicholson, in his description of this species, under the name of *Monticulipora* (*Peronopora*) *molesta* (see syn. above), fails to recognize several important characters, and besides gives an incorrect measurement. He gives the diameter of the cells as from $\frac{1}{80}$th to $\frac{1}{90}$th inch. I have not seen any specimen of this species in which the ordinary cells had a greater diameter than $\frac{1}{120}$th of an inch, nor do the cells in his tangential section, as figured by him, appear to have had a greater diameter. At any rate, it is certain that the cells in that figure are not so large as those figured of some other species, which, according to the measurements given by him, ought to be smaller. He did not recognize the nature of the interstitial (?) tubes, but regards them as true interstitial tubes, and of the same nature as in *Peronopora decipiens*, Rominger, and *Heterotrypa frondosa*, D'Orb.; but as I have above stated, this is not their true nature. His tangential section cuts the tubes transversely through the 2d phase mentioned by me in my description of the tangential section of this species, and because it shows a rather large number of the intercalated small tubes, I believe that it was prepared from one of the frondescent examples, tangential sections of which always present a greater number of the small tubes than do transverse sections of the massive specimens. This I consider due to the fact that in the frondescent forms the divergence of the tubes is much greater than in the massive examples, making it necessary that young cells be more numerously and rapidly developed in the former than in the latter.

I would suggest and recommend that Nicholson's name *molesta* be retained as a varietal designation for the frondescent examples of this species, as some title, by means of which it may be distinguished from the massive and lobate examples, is, if not really necessary, at least desirable.

Formation and locality: Cincinnati Group. The massive and lobate variety can not be called common at any horizon or locality. The best localities known to me are on the hills south and west of Covington, Ky.: at an elevation of about 300 feet above low water mark in the Ohio river. The var. *molesta* becomes a common fossil in strata from 75 to 100 feet higher in the series. The species appears to be confined to these limits.

MONTICULIPORA LÆVIS, n. sp. (Plate X., figs. 1-1*b*.)

Zoarium free, and forming small, sub-globular or irregular masses;

or attached at the base to some foreign substance. Surface smooth, or faintly raised at intervals into low and broad monticules, which are occupied by groups of cells of a larger size than the average; the largest have a diameter of about $\frac{1}{90}$th inch. The ordinary cells have a diameter varying from $\frac{1}{120}$th to $\frac{1}{130}$th of an inch, are polygonal, and have very thin walls.

Longitudinal sections (Plate X., fig. 1*b*,) show the tubes in the "immature" portions of their length to have excessively thin walls, and to be crossed by straight, though usually obliquely directed diaphragms, placed at distances apart of one tube diameter or a little less; a few of the tubes in this zone have one side lined with correspondingly large cystoid diaphragms. In the "mature" zones, the tube-walls are slightly thickened, more cystoid diaphragms are developed, and as well, the straight diaphragms become somewhat crowded. At the junction between the upper end of the "mature," with the lower portion of the next succeeding "immature" zone, the continuity of the cell-walls is always more or less disturbed. The young tubes have their lower end divided transversely by numerous diaphragms, but they rapidly attain the diameter and character of the more fully developed tubes.

Transverse sections (Plate X., fig. 1*a*) show that all the tubes of the zoarium are polygonal and thin-walled, and the walls, in the mature region, have a peculiar granular appearance, with light streaks apparently passing through the substance of the walls, as though they might have been porous.* As is the case in all Monticuliporoid species possessing cystoid diaphragms, the visceral chamber of the tubes is crossed by a delicate lamina, which is deeply excavated on one side in a triangular or crescentic manner, their presence being due to the intersection of the cystoid diaphragms, that, as is shown in a longitudinal section, line one side of the tube. Interspersed among the tubes that have attained the mature size, are a small number of more or less developed young tubes.

The form to which the attached examples present the greatest resemblance, and with which it may be readily confounded, is the *Prasopora hospitalis*, Nicholson. The external points of difference are found in the slightly larger cells, thicker cell walls, and numerous interstitial cells, characterizing Nicholson's species. In comparing any well pre-

* The same character may be observed in *M. mammulata*, and other species, and it seems probable that the walls of the tubes, in species of *Monticulipora*, were pierced by connecting foramina.

served examples of the two species, these differences become at once apparent to the practised eye.

Formation and locality: Cincinnati Group. The specimens upon which the species is founded were collected by the author, at Oxford, O., in strata equivalent to an horizon of 650 feet above low-water mark in the Ohio river, at Cincinnati, O.

MONTICULIPORA CONSIMILIS, n. sp. (Plate X., fig. 2.)

Of this species or variety I have unfortunately been able to obtain only a single specimen, and what is left of it after breaking it to secure material for the necessary sections is very well represented by the figure on Plate X. Its form was that of a small dome-shaped mass, that on the lower side is attached to the shell of a *Strophomena*. The upper surface carries somewhat unequally distributed, compressed, and very prominent monticules, the summits of which appear to be mostly occupied by the apertures of very small cells, and their slopes by cells slightly larger than the average. The ordinary cells are polygonal, thin-walled, and from $\frac{1}{110}$th to $\frac{1}{120}$th of an inch in diameter.

Transverse sections are precisely similar to those of the preceding species, while longitudinal sections of the two appear to differ slightly only in one respect, viz: the diaphragms crossing the tubes of *M. consimilis*, are placed at slightly greater distances apart than is the case in any of the sections of *M. lævis* examined by me. Further discoveries may prove it to be only a variety of that species. In its general outward appearance the specimen presents a remarkable resemblance to a species of *Prasopora*, collected by me in Upper Trenton strata, at Nashville, Tenn,, and which is further on described under the name of *P. nodosa.*

Formation and locality: same as the preceding.

MONTICULIPORA PARASITICA, n. sp. (Plate X., figs. 3, 3*a*.)

Zoarium usually attached to *Streptelasma* (*corniculum ?*); the layers according to age, may vary in thickness from excessively thin, to nearly .1 inch. The surface of the *Streptelasma* often carries a number of these parasitic patches, which, as they increase their diameter by lateral development, at last join each other. The line of junction is always marked by a slightly elevated, calcareous ridge. Not infrequently one proves the strongest, and gradually grows over the other colonies. Regularly arranged in decussating series, and at distances apart of about .1 inch, the surface presents small conical monticules,

the summits of which usually appear to be solid, as they are occupied by minute cells; while on their slopes they carry the apertures of slightly larger cells than the average. The largest of these have a diameter of $\frac{1}{85}$th of an inch. The spaces between the monticules are flat, and are occupied by the polygonal, and moderately thin-walled, ordinary cells, their diameter varying from $\frac{1}{110}$th to $\frac{1}{100}$th of an inch. Interstitial cells (if they can be so called) are developed only in the monticules, the summits of which are usually occupied by their apertures.

Tangential sections (Plate X., fig. 3*a*) show the tubes to be polygonal and thin-walled. Their angles of junction are usually thickened, and the small space thus formed incloses, almost invariably, a minute lucid spot. They represent in all probability very small spiniform tubuli. The appearance of the best section examined leaves me little room to doubt that the tube walls were really pierced by numerous and excessively minute foramina. Where these are not clearly shown, the wall has a peculiar granular appearance. Within the visceral chamber of each of the ordinary cells, the intersected cystoid diaphragms are shown. In a large number the cut edges of the cystoid diaphragm gives the appearance of a secondary oval cell, within the polygonal walls of the tubes. Between the groups of slightly larger cells, a few thick-walled, minute tubes (interstitial) may generally be observed.

Longitudinal sections (Plate X., fig. 3) show that all the matured tubes have one or both sides lined by a series of cystoid diaphragms, while the space between the double series, or single series and opposite wall, is crossed by straight diaphragms, which are placed at distances apart of about one third of a tube-diameter.

I know of no associated species with which *M. parasitica* might for a moment be confounded. It is probably more nearly allied to the *M. cincinnatiensis*, Nicholson, than to any other species described from the Cincinnati Group. The larger, more closely arranged, and much more prominent monticules of that species, constitute a point of difference so decided and readily apparent, that examples of the two species may be distinguished at a glance.

Formation and locality: Cincinnati Group. Not uncommon at Oxford, O., and other localities, exposing strata having a height equivalent to an horizon of nearly 700 feet above low-water mark in the Ohio river, at Cincinnati, O.

MONTICULIPORA WETHERBYI, n. sp. (Plate X., figs. 4 4*b*.)

Zoarium forming a patch over foreign bodies, to which it is parasi-

tically attached ; it is usually very thin ; sometimes, however, the center is elevated, so as to give the zoarium the form of a depressed cone. The surface is often nearly smooth, but in the more typical forms is raised at intervals into low and broad monticules. Cells polygonal, with very thin walls, the diameter of those of the ordinary size varying from $\frac{1}{100}$th to $\frac{1}{90}$th of an inch. Groups of larger cells, having a diameter not exceeding $\frac{1}{80}$th of an inch, occupy the summits and slopes of the monticules, or in the smooth forms are scattered over the surface at intervals of .1 inch, measuring from centre to center. The surface extension of numerous spiniform tubuli, situated at the angles of the cells, may be observed in well-preserved examples.

In longitudinal sections (Pl. X., fig. 4*b*) the tubes have thin walls, and are crossed by straight diaphragms, at distances apart varying from one third to a full tube diameter. All the tubes have cystoid diaphragms, which, however, are only rarely arranged in series. The spiniform tubuli can always be recognized in a section of this kind.

In transverse sections (Plate X., fig. 4*a*) the tubes are polygonal, and have very thin walls. The spiniform tubuli are numerous and rather large ; they almost invariably are situated at the angles of the tubes.

The large spiniform tubuli, and the erratic disposition of the cystoid diaphragms are characters which will distinguish *M. wetherbyi* from all other species of the genus known to me. Named for my friend, Prof. A. G. Wetherby, whose papers have added so much to our knowledge of the fauna of the Trenton Group of Kentucky.

Formation and locality : Trenton Group, in strata about in the middle of the series, at High Bridge, Ky. Collected by the author.

HOMOTRYPA, nov. gen.

External characters.—Zoarium ramose to subfrondescent ; surface smooth, or with more or less prominent monticules. Cells circular, ovate or polygonal, with moderately thin walls. At intervals there are groups of larger-sized shells, which again sometimes inclose small stellate maculæ, consisting of much smaller, angular cells. The surface extensions of spiniform tubuli may often be observed at the angles of the cells.

Internal characters.—In the axial portion of the branches or fronds, the tubes are "immature," and may be crossed by straight diaphragms; usually diaphragms are entirely wanting in this region. The tube-

walls are excessively thin until they reach the peripheral regions, when they are much thickened, and bend outward to open at the surface. In the peripheral or "mature" portion of the zoarium, the tubes are provided with a series of cystoid diaphragms; the space intervening between their flexuous inner line, and the opposite wall of a a tube, is crossed by equally numerous straight diaphragms. The tube-walls are perforated by rather large connecting foramina. In the tuberculated species the spiniform tubuli are numerous, but very small, and not easily recognized, while in the smooth forms they are much larger, and constitute a conspicuous feature in sections. The internal structure of the small tubes, which form the maculæ of some species, is not remarkably different from that of the ordinary tubes. The only difference that I have been able to detect is found in the fact that cystoid diaphragms are but rarely developed in them.

Type: *Homotrypa curvata*, n. sp.

By comparing the above description with my erroneous definition of the subgenus *Trematopora*, on page 153, it becomes apparent that both were based upon the same group of species. As before stated, I was formerly in doubt whether they could be separated generically from *Monticulipora*, but now I do not hesitate to say that they are entitled to rank as a distinct genus. The zoaria of all the species of *Monticulipora* are, normally, incrusting or massive, while in *Homotrypa* they are truly ramose or frondescent, and the difference between the characters of the tubes in the axial and peripheral regions of the zoarium, is always strongly marked and constant. As is shown in tangential sections, the tubes in the "mature" region of a species of *Homotrypa*, have thick walls, and the visceral cavity is more or less rounded, and not polygonal, while it can not be said of any species of *Monticulipora* that it has thick-walled cells, or that the visceral cavities of the tubes are not polygonal. Internally, *Trematopora tuberculosa*, Hall (the type of that genus), differs from species of *Homotrypa* in having peculiarly inflected, thin-walled tubes, which are surrounded, and often completely isolated by smaller, angular, and closely tabulated interstitial tubes. Externally, the proper cells differ in having their margin raised into a thin rim, which, however, seldom extends in a continuous line around the cell-aperture.

Beside the two species next described, the Cincinnati Group furnishes at least three other distinct forms, having the characters of this genus. One of these was described and figured by Nicholson, under the name of *Monticulipora* (*Heterotrypa*), *dawsoni* ("Genus Monticulipora," p.

141, Plate V., figs. 3-3*f*, 1881). His figures of that species fail to represent two of the most important characters, nor are they mentioned in his description, viz: the connecting foramina, and cystoid diaphragms. I feel confident that his sections were prepared from a portion of a frond not fully matured, since his figures and description of the internal characters of the species, apply in all respects to sections prepared by me from examples in that condition. In a tangential section of a fully matured specimen, cutting the tubes just below the surface, the walls of same have a thickness about equal to those of *H. curvata*, as represented by fig. 7*d*, Plate X., and the connecting foramina (clearly shown in one of my sections), are precisely like those piercing the walls of the tubes in *H. obliqua* (Plate X., fig. 6*b*). The cystoid diaphragms are large, and developed in only a minority of the tubes, and in this character *H. dawsoni* differs from all the other species of the genus. This species is further characterized by its frondescent growth, and remarkably prominent and closely arranged monticules.

Homotrypa curvata, n. sp. (Plate X., figs. 7-7*d*.)

Zoarium ramose, consisting of compressed, often greatly flattened branches. An average specimen has a height of over two inches, a width of about seven tenths of an inch, and a thickness of two tenths of an inch. The most conspicuous feature of the surface is found in the small, stellate maculæ, which, under a low magnifying power, appear to be solid, but, as is shown by a higher power, are composed of very shallow, and angular, small cells. These maculæ are on a level with the general surface, and occur at intervals of about .11 of an inch, measuring from center to center. The ordinary cells are usually rounded, though sometimes slightly angular, have moderately thick walls, with a diameter varying from $\frac{1}{140}$th to $\frac{1}{130}$th of an inch. The cells immediately surrounding the stellate maculæ are larger, and may attain a diameter of $\frac{1}{90}$th of an inch. When the specimen examined is in a good state of preservation, the surface spines (spiniform tubuli) may be detected. They never constitute a conspicuous feature of the surface.

Tangential sections (Plate X., fig. 7*d*) show that the tubes in the outer or "mature" portion of the zoarium have thickened walls, more or less rounded visceral cavities, and that they are apparently completely amalgamated with one another. The walls, between the narrow lucid ring which surrounds each of the tubes, has a peculiar granular

structure, and is crossed by the connecting foramina, of which my sections show three or four to enter each tube. The spiniform tubuli are numerous, of moderate size, and have the usual appearance. In longitudinal or vertical sections (Plate X., fig. 7*c*) the tubes in the axial region have excessively thin, and slightly flexuous walls, and are crossed by diaphragms at distances apart of from one to two tube-diameters. As they bend outward into the peripheral region, their walls are much thickened, the diaphragms occur at shorter intervals (one third to one half a tube-diameter), and correspondingly crowded series of cystoid diaphragms are developed in nearly all the tubes. Lastly, the spiniform tubuli may be recognized.

In transverse sections (Plate X., fig. 7*b*) the tubes are polygonal, the walls excessively thin, and the calcite filling them is divided by irregular cruciform lines, that often are so distinct as to cause the observer some trouble to exactly determine the outlines of the tube walls. (The same feature occurs in many other species of the *Monticuliporidæ.*)

Formation and locality: Cincinnati Group. An abundant species on the hills surrounding the city of Cincinnati, but very limited in range, being apparently restricted to a few feet of strata at the 300 ft. level. A very similar if not identical form occurs near the top of the formation.

Homotrypa obliqua, n. sp. (Plate X., figs. 6 and 6*b*.)

Zoarium ramose, branches cylindrical or compressed, from two to four tenths of an inch in thickness. Typically the surface is covered by rather prominent and closely arranged monticules, the summits of which carry cells with thicker walls than the average. The monticules are not a constant feature in this species, examples with an almost entirely smooth surface being of frequent occurrence. The ordinary cells are polygonal, have rather thin walls, more or less oblique apertures, and a diameter varying from $\frac{1}{120}$th to $\frac{1}{110}$th of an inch. In the axial region the tubes are thin-walled, polygonal, subequal, without diaphragms, and almost vertical in direction, as they pass into the peripheral region, bending outward very gradually, their walls become thickened, and a moderate number of both straight and cystoid diaphragms are developed. The tubes appear to be of one kind only. Tangential sections show, often in a very distinct manner, the connecting foramina, and a structure of the tube walls precisely similar to that of *H. curvata.* The spiniform tubuli are small, and more

or less numerous, but never conspicuous, and developed at the angles of junction of the cells, or in the substance of their walls.

In its typical form this species may be readily distinguished from the preceding by its tuberculated surface. The more nearly smooth examples can be distinguished by the thicker cell walls, stellate maculæ, and much more flattened branches of *H. curvata*.

Formation and locality: Cincinnati group. Rather common near the tops of the hills at Cincinnati, O.

PERONOPORA UNIFORMIS, n. sp. (Plate X., figs. 8, 8*a*.)

Zoarium composed of erect, flattened, smooth, and undulating expansions, of several inches in height, varying in thickness from one to nearly three tenths of an inch ; composed of two layers of cells, growing in opposite directions from the median plate, which is double, and constituted by the adhesion of their epithecal laminæ. The cells are polygonal, subequal, and thin-walled, with an average diameter of about $\frac{1}{100}$th of an inch. Interstitial cells are almost entirely wanting, being usually restricted to small, insignificant clusters, or irregularly scattered among the proper cells.

In a longitudinal section (Plate X., fig. 8) the tubes at first are thin-walled. and lie prostrate upon the flexuous median lamina; but they soon bend outward and proceed straight to the surface, their walls becoming at the same time moderately thickened; a few are crossed throughout their length by only straight diaphragms, while in the greater number, they are nearly wanting, and instead, a closely arranged series of large cystoid diaphragms lines one of the walls. The diaphragms in the interstitial tubes are crowded.

In tangential sections (Plate X., fig. 8*a*) the tubes are polygonal, the walls of moderate thickness, and the interstitial tubes are almost entirely absent, and never present in great numbers. The spiniform tubuli are comparatively few and small, and usually only developed at the angles of junction of the tubes.

The general outward appearance of the zoarium of this species is in all respects like that of *P. decipiens*, Rominger. By the aid of a magnifier, *P. uniformis* may be readily enough distinguished from that species by its thinner walls and very few interstitial tubuli. *Peronopora compressa*, Ulrich, is a small species, also with thin-walled cells. It differs, however, from *P. uniformis*, in having numerous interstitial tubes, and a great number of well developed spiniform tubuli.

Formation and locality: Cincinnati Group. Rather rare near the tops of the hills at Cincinnati, O.

PRASOPORA NODOSA, n. sp. (Plate XI., figs. 1-1*b*.)

Zoarium forming small, irregular, or hemispheric masses, from a half inch to one and a half inches in diameter. The lower side is concave, and lined with a wrinkled epitheca, while the upper convex surface is covered by the cell-apertures.

The cell-bearing surface is covered by prominent, closely arranged. but usually unequal monticules; some may be small and conical, others compressed and large, or several may be united, so as to form an irregular node. The ordinary cells have sub-circular apertures, with thin walls, and a diameter varying from $\frac{1}{120}$th to $\frac{1}{110}$th of an inch (*i. e.* 11 or 12 may be counted in the space of .1 inch). The orifices of the angular interstitial cells under a low magnifying power are not always readily recognized at the surface.

As regards internal structure the zoarium is made up of two kinds of tubes, large and small. The large tubes have perfectly distinct, though very thin walls, a diameter of about $\frac{1}{120}$th of an inch, are oval or subcircular in shape, and consequently in contact only at limited points; the interspaces between them are filled by much smaller, and angular interstitial tubes, which apparently are never collected into groups or maculæ. The diaphragms of the large tubes are of two kinds, cystoid and straight, and so arranged that the former form a series of convex vesicles on one side of the visceral chamber, while the latter run straight from the preceding to the opposite wall, or, if the cystoid diaphragms are wanting in some parts of a tube, they pass directly across the tube from side to side. The diaphragms of the interstitial tubes are numerous and close set, and are always horizontal. A moderate number of small spiniform tubuli may be observed in tangential sections.

The strongly tuberculated surface, and irregular growth of this species, will distinguish it from all other species of *Prasopora* known to me.

Formation and locality: I collected this species in considerable numbers at Nashville, Tenn., in Safford's "Orthis Bed," which I regard as being equivalent to the upper beds of the Trenton Group in Kentucky.

DIPLOTRYPA MILLERI, n. sp. (Pl. XI., figs. 2-2*c*.)

Zoarium discoid or hemispheric, less than an inch in diameter, the under surface flattened or concave, and covered by a concentrically

striated epitheca ; the upper surface convex, and covered by the cell-apertures. Cells of two principal kinds, large and small, the latter being nearly equally distributed throughout the zoarium. The larger or proper cells have subcircular apertures, arranged in series from six to seven in the space of .1 inch. At regular intervals there are scarcely perceptible clusters composed of slightly larger cells. The interstitial cells usually occupy only the spaces left between the points at which the rounded larger cells are in contact.

In transverse sections (Plate XI., figs. 2*a*, and 2*b*) taken just below the surface, the larger cells are subcircular, and in contact at limited points, while each has its own complete, but very thin wall. The angular spaces left, which often are rhomboidal, but more frequently of an hour-glass shape, are partially occupied by the interstitial tubes, each of which also has its own distinct wall, and a more or less rounded visceral cavity. The small spaces now left are usually triangular, and filled (apparently) by a light-colored, structureless sclerenchyma. In sections taken at a lower level, the appearances presented are somewhat different. The duplex character of the walls is much obscured, if not obliterated, all the cells are more angular, and the interstitial cells are proportionally much larger, and usually hexagonal.

Longitudinal sections (Pl. XI., fig. 2*c*) show that the larger tubes are crossed by numerous horizontal, or slightly oblique diaphragms, about two thirds of a tube-diameter apart. The interstitial tubes are likewise crossed by horizontal diaphragms, which are nearly twice as numerous as those in the larger tubes.

The species above defined has all the essential characters of Nicholson's genus *Diplotrypa*. It differs from the previously described species (*D. petropolitana*, Pander, sp., and *D. whiteavesi*, Nicholson), in having thicker, and more distinctly duplex walls, and less distinctly angular cells. Associated with *D. milleri*, is a small species of *Monotrypa*, which so closely resembles it in its growth and general appearance, that, when the specimens are but slightly worn, it is almost impossible to distinguish them without the aid of sections When in a good state of preservation, the thin-walled cells, and the angular cell-apertures which characterize the *Monotrypa* sp., will serve to distinguish them.

Named in honor of Mr. S. A. Miller, whose published works have aided so materially to the advancement of the science of palæontology.

According to Dybowski, *Diplotrypa* is a synonym for *Dianulites*, Eichwald. Whether this is true or not, I am unable to say. What I

can say, however, is, that I should never have believed it without being able to study some better definition of *Dianulites*, than the utterly worthless one given by the author of the name. I am totally averse to the resurrection of old generic or specific names, of which the original definitions are obscure, and consequently worthless, nor shall I recognize any such restorations. But the redefinition of such long current names as *Favosites petropolitanus*, Pander, *Monticulipora mammulata*, and *M. frondosa*, D'Orbigny, I regard as entirely proper. These cases are, however, in no way parallel, since the latter is a benefit to the science; on the other hand, an attempt to restore an old, illy defined, and often quite forgotten name, does much to retard the progress of knowledge, because it is always equivalent to adding a source of much trouble and discussion. In this class of fossils it is especially necessary to have the characters upon which a genus or species is founded, *clearly defined* and *figured*, as it is quite impossible to identify a species, with any degree of certainty, unless those requirements are complied with. In whatever light other palæontologists may view this subject, I for one will not recognize any of the recent publications (preliminary publications of work done for delayed State surveys, etc., alone excepted), in which the names proposed are not clearly defined, and the specific characters of the fossils figured.

Formation and locality: Niagara Group. Rare at Osgood, Ind. The small species of *Monotrypa* mentioned as being an associated fossil, is common at that locality.

MONOTRYPELLA ÆQUALIS, nov. gen. et. sp. (Plate XI., figs. 3-3*a*.)

Gen. char. *ante* p. 153.

Zoarium somewhat irregularly ramose, the branches cylindrical or compressed, and form two to five tenths of an inch in diameter. Surface often, smooth, usually however exhibiting low, rounded monticules, which are occupied by clusters of large cells, the diameter of which does not exceed $\frac{1}{55}$th of an inch. The ordinary cells are thin-walled and polygonal in shape, with an average diameter of about $\frac{1}{90}$th of an inch. Occasionally a few cell-apertures, having a slightly smaller diameter than the ordinary cells, may be observed among the large cells occupying the monticules. The latter are arranged at distances apart of about .15 inch, measuring from center to center.

In tangential sections (Plate XI., fig. 3) the tubes are regularly polygonal, with moderately thickened walls, and in contact with each other on all sides. The line of demarcation between contiguous tubes

is sometimes clear and distinct, while at other times it is scarcely detectable. The walls are occasionally thickened at the angles of junction of the tubes, giving somewhat the appearance of spiniform tubuli. It is quite evident though that these nodal thickenings are not of this nature.

Longitudinal sections (Plate XI., fig. 3*a*) show that the tabulation of the larger tubes composing the clusters observed at the surface, is not different from that of the ordinary tubes, the diaphragms in all the tubes being straight and usually horizontal, in the axial region either wanting or remote, and in the peripheral portion of the branch, closely set, and often crowded. These sections also show that true interstitial tubes are entirely absent.

In transverse sections the tubes in the axial region are subequal and polygonal, with very thin walls, while around the margin, where the tubes are cut longitudinally, they have the same appearance as in the peripheral portion of a vertical section.

This species is nearly allied to the European *M. pulchella*, E. and H., a Wenlock Limestone species, from which it differs principally in having more numerous diaphragms, and the line of demarcation between adjoining tubes less strongly marked.

The species above described I regard as the type of the genus *Monotrypella*, proposed in my scheme of classification, on page 153. The genus will include, beside *M. æqualis*, and the species next described (*M. subquadrata*), *M. pulchella*, E. & H. (Wenlock), *Chætetes quadratus*, Rominger (Cin. Gr.), *M. briareus*, Nicholson (Cin. Gr.), and *Chætetes consimilis*, Hall (Nia. Gr.) The Trenton Group of Kentucky furnishes one new species, while the Cincinnati Group has probably two more. The genus in its typical forms is probably most nearly allied to *Monotrypa* (as founded upon *M. undulata*, Nicholson), and is characterized by a ramose zoarium, made up of polygonal tubes, usually of one kind only, that in the axial region are thin-walled. As they bend outward and approach the surface the walls are appreciably thickened, and the boundary line between adjoining tubes becomes more or less distinctly marked. I have studied two species which differ from the typical forms of the genus in one character, namely, in possessing a limited number of smaller cells than the average, which appear to be of the nature of interstitial cells. The next described species, *M. subquadrata*, is one of these. This species, in all other respects, resembles *M. quadrata*, so nearly that I am forced to regard them at least as belonging to the same genus. The other species,

though quite distinct, is yet so near to *M. æqualis*, that despite the interstitial tubes, I can not regard it as belonging to another genns.

Formation and locality: Cincinnati Group. Rather rare at several localities about Cincinnati, O., at an elevation of 100 to 200 feet above low-water mark in the Ohio river.

MONOTRYPELLA SUBQUADRATA, n. sp. (Plate XI., figs. 4-4*b*.)

Zoarium ramose, the branches slender, cyclindrical, and from one to nearly two tenths of an inch in diameter. Surface smooth, without monticules or clusters of large cells. Cells usually quadrate or rhomboidal, the apertures circular or broadly elliptical, and arranged in regular, more or less curved diagonal lines; at other times the arrangement is peculiarly irregular. Their walls are moderately thick, and on an average twelve may be counted in the space of .1 inch. A few smaller cells (which sections show to be of the nature of interstitial tubes) are intercalated among the ordinary cells.

Tangential sections (Plate XI., fig. 4*a*) show that the tubes have moderately thick walls, which preserve, more or less distinctly, the primitive boundary line between adjoining tubes. Small interstitial tubes are always shown. and although their number varies in different sections, they are never numerous.

In longitudinal sections (Plate XI., fig. 4*b*) the tubes in the axial region of the branch have very thin walls, and diaphragms are usually wanting in this region. As they approach the surface their walls are moderately thickened, and comparatively remote horizontal diaphragms are developed (from one half to two tube-diameters distant from each other). Occasionally the section cuts one of the interstitial tubes, in which the diaphragms are about nearly as numerous as in the ordinary tubes. The development of young tubes, by gemmation, takes place simultaneously in all the tubes at a point on a line crossing the branch at regular intervals, with a strong upward curve. Eight or nine of these intervals occur in the space of .3 inch. In transverse sections the tubes in the central portion of the branch are thin-walled and strictly quadrate or rhomboidal.

In many respects this species closely resembles *M. quadrata*, Rominger, and might almost be regarded as a dwarfed variety of that species. were it not for the certain presence of interstitial cells in *M. subquadrata*. Another difference is found in the size of the cells. Rominger's species having from seven to eight in the space of .1 inch, while in the new species there are about twelve in the same space.

Besides, *M. quadrata* is a much more robust species with branches varying in diameter from three to six tenths of an inch.

As before remarked, I can not at present consider the existence of interstitial tubes in *M. subquadrata*, as of more than specific importance, in so far as it has reference to the separation of the species from *M. quadrata*.

Formation and locality: Cincinnati Group. I have collected this species at Osgood, Ind., where the strata exposed are very near the top of the formation, Also at Jackson, Blanchester, and Westborough, where the beds exposed are at least 100 feet lower than those at Osgood, Ind., and equivalent to a height of nearly 700 feet above low-water mark in the Ohio river, at Cincinnati, O.

Callopora elegantula, Hall. (Plate XI., figs. 6-6*b*.)

Callopora elegantula, Hall, Pal. N. Y., Vol. ii., p. 144, Plate XL., figs. 1*a*-1*n*, 1852.

Zoarium ramose, consisting of subcylindrical branches from one to two tenths of an inch in diameter, that frequently divide dichotomously, and sometimes inosculate. Surface without monticules. Cells with rather thin walls and circular apertures, that have a diameter varying from $\frac{1}{70}$th to $\frac{1}{60}$th of an inch. Often the apertures are closed by opercula having a small central perforation, from which six or seven small ridges radiate to the margin, giving the false appearance of a septate aperture. Interstitial spaces of variable width, and occupied by small angular interstitial cells, which often completely isolate the proper cells. According to the width of the interstitial spaces from four to six of the proper cells may be counted in the space of .1 inch.

Tangential sections (Plate XI., fig. 6) show that the zoarium is conspicuously divided into two sets of tubes, large and small. The large tubes have rather thin walls, are nearly uniform in size, and generally, circular in shape. The small or interstitial tubes are usually angular, very variable in size and form, and often so numerous as to form a complete zone around the large tubes, which usually consists of one row, though sometimes an incomplete second row is developed. At other times they occupy only the triangular interspaces formed by the junction of three of the large tubes. There is no boundary line between adjoining tubes, the walls of all the tubes being apparently fused together. These sections show conclusively that the diaphragms, in at least the peripheral portion of the zoarium, represent

opercula which have been left behind in the tubes at successive stages of growth.

In longitudinal sections (Plate XI., fig. 6*a*) the difference in structure between the proper and interstitial tubes is conspicuous, both sets being crossed by complete horizontal diaphragms, which are much more numerous in the small tubes than in the large ones. Just above the point of development, the young tube is crossed by closer set diaphragms than in any portion of its length after it has attained the mature size. This feature gives the young tubes the appearance of interstitial tubes, and they may really have been of that nature in their undeveloped stage. In the axial region the diaphragms in the tubes of full size are distant from each other about one tube diameter, while in the peripheral region they are about half that distance apart.

Transverse sections (Plate XI., fig. 6*b*) show that the tubes in the axial region may be divided into two sets, one consisting of sub-cylindrical tubes of nearly uniform size (the fully matured tubes), and the other of smaller, unequal and angular tubes (the young tubes in various stages of development).

Nicholson (Pal. Tab. Cor. p. 304, 1879, and Genus Mont., p. 91, 1881) regards *Callopora*, Hall, as "unquestionably congeneric" with *Fistulipora*, McCoy. After describing and figuring (Plate XI., figs. 6-6*b*) the characters of *C. elegantula*, Hall, the type of the genus *Callopora*, such an assertion scarcely merits a serious verbal refutation. His idea of *Callopora* is clearly based upon *Fistulipora incrassata*, which he originally referred to the former genus. But because the *Callopora incrassata* proved on investigation to have the same general structure as *Fistulipora minor*, McCoy, it certainly does not follow that *Callopora* is a synonym for McCoy's older name *Fistulipora*. In both the works cited he makes the rather equivocal declaration that "the identity of *Fistulipora*, McCoy, and *Callopora*, Hall, has long been more than suspected," and further adds, "having carefully examined specimens of *F. minor*, McCoy, the type of the genus *Fistulipora*, and having compared these with typical examples of Hall's genus *Callopora*, from the Silurian and Devonian rocks of North America, I am satisfied that the two are unquestionably congeneric, and that both must be united under the older name of *Fistulipora*, McCoy." To an inquisitive searcher after the truth, there is nothing satisfactory in either of the quoted statements, and so far as I am able to judge, nothing that he has said upon the subject, has any direct bearing upon the actual point at issue, *i. e.*, the suspected

identity of *Callopora* and *Fistulipora.* At any rate it is very evident that he did not pay as much attention to the type species of the former, as he did to the type species of McCoy's genus. The internal structure of *Callopora elegantula*, Hall, as I have worked it out from examples of the species presented to me by Prof. James Hall himself, shows, first, that Nicholson's *Callopora incrassata* is as far removed in its structure from the type species of *Callopora*, as McCoy's *Fistulipora minor;* and second, that a large proportion of the heterogeneous assemblage of forms placed by Nicholson in his division *Heterotrypa*, have precisely the same general structure as *C. elegantula.* The species in question are *M.* (*H.*) *ramosa*, D'Orb., and var. *rugosa*, Ed. & H., *M.* (*H.*) *dalei*, Ed. & H., *M.* (*H.*) *sigillaroidea*, Nich., *M.* (*H.*) *nodulosa*, Nich., and *M.* (*H.*) *andrewsi*, Nicholson. All these species have a zoarium constructed in a precisely similar manner. In all we have numerous interstitial tubes, which may be either rounded or subangular, and always have more closely set diaphragms than the proper or larger cells; the latter again in all have subcircular or ovate visceral cavities (in tangential sections), surrounding which is a more or less distinct ring of dark sclerenchyma. All the tubes, however, are firmly united together, and never, so far as I have been able to ascertain, show any distinct boundary line between them. A fourth character common to all, is found in the fact that the tubes in the axial region of the zoarium may be properly divided into two quite distinct sets of tubes, large and small, the latter (as is shown in transverse sections) being nearly always more angular than the former. In a longitudinal section the tubes immediately above their origin in the axial or "immature" region, are crossed by more close set diaphragms than when they have attained their full growth. This feature gives the tubes, in their primitive stage, the appearance of interstitial tubes, though I am far from asserting that any of the tubes in the axial region, even in the earlier periods of their development, performed the unknown functions of interstitial cells. At any rate, the character under consideration is one of the distinctive features of *Callopora*, and may be more or less readily recognized in all the species of the genus known to me. Besides the five species and one variety above mentioned (*C. ramosa*, D'Orb., and var. *rugosa*, Ed. & H., *C. dalei*, Ed. & H., *C. nodulosa*, Nich., *C. sigillaroidea*, Nich., and *C. andrewsi*, Nich.,) the Cincinnati group furnishes at least four other species which have the characters of *Callopora*, but are as yet undescribed. Of the numerous species referred to the genus by Hall, I can at the present

time only say, that with but few exceptions their structure is quite different from that of the type species. The same may be said of the majority of the species placed by the same eminent palæontologist with *Trematopora.*

Formation and locality: Niagara Group. The original locality for the species is Lockport, N. Y., but a short time since I collected several examples at Osgood, Ind.

CALLOPORA SUBPLANA, n. sp. (Pl. XI., figs. 7-7*b*.)

Zoarium ramose, the branches cylindrical, from .2 inch to .5 inch in diameter, and divided dicthoomously at intervals varying from .6 inch to one inch. Cells polygonal in unworn examples, subpolygonal or rounded in worn specimens. The surface exhibits clusters of from four to eight cells, that occasionally are slightly elevated above the general surface, and are conspicuously larger than the ordinary cells which surround them. The latter vary in diameter from $\frac{1}{70}$th to $\frac{1}{60}$th of an inch (*i. e.* six to seven cells may be counted in the space of .1 inch), while those composing the clusters may attain a diameter of $\frac{1}{40}$th of an inch, though their usual diameter is only about $\frac{1}{50}$th inch. The interstitial cells are comparatively few, being most numerous and noticeable between the large cells of the clusters mentioned. Over the other portions of the surface they usually occur at the angles of junction of the ordinary large tubes. They are, however, always inconspicuous, and easily overlooked.

In longitudinal sections (Plate XI., fig. 7*b*) the tubes in the axial region of the zoarium, have very thin, flexuous, and often crimped walls. Diaphragms are usually not developed here, excepting a few (six to nine) in the young tubes just above the point of their origin. These are placed at distances apart equaling about two of their diameters at the point of crossing. As the tubes bend outward to reach the surface their walls are thickened, the interstitial tubes make their appearance, and numerous diaphragms are developed in the large tubes, the latter often inosculate, while the distance between them usually varies from one fourth to one half of the diameter of the tube crossed. The diaphragms in the interstitial tubes are always complete and equally crowded in all.

Tangential sections (Plate XI., fig. 7*a*) show that the tubes just below the surface have much thickened walls, their visceral chambers being rounded or oval. The walls of adjoining tubes are seemingly fused together, so that the original boundary line can not be detected.

The cavity of each tube is surrounded by a secondary deposit of dark, concentrically laminated sclerenchyma, while the original wall is represented by apparently structureless (in this section) sclerenchyma, of much lighter shade. The interstitial cells are variable in size and shape, and comparatively much reduced in number, being, as a rule, less numerous than the proper tubes.

The characters which distinguish *C. subplana* from all other species of the genus known to me from the Cincinnati Group, are found in its robust growth, the large size of the cells, the conspicuous clusters, and the proportional paucity of the interstitial tubes.

Formation and locality: Cincinnati Group. Not an uncommon fossil near the tops of the hills south and west of Covington, Ky. The range is limited, being apparently not more than 25 feet. *Callopora dalei*, Ed. & H., *Homotrypa curvata*, Ulrich, and *Heterotrypa subpulchella*, Nich., are associated species, and appear to have a nearly equally limited range.

Amplexopora cingulata, n. gen. et sp. (Plate XI., figs. 5-5*b*.)

Generic char., *ante* p. 154.

Zoarium ramose, consisting of cylindrical or subcylindrical branches, which divide dichotomously at irregular intervals, and vary in diameter from three to seven tenths of an inch. The surface is perfectly smooth, and destitute of monticules. When in the best state of preservation, the cell-apertures are subpolygonal, the walls are moderately thin, and occupied by small granules. In the usual condition the cell-apertures are rounded, the walls comparatively thick and smooth. The surface also shows groups of from seven to fifteen cells, of a larger size than the average, their diameter varying from $\frac{1}{80}$th to $\frac{1}{60}$th of an inch, while that of the smaller ordinary cells is almost constantly about $\frac{1}{90}$th of an inch.

Tangential sections (Pl. XI., figs. 5*a* and 5*b*) show that the cells are of one kind (*i.e.*, no interstitial tubes are present), and that, between the groups of larger cells, they are of a very uniform size. The original polygonal walls can still be readily recognized; but their internal cavities are more or less rounded by a secondary deposit of dark, concentrically laminated sclerenchyma, which has a variable thickness in different sections. The original line of demarcation between adjoining tubes is always more or less distinctly preserved, and is made especially conspicuous by the numerous small spiniform tubuli, which, in this species, are developed only on the line of junction. One is situated at each angle, and one or two more on the line between the angles.

Longitudinal sections (Pl. XI., fig. 5*c*) show that the tubes in the axial region have very thin walls, and are traversed by remote horizontal diaphragms, from two to three times the diameter of a tube distant from each other. As they approach the surface, they bend outward rather abruptly, their walls are much thickened, and the diaphragms become much more numerous. The tube-wall in the peripheral region is divided into four longitudinal portions, by three distinct dark lines. The two inner portions represent the original walls of two adjoining tubes, and are composed of a fibrous structure, the fibres being directed obliquely upward to meet along the dark central line. The two outer zones, which are of a darker color than the inner layers, represent the secondary deposits within the original polygonal walls of the tubes. The diaphragms in the outer portion of the tubes are usually nearly horizontal. All of my sections, however, show a few very peculiar diaphragms. In the section they are represented by two curved plates which spring from the opposite walls of a tube, nearly meeting, either in the center, or nearer one side of the tube-cavity, when they proceed as nearly parallel lines downward to the next straight diaphragm. Their shape was undoubtedly that of a funnel, of which the position of the lower tubular portion, with regard to the expanded mouth, was somewhat erratic.

In transverse sections the tubes in the axial region have very thin walls, and are strictly polygonal.

The species above described I regard as the type of the genus, *Amplexopora*, proposed by me in the last number of the Journal, p. 154. At the present time I am unable to give the exact limits of the genus, as I have not yet fully determined where the boundary line between *Stenopora*, Lonsdale, and *Amplexopora*, is most properly drawn. If the periodic thickening of the tube-walls is regarded as a necessary feature of species of the former, and I believe that it should be, then the limits of the latter genus might be extended so as to include a number of Devonian and Lower Carboniferous species (*e.g. M. moniliformis*, and *M. barrandi*, both Nicholson). At any rate the Cincinnati Group contains at least five other distinct species, which in their general characters precisely resemble *A. cingulata*. Of these but two have been described, one by the author, under the name of *Atactopora septosa*, and the other by Nicholson, originally, under the name of *Chætetes discoideus*, but latterly (Genus Monticulipora, p. 193) he refers the species to his section *Monotrypa*, to which, however, I do not find it to be more than remotely related. The fourth species (*A. ro-*

busta, n. sp.) is next described, while two other ramose species, the fifth and sixth, must for the time being remain unpublished.

Formation and locality: Cincinnati Group. This species I found to be abundant in a single layer at McKinney's Station, on the line of the Cincinnati Southern R.R., where, after crossing the Trenton exposures, on each side of the Kentucky river, the observer again meets with the Cincinnati Group. Judging from the associated fossils, the strata exposed at McKinney's are equivalent to those near the tops of the hills about Cincinnati, O. This is made the more probable by the fact that a single fragment was discovered at Cincinnati, by Mr. Ernst Vaupel, at an elevation of 375 feet above low-water mark in the Ohio river.

As some of the genera proposed by me in my scheme of classification (*ante* p. 149, *et. seq.*), have not yet been fully established by a description of the type species, and because my memoir is unavoidably divided into parts, I have thought it advisable to anticipate, in a measure, the parts yet to be published, by noting those species already described, which I propose to refer to one or the other of the genera in question. Besides, I wish to publish a few notes on other points whereon my views differ from those of Dr. Nicholson.

Of the twelve species referred by Nicholson, to *Monotrypa* ("Genus Monticulipora," 1881), only the four species *M. undulata*, Nicholson, *M. petasiformis*, Nich., *M. winteri*, Nich., and *M. irregularis*, Ulrich, can be considered as unquestionably congeneric. *M. calceola*, Miller and Dyer, and *M. clavacoidea*, Nicholson, I regard as species of doubtful position. Of the six other species *M. briarea*, Nich., *M. pulchella*, E. and H., and *M. quadrata*, Rominger, are congeric with *M. æqualis*, Ulrich, the type of the new genus *Monotrypella; M. pavonia*, D'Orb., is a *Ptilodictya*, *M. discoidea*, Nicholson, should be referred to *Amplexopora*, and *M. tuberculata*, E. and H., is one of four species upon which the new genus *Spatiopora* is founded. (The other three species, among them the one which is selected as the actual type of the genus, are as yet undescribed). *Chætetes subglobosus*, Ulrich (Cin. Gr.), and *Ch. monticulatus*, Hall (Lower Helderberg), are typical species of *Monotrypa*.

The genus *Batostoma* is founded upon *M. implicata*, Nicholson.* The genus also includes *M. jamesi*, Nich., and *M. girvanensis*, Nichol-

* This species I named in my Cat. of the Foss. of the Cin. Gr., but did not figure or describe it, consequently I have no right to claim the species, although Dr. Nicholson has seen fit to credit me with the name.

son, the former from the Cincinnati Group, the latter from British Lower Silurian deposits.

The genus *Petigopora* is founded upon an, as yet, undescribed species. It, however, includes *Chætetes petechialis*, Nicholson.

Dekayella is also founded upon a new species, but *M. ulrichi*, Nicholson, is a congeneric species. Several undescribed species are known to me.

The type species of *Discotrypa*, is the form described by me in the second volume of this JOURNAL, under the name of *Chætetes elegans.*

Stellipora antheloidea, Hall, is restricted to the Trenton Group of New York, and is not by any means the same as the Cincinnati Group species usually identified with it. The zoarium of the former is thin and incrusting, while that of the latter grows upward into branches or narrow fronds. As it has never received a distinct name, I here propose that it be called *Constellaria florida.* It may be briefly characterized as follows :

CONSTELLARIA FLORIDA, n. sp.

Zoarium ramose or subfrondescent, from one to two tenths of an inch in thickness, and from one to three inches in height. Surface with numerous areas, which typically are stellate, about .08 inch in diameter, and placed at intervals of about .12 inch (measuring from center to center) and are usually arranged in transverse rows. Each consists of a depressed central space, surrounded by from five to nine prominent and radially arranged elevated ridges. Often these areas coalesce and form transverse ridges, that not infrequently are continuous around the branches. Cells of two kinds, differing in size and other features. The proper zooecia are oval or circular, and on an average about twelve occupy the space of .1 inch. Their apertures are surrounded by a small but distinct rim. The central depressed areas of the stellate monticules are composed entirely of the interstitial cells, which occupy also all the interstices between the proper circular cells.

As I find myself unable to do justice to the complicated internal characters of the species, without the aid of figures, I beg leave to reserve this portion of the description, until, in the course of my memoir, *Stellipora* and *Constellaria* come up for consideration. For the identification of the species, a knowledge of its internal structure is not, at the present time necessary, since *C. florida* is one of the most characteristic and common fossils of the Cincinnati Group.

The genus *Cheiloporella* is founded upon *Fistulipora flabellata*, described by me in the second volume of this JOURNAL.

Crepipora is founded upon a new species. *Chætetes venustus*, Ulrich, will be referred to the genus.

[TO BE CONTINUED.]

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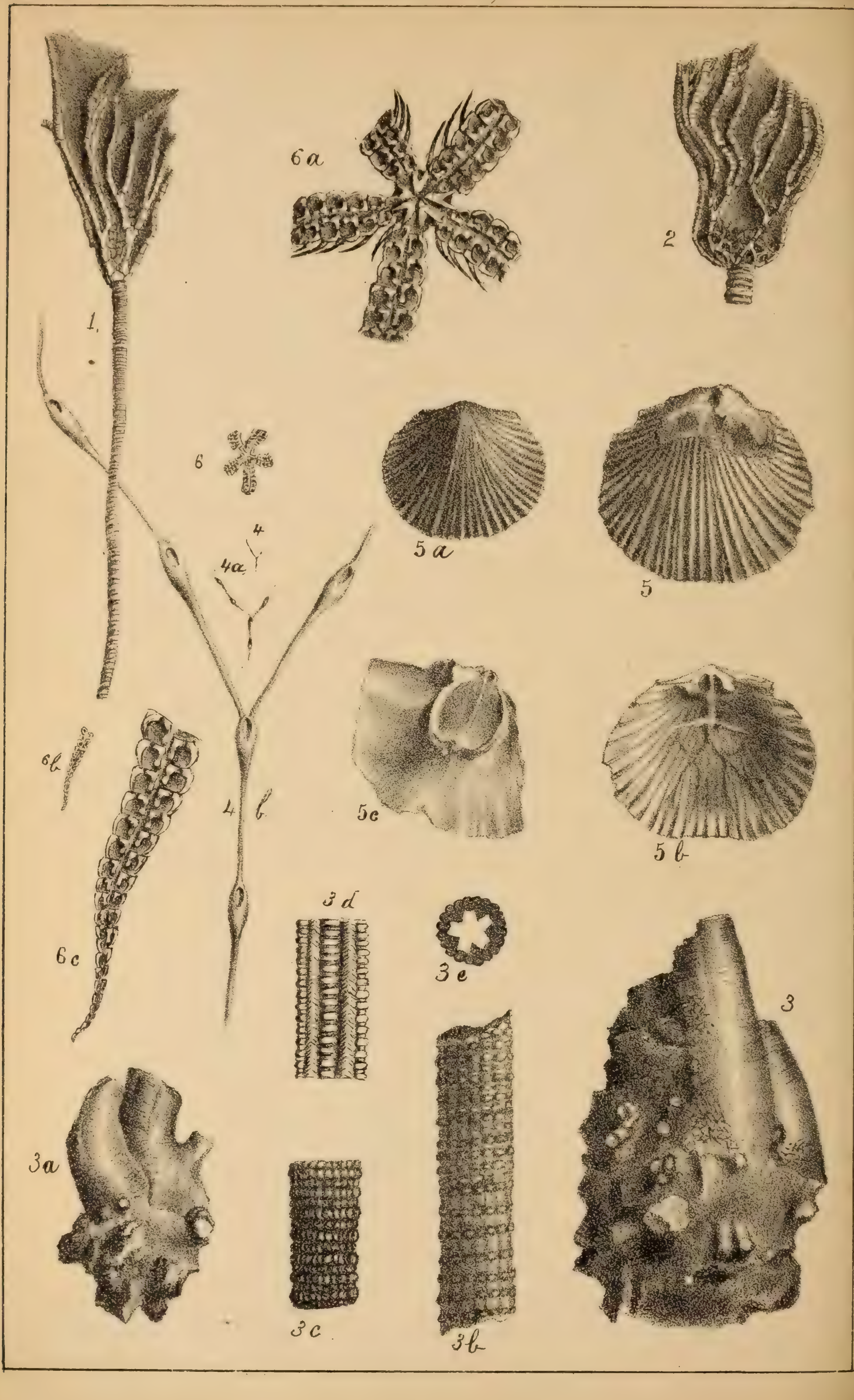

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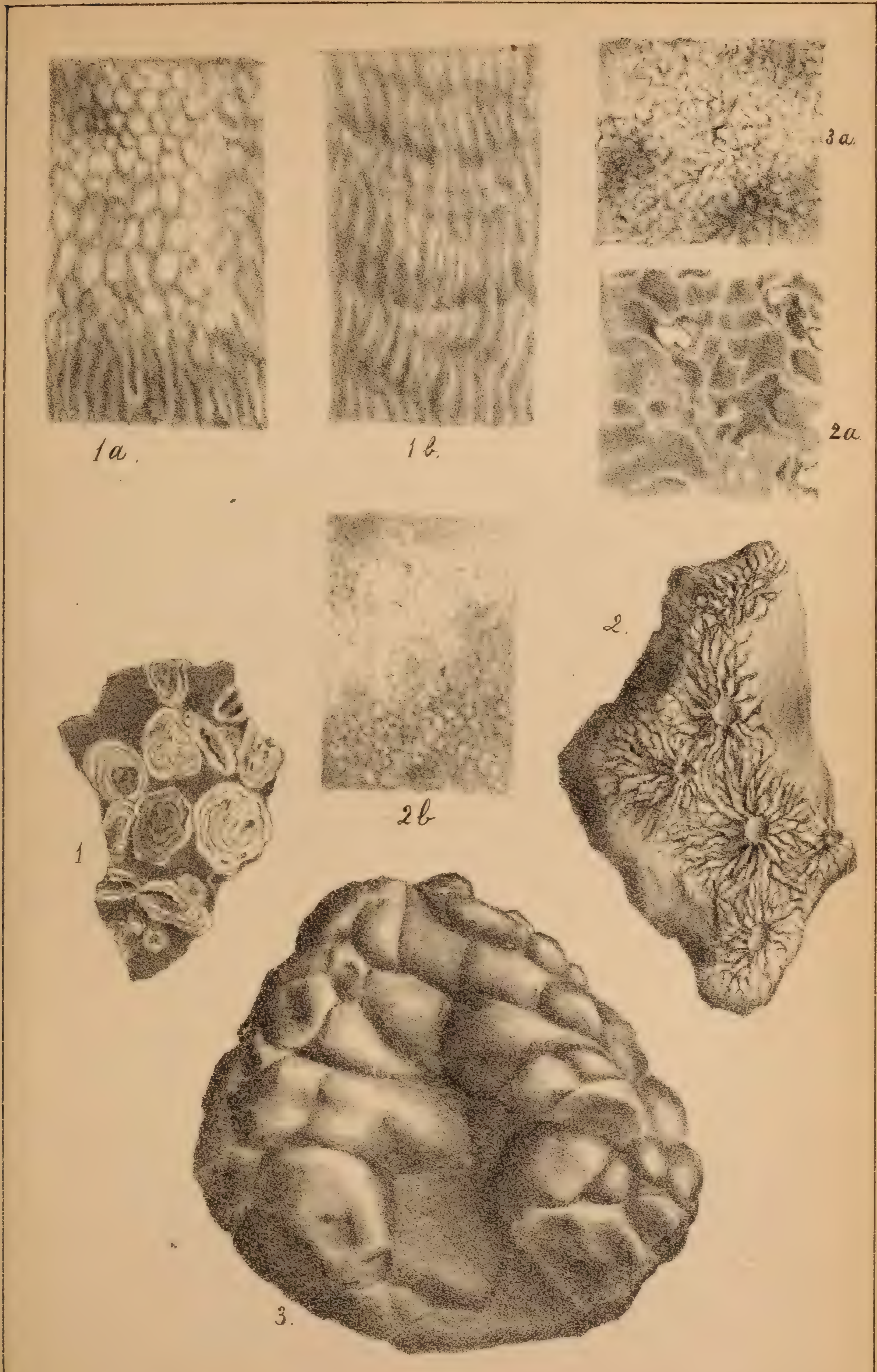
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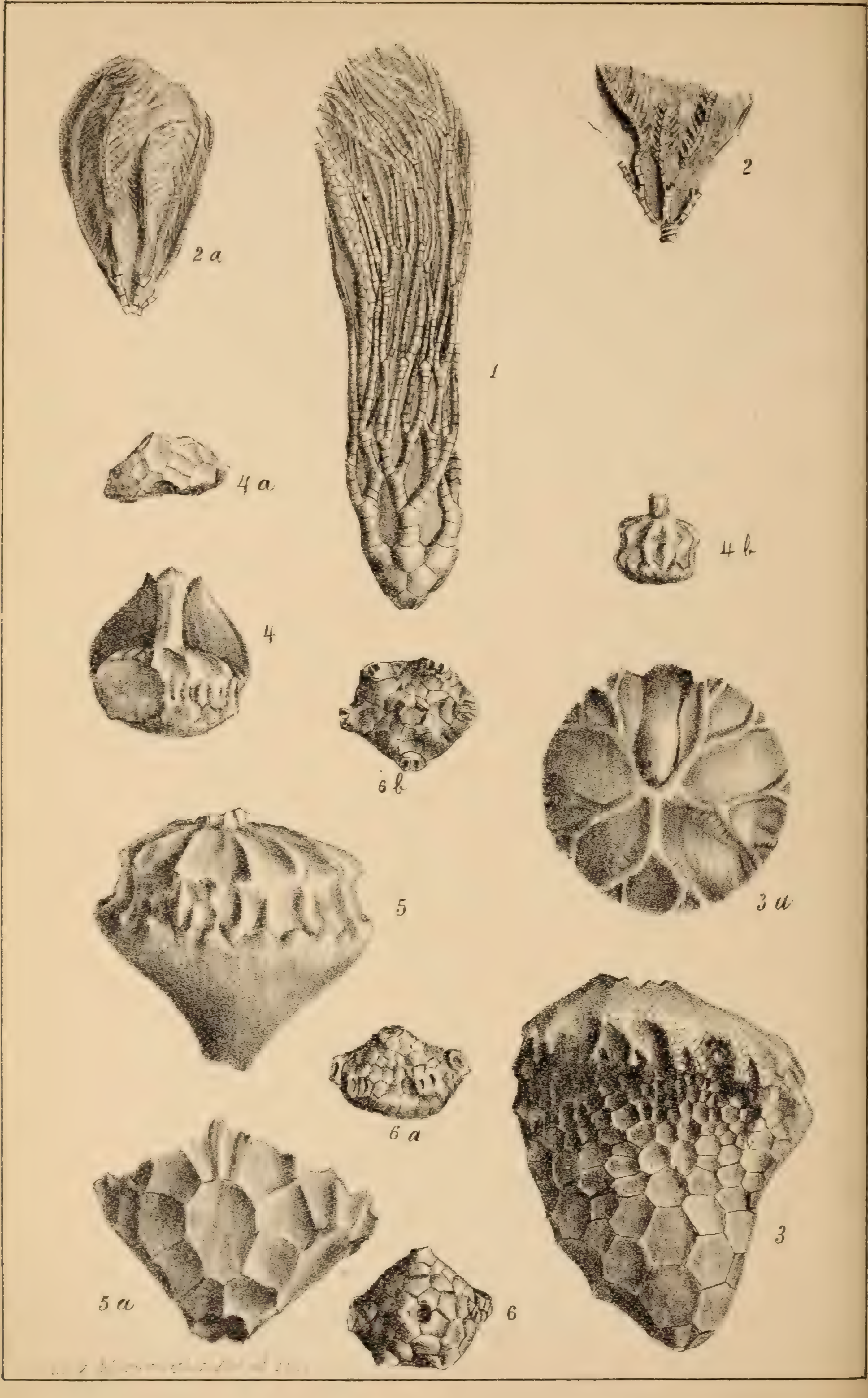
2 a
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4 a
4 b
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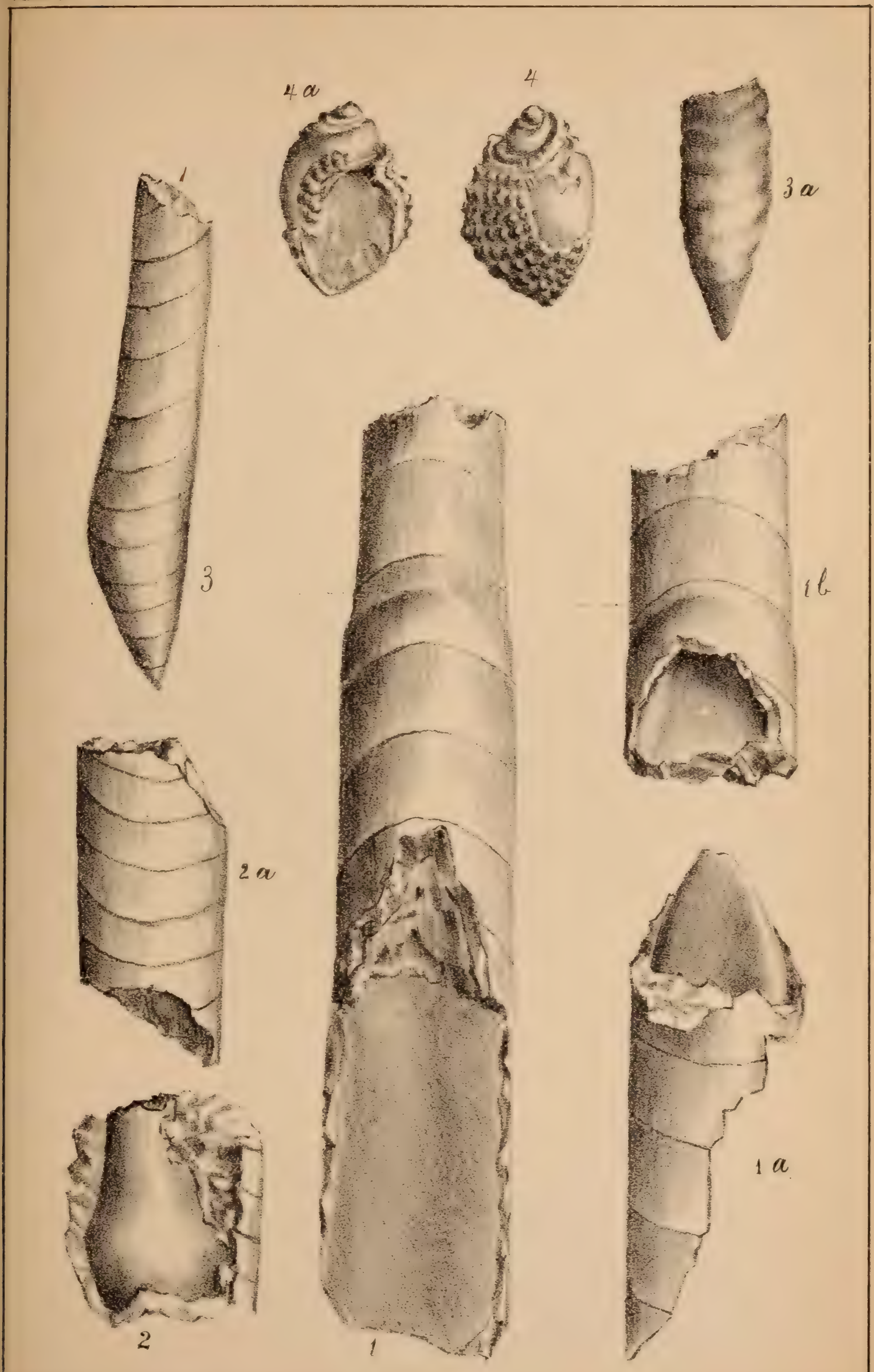
4 a
4
3 a
1
3
1 b
2 a
1 a
2
1

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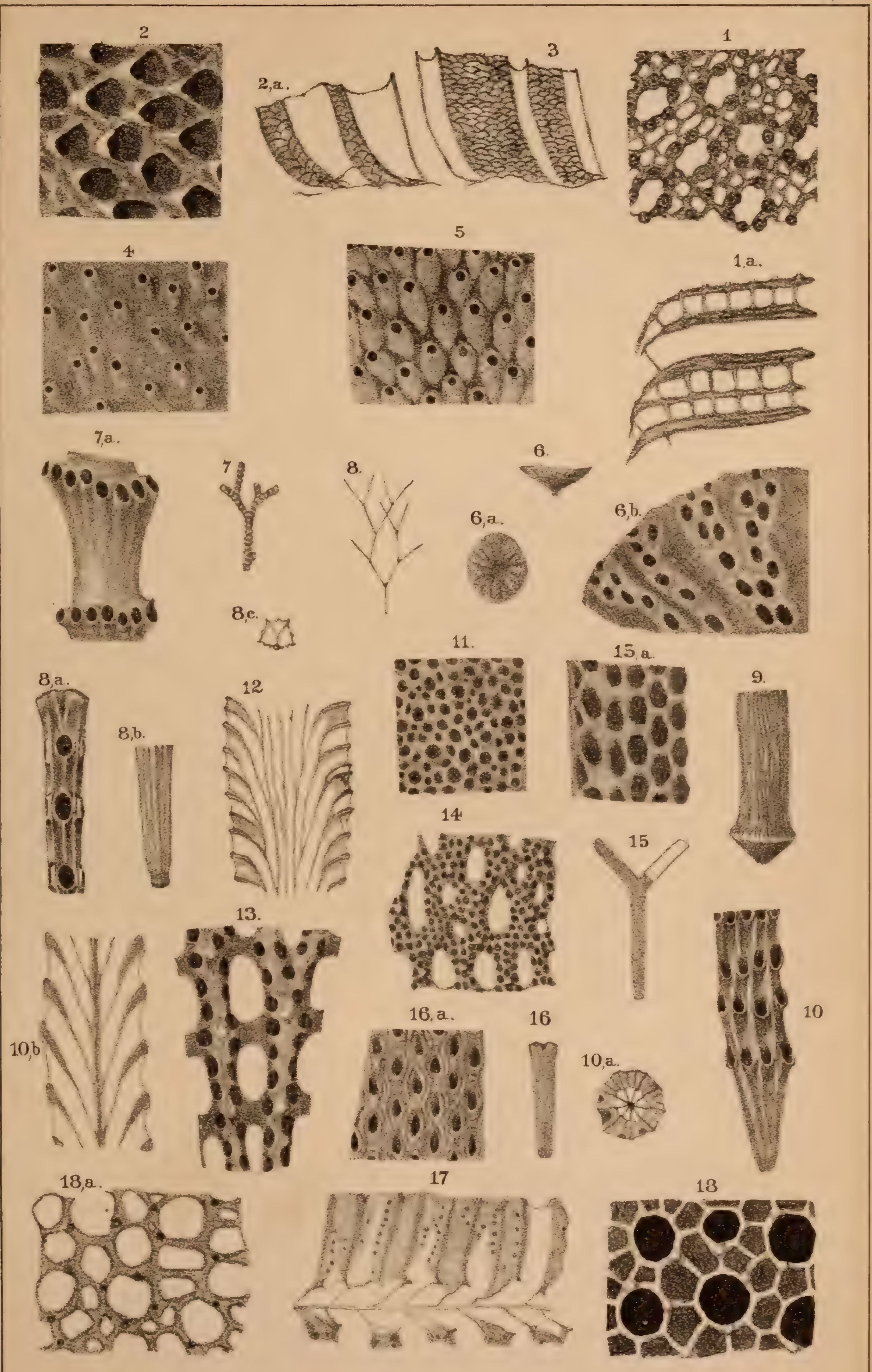

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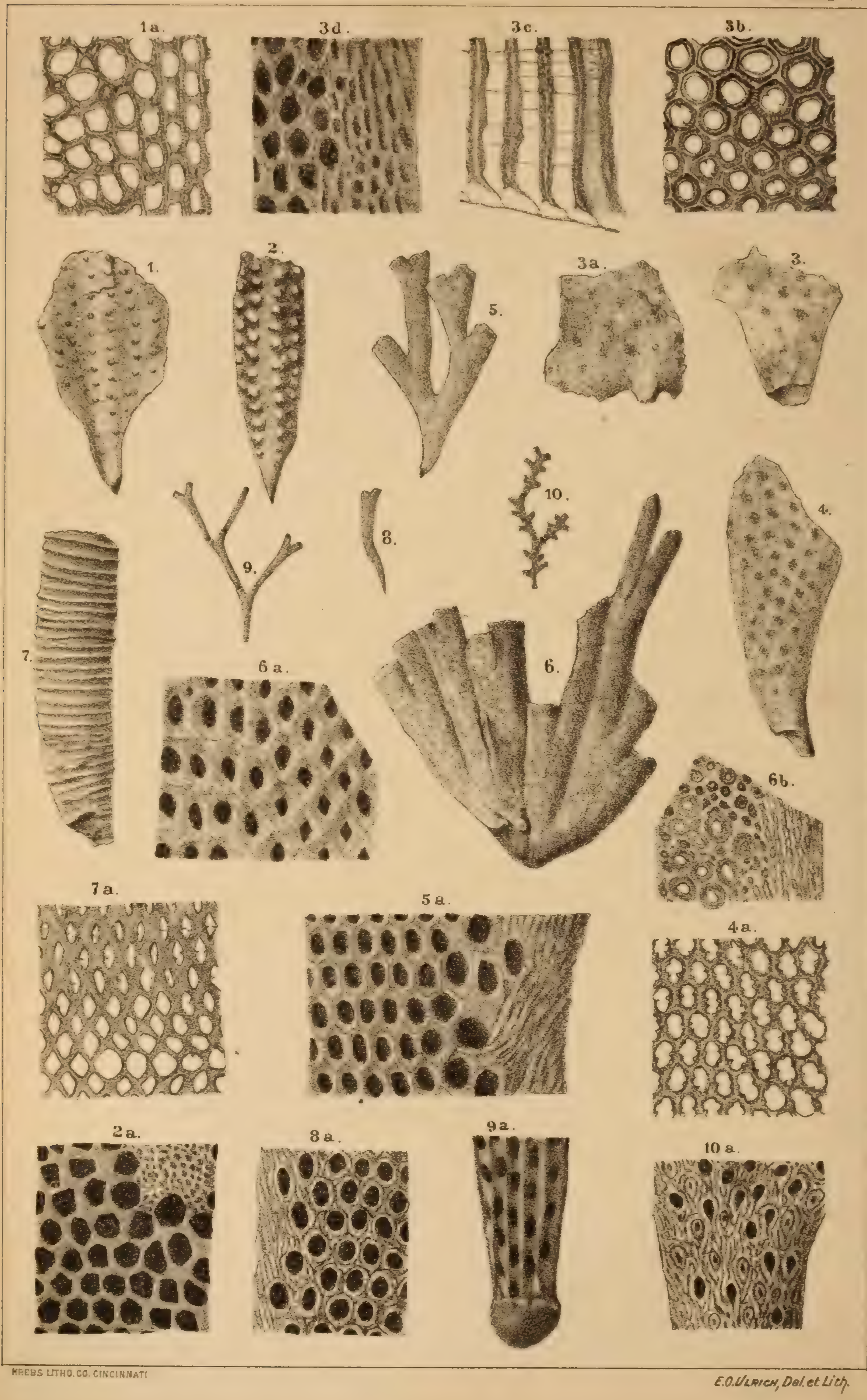

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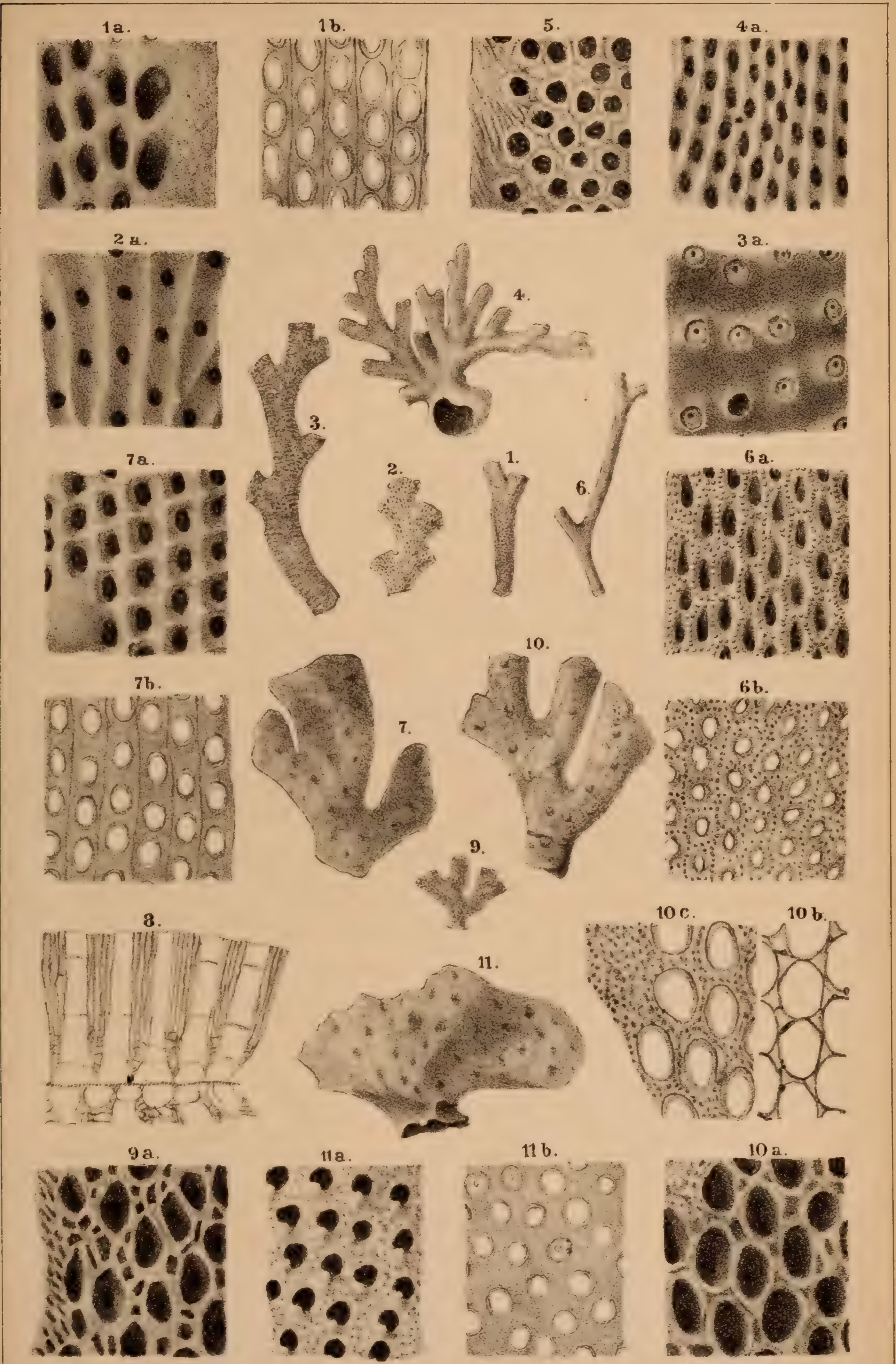

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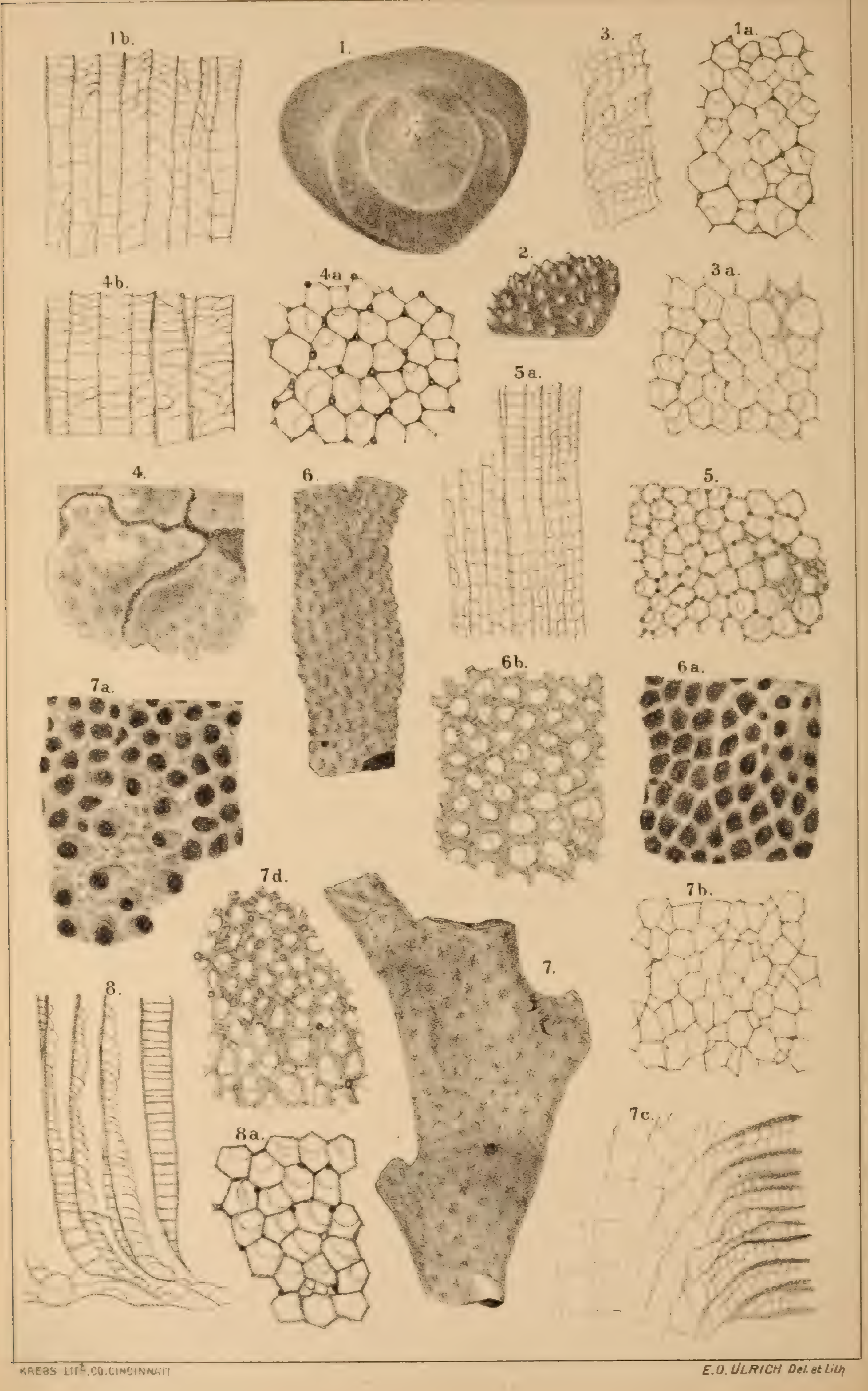

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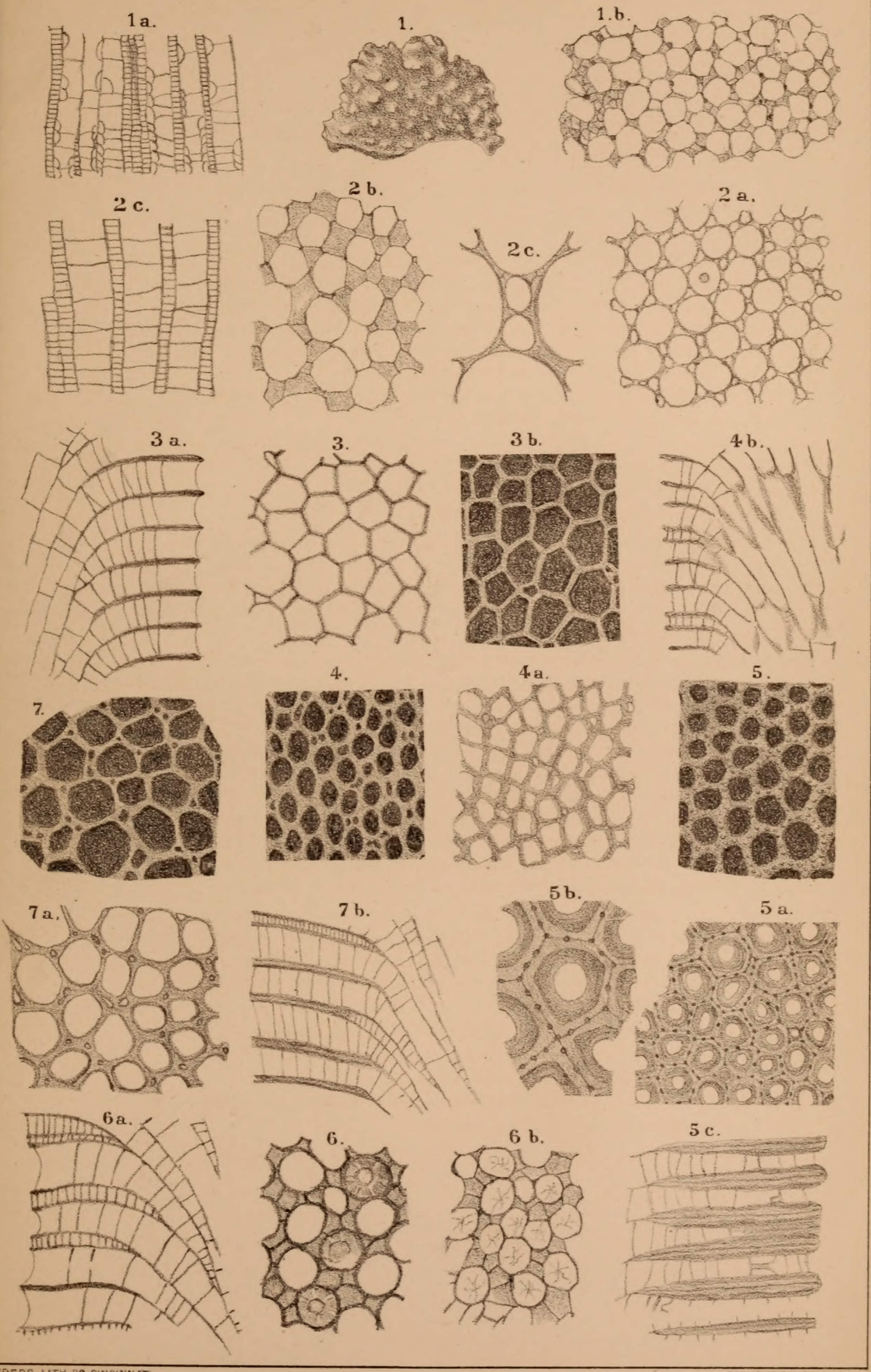

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