University of the State of New York

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FREDERICK J. H. MERRILL *Director*

No. 39 Vol. 8

October 1900

PALEONTOLOGIC PAPERS

BY

JOHN M. CLARKE Ph.D.

State paleontologist

GEORGE B. SIMPSON, FREDERICK B. LOOMIS Ph.D.

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1900

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With the compliments of

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Oneonta sandstone in the Clarke Co.'s quarry, Oxford N. Y. 18 foot layer showing vertical *Orthoceras* near the base

A REMARKABLE OCCURRENCE OF ORTHOCERAS IN THE ONEONTA BEDS OF THE CHENANGO VALLEY, N. Y.

BY JOHN M. CLARKE

(Plates 1–4)

At Oxford in the valley of the Chenango river in southern central New York are the extensive bluestone quarries of the F. G. Clarke Co. These quarries lie in the westward extension of the formation termed by Vanuxem the Oneonta beds. I have shown on previous occasions that these Oneonta beds represent in the Chenango valley region a peculiarly local development of the later deposits made during the period of time known as the Portage age. They are underlaid by the lower beds of the Ithaca stage, bearing an abundant marine fauna very closely allied in specific traits to the fauna of the Hamilton shales beneath. The Oneonta deposits were evidently laid down in a shallow or receding sea or perhaps, speaking with more precision, in an estuary while shut off from the open sea and freely receiving terrestrial drainage. The deposits contain no forms of life similar to those of the upper beds of the Ithaca formation with which they are apparently stratigraphically continuous and which bound them on the west. Their strata consist for the most part of schistose sands here and there interstratified with fine-grained argillaceous shales carrying in places considerable calcareous matter. The deposits are several hundred feet in thickness in this section, and are often highly colored by the green and red tints of iron oxids, in which respect they are not unlike some of the sands of the Catskill formation. With our present knowledge we interpret the Oneonta sedimentation as of similar origin to that of the Catskill and the precursor or the introduction of the latter in the meridian of the Chenango valley. Here the Chemung beds, carrying a marine fauna, extend over the Oneonta sediments and separate them from the Catskill above, but, passing eastward into Delaware co., the Chemung strata finally disappear or become indeterminate, and the Oneonta sedimentation is continued without interruption directly into the Catskill, the entire series of beds representing there a continuance of similar estuarine conditions. Organic remains in these Oneonta deposits are by no means of common occurrence. Fish remains are sometimes found in most excellent preservation, and some of these have been described, but these nectonic animals are not necessarily to be regarded as proper members of the fauna of this estuarine province. Large quantities of terrestrial driftwood, often forming handsome specimens of Lepidodendron and fern fronds, have been brought in by the surface drainage, and over the surface of the soft shales one may find traces of annelid tracks, crustacean trails and impressions of ostracodes. The most characteristic fossil of the entire series however is the Cypricardites catskillensis, of Vanuxem, the Amnigenia catskillensis, of Hall. This large Unio-like shell, showing in its form and hinge structure its relation to its fresh-water descendants, abounds in some places in the Oneonta beds, particularly in the outcrops about Oxford.

In the Clarke quarry at Oxford the principal bluestone layer is a compact, fine-grained, greenish gray sandstone lying at the base of the opening, having a thickness of about 25 feet and known by the quarrymen as "liver rock", an expression equivalent to the better known term, freestone. Below this layer the quarrymen at times expose a similar sandstone having a thickness of about 5 feet which, though not always accessible, is regarded as of excellent quality for commercial purposes. Some months ago, by the favor of E. E. Davis of Norwich, my attention was called to the fact that this rock, which is really seldom exposed, is crossed vertically by regular specimens of Orthoceras standing with the apexes downward and traversing the entire thickness of the layer. The specimens brought to me at that time had been dislodged from the matrix and showed that the shell had been replaced entirely by the sand and all its cavities filled in the same way by the sediment. The cones also had been more or less compressed laterally and yet preserved the evidence

Plate 2

Nearer view of the basal layer shown in plate 1. The staff with upper end resting on wall of drill hole is 3 feet long and indicates the length of the longer *Orthoceras*. A second individual is seen at the base of the layer

of septation and showed the position and form of the siphuncle. On examining this stratum in place I have found that these shells are seldom deflected from the vertical; and they are exposed on any broken face of the rock in such a way that the quarrymen have long designated the stratum as the "core bed", speaking of the fossils themselves as "cores", an expressive term in view of the fact that in most cases they have about the same size as the drill holes, which also penetrate the bed vertically. One is often forcibly impressed with the appearance of a fragment of the stratum bearing on its face alternate drill holes and casts of Orthoceras. These shells appear to have made no interruption in the sedimentation. The straticular lines run horizontally to them, may often be seen crossing them, or if not crossing they are not deflected or disturbed about them. The number of shells in this particular stratum is incalculable. On the surface of a stone measuring 3 feet by 18 inches I have counted the transverse sections of 15 individuals, this but an average instance. In the stratum overlying the "liver rock", these shells are less numerous but are present, and one of our photographs shows one about 4 feet in length in the lower bench of this bed.

It is not only in the quarry of which I speak that these Orthoceras-bearing strata have been observed. On the east side of the Chenango valley at Oxford they occur in small quarries situated from three fourths to one mile away from the Clarke quarry, and likewise in the old Miller quarry (controlled by the Clarke Co.) at Coventry or South Oxford, 2 miles due south of Oxford. The dip of the rocks throughout this region is very slight, and, as the strata at Coventry are pretty high, I am disposed to believe that the appearance of this peculiar rock at the latter place is not a reappearance of the same stratum, but indicates a recurrence of the same phenomenon at a subsequent period. The rock at Coventry differs from that at Oxford in this respect. Instead of being a compact sandstone, the layer is schistose and is taken out for unsawn flagstone. The individuals of Orthoceras are seen penetrating successive layers of flags, and on the sedimentation surface of these flags the transverse sections of the Orthoceras appear as circular or oval discolorations elevated or depressed and are known to the quarry men as "knots." In no instance have I noticed any marked deviation in the position of these long, straight cephalopod shells from the vertical, nor are they oriented otherwise than with the apexes down and apertures up.

We have then here layers of sand, deposited in a shallow, retired sea or arm of the sea at a depth and under conditions extremely unfavorable for the development and growth of true marine life, crowded with innumerable thousands of these cephalopods in this most peculiar and unexpected attitude. As to the cause of this occurrence, one fact seems perfectly clear, that these shells have been borne in by the waves from deeper waters, as it is well established that Orthoceras, like most of its heavily shelled allies, was a benthonic animal. These remains must also have been floated in as dead shells, but their position with the apex down is not easy to account for unless we conceive that the early chambers had been broken into and more or less filled with mud or sand. As to the source whence they came, it may be said that, though these fossils have not clearly retained specific characters, an Orthoceras of similar large size and general proportions is occasionally found in the fauna of the Ithaca group which occupied the province immediately to the west during the deposition of the Oneonta beds.

In the discussion of this problem before the geologic section of the American association at its Columbus meeting (1899) it was suggested that a sudden incursion of fresh water from the continental drainage way into the marine province occupied by these Orthocerata would be a sufficient cause for the sudden and immediate extinction of their life. I should regard this as a probable explanation of that general and widespread destruction. Such a cause would have annihilated all associated marine life, and it is evident that the Orthocerata have been carried well away from their habitat by flotation after death. With the apical chambers of the shells weighted with

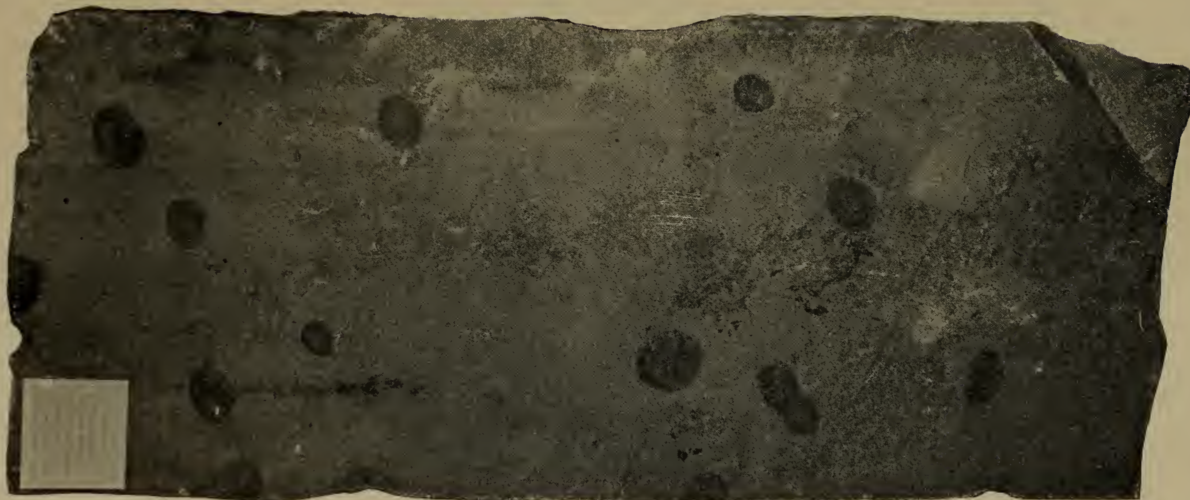
Plate 3

A block fallen from the rock wall in an inverted position. The *Orthocerata* show the septa directed downward or toward the quarry floor, and one of them shows the position of the siphuncle

Plate 3a

A fallen block of sandstone showing 3 *Orthocerata* and a drill hole

Plate 4



A slab of flag stone from the Clarke Co.'s quarry at Coventry, showing horizontal sections of 15 shells of *Orthoceras*. Size of slab 40 x 18 inches (N. Y. state museum)

mud and the later chambers filled with gases of decomposition, the erect position of the shells, maintained continuously while the sedimentation went on about them, would naturally be assumed.

In the flagstones appearing throughout the quarry region in the vicinity of West Hurley, Ulster co., evidence of similar occurrences of vertical Orthoceras has been observed. Doubtless the greater part of the entire mass of these flagstones, which according to the estimate made by N. H. Darton are not less than 4000 feet thick, represents physical conditions quite similar to those evident in the rocks of the Chenango valley, conditions which here are completed and terminated only with the termination of the Catskill formation. Some of the evidences of the vertical Orthoceras from these rocks are conclusive, though in respect to abundance and mode of preservation they are less impressive than the occurrence at Oxford. In association with these organic remains are, however, often found formations of similar appearance, likewise crossing the strata vertically, frequently of small size, and when the rock is schistose, showing concavities on one side and convexities on the other side of the slabs. The majority of these are doubtless of mechanical origin, perhaps in part representing vertical tubules or vertical disturbances of straticulation by the bubbling of confined gases or air up through the sediments.

PAROPSONEMA CRYPTOPHYA

A peculiar echinoderm from the Intumescens-zone (Portage beds) of western New York

BY JOHN M. CLARKE

(Plates 5-9)

While prosecuting paleontologic work in the Portage formation of western New York during the season of 1895, D. D. Luther brought to light a number of interesting hexactinellid sponges or Dictyospongidae at the horizon of the Portage sandstones in the Tannery gully at Naples N. Y. These proved to belong largely to the genus Hydnoceras and constitute the first evidence obtained of the existence of such bodies in this formation. Among them was a single incomplete fragment, showing a radial surface structure modified by fine, interrupted cross-lines, that give the surface of the body a plaited aspect suggestive of minute basket work. The body, through incompleteness and obscure retention, failed to explain itself or even suggest its true nature, though it was clearly evident that it had no relation to the sponges with which it was found. In the season of 1897, Mr Luther obtained from a loose slab of Portage sandstone in the vicinity of the former locality several specimens of this fossil in so complete a state as to justify the inference that all the parts capable of preservation in such sediments are here retained. Since then he has been successsful in locating the stratum containing the fossil. These specimens are in different conditions of excellence; one has suffered little modification in outline, another is but slightly irregular in its periphery, and of the rest only portions greater or less are preserved.

The fossil is discoid and of quite regularly elliptic outline; the one best preserved has a length of 190 mm and a width of 160 mm, the original shell being thus of no inconsiderable size. The thickness of these large disks is very slight. We shall presently observe the total difference in the aspect of the upper and lower surfaces, and yet some of the examples show that between these surfaces there was but a very narrow space. In the specimen represented by the two figures, plates 6 and 7, which are opposite faces, the space intervening had not more than the thickness of a piece of blotting paper and had been filled, not with matrix or any ancient deposit, but with a comparatively recent, discontinuous deposition of infiltrated, amorphous calcite of the same character as that elsewhere observed on more exposed partings of the matrix. In another specimen this interval is greater, though variable, and is seen to be filled with the sandy matrix. It is to be assumed that such disk-shaped bodies in rocks of this character under no little vertical pressure from superjacent sediments, must have, unless highly resistant, been compressed to the almost complete extinction of the interior space; and, on investigation of these structures, it seems that the original matter of the fossils, so far from being capable of withstanding high pressure, probably yielded to very slight strains.

One of the two sides is smooth, that is to say, devoid of regular structure or intimate detail. Its surface is however wrinkled and puckered. Where this character is best manifested it is clear that the largest of the wrinkles as well as the vast number of very minute ones are the outcome of compression; the former are pinched up into one or two prominent folds, the others lie over the surface principally of the median portion. This median part of the fossil evinces by these indexes the greatest compression. More regularity marks the series of wrinkles which depart from the central area toward the periphery, ramifying, inosculating and spreading outward but becoming extinct before the actual margin of the disk is reached. In some cases traces of finer, direct radial striae are visible over the smooth peripheral border, but these are not always clear. Such is the aspect of the surface which for convenience and perhaps with propriety we may term the ventral; but it is the aspect shown by the removal from this surface of the opposite side of the disk, and doubtless its contour is that of the interior side of this ventral shell. Let us reverse, therefore, the contour as described and we shall have the aspect of the exterior ventral surface, on which there will be the casual wrinkles as before, but the radiating and true structural features will be anastomosing grooves and channels, strikingly similar to those found on the ventral side of any Scutella.

The opposite or dorsal side likewise gives evidence of these structural channels. I am satisfied however, that these do not appertain to this surface but have been developed in such specimens by compression against the ventral surface; for where these channels are most strongly developed they correspond in shape and position on the two sides, as is seen by laying one side on the other, as it was when they were found in the rock; furthermore, specimens which have been somewhat obliquely compressed, or lodged in the matrix at such an angle that compression failed to bring the opposite faces into contact do not bear these markings. The leading character of this dorsal surface, however, consists of a great number of radial lines departing from the central point of the disk. We observe, first, that these radial lines about the center have somewhat the appearance of broad cords closely knotted at regular intervals. We may conceive of two such knotted cords lying side by side, the knots of one fitting into the intervals of the other, each pair very gradually widening outward from the center and each separated from the next pair by a smooth, ligulate area not wider than the cords. Or these radii may be likened to a series of braids widening outward. The number of such braids meeting at or departing from the center has not been definitely determined, as in the most complete of the specimens they are not sufficiently distinct to permit enumeration. They are, however, very numerous. Where most clearly retained there are about 25 in approximately one half of the surface. Probably it would not be an overstatement to place at 50 the number of these radial braids actually departing from the center of the disk.

These radial bands are, however, simple for only a part of the radial length. At a point considerably within one half of the radius of the disk each tapers to a definite extremity. In other words, the smooth intervening areas bifurcate and the branches of each join with the branches at their side. Thus by the branching and inosculating of the intercalary areas the braids of the median series are terminated and new series initiated, these arising within the branches mentioned. Several specimens show very clearly that the new series of braids begins at a given radial length and forms a distinct cycle. Still another bifurcation of the smooth radii occurs about half way between the first cycle and the margin of the disk, and this again occurs at the same radial distance for each radius. Each smooth intercalary area which starts from the center is represented by four branches at its distal termination. All radii, both structural and structureless, taper and become extinct within the margin of the disk, leaving a smooth border about the disk. The actual structure of the radial areas which we have spoken of as braids, though not apparent about the center, becomes clearer as these areas widen in the second cycle and pass to their final extinction in the third.

It is necessary to premise that the specimens showing this surface of the disk are preserved as sculpture casts, so that, while the actual substance of the body has been removed without replacement, we see the surface with the original relief of the exterior.

The broader parts of the radial braids, from near the commencement of the second cycle to their extinction, bear a regular succession of horizontal rows of pores. Beginning at the lateral margin of one of these poriferous areas or braids, two adjoining rows of pores will be found to converge slightly and terminate by such convergence. Such a pair of rows will have the position of its apex on or near the central line of the area and between the apexes of two similar pairs on the other half of the area. The rows of pores are separated by low ridges on the sculpture cast, but the ridges between rows of the same pair are distinctly less prominent than those between adjoining pairs. This structure is, as observed, most clearly retained over the second cycle of braids, where their diameter is greatest and both pores and poriferous plates are most pronounced; outward toward the periphery the horizontal extent of the pore rows is less, the pores themselves more restricted to the margins of the area and apparently of considerably larger size. The effect of this structure is to make the poriferous bands appear to branch not far within their extinction, rather than the intervening unporous areas; an appearance well depicted in several of our figures but somewhat illusory as explained by the diagram (plate 5). We have then, evidently, in these porous radial bands, well defined ambulacral areas. The limits of their component plates are almost completely obsolete, but notwithstanding the general obscurity there are places where their margins are clearly discernible. The character of these ambulacral areas of the first cycle does not differ from that of later cycles, but their aspect is different: the close crowding of the alternating knots or short, horizontal ridges produces the braid-like appearance already described, and the pores are only obscurely shown, perhaps because of imperfect retention and perhaps from incomplete development; but when visible they are seen to lie in the grooves between the horizontal knots.

At the point of convergence of these radial bands near the center of the disk we have looked in vain for any evidence of structure. In three or four specimens this area is retained and in these it is simply a smooth, structureless spot where with the most obscure beginnings the ambulacral radii come into being. It is difficult to believe that the space did not possess some differential structure, but in that event it was of so delicate detail that it has been lost in the rather rude retention of these fossils. Nor is there any other single spot or area on this dorsal disk to which any special structure may be ascribed. Let us farther emphasize this significant fact; outside of the ambulacral areas there is no palpable evidence, either on the dorsal or ventral faces of the disk, of geometric plates, nor anywhere of a tubercled, scrobicular surface.

All the evidence, then, that can now be educed from this fossil leads to the following inference. The organism is probably an echinoid. In form it is a flattened, oval disk, not unlike Scutella in this respect. In an uncompressed condition the imperforate side may have been slightly concave; the other surface was distinctly convex. Its ambulacral region is restricted to one side, as in many clypeastroids and spatangoids. The imperforate side bears radiating and inosculating surface channels not unlike those of Scutella. The ambulacra are in radial bands, which at the center of the disk are not less than 25 and are probably as many as 50 in number. These increase by the simple bifurcation of the long and narrow interambulacral spaces, at two distinct ontogenic periods, so that the outcome of this subdivision is three slightly interpenetrating cycles of ambulacral bands. No oral, genital or anal structures have been determined. The center of the surface is the point of convergence of all the ambulacral bands and is smooth or has not retained essential structural details. The existence of geometric plates on these ambulacra is shown in only a few places; most distinctly along the edges of the interambulacral spaces of the second cycle, where the lateral ends of the ambulacral plates make a visible notching of the margin, and again now and then the horizontal edges of the perforate plates are shown. In no part of the fossil is there evidence of plates on the imperforate surfaces.

The evidence of the presence of plates over the ambulacra is definite though imperfect, but their apparent total absence on the major parts of the surface of the body prompts the following suggestion. The matrix of the fossils, a highly laminated or "reedy" silico-felspathic sandstone, contains, in the Tannery gully at Naples, dictyosponges and considerable masses of comminuted floatwood, but no fossils with calcareous test of considerable thickness. Elsewhere this same Portage sandstone is not infrequently found to contain joints of crinoid columns preserved in the usual crystalline calcite. If these echinoid bodies, which we propose to term Paropsonema cryptophya, possessed a calcareous test in any degree corresponding to their considerable size, we should expect to find even in this arenaceous matrix some direct or at least more reliable indirect evidence of its presence. It may, therefore, be well to consider whether these fossils were not provided for the most part with a leathery or imperfectly calcified integument.

The foregoing description gives an account of the characters of this singular fossil so far as it seems possible to make them out. These are so unusual and so different from structures presented by the fossil and recent Echinodermata that it would be venturesome to make farther suggestions as to the probable affinities of the organism. The specimens and drawings have been submitted to several accomplished morphologists, one of them, Dr Robert T. Jackson of Boston, specially familiar with the Echinoidea, and, while these gentlemen have kindly taken time for careful examination of the various structural features determinable, none have been willing to express a definite opinion as to the precise taxonomic position of the fossil. To one intimation from Dr Jackson however I shall take the liberty to refer, as it seems to some extent borne out by the material at hand. This is, in effect, that the ambulacral series 1 and 3 (*see* accompanying diagram, plate 5) may have been continuous in early stages of growth or in preexisting, more elementary types, and that series 2, therefore, may have been continuous from the center of the disk, thus making two series of small ambulacra, each bifurcating at its extremity in the region of the periphery. The suggestion, and it was intended to be no more than this, would imply that the discontinuity of the ambulacral series was due to the exigencies of growth, series 1 and 3 being crowded asunder by the lateral growth of series 2. Such a modification of structure would simplify the interpretation of the organism. Among the material illustrated is a young specimen not so distinctly preserved as some of the larger examples, but so far as it is possible to make out, these ambulacral rows do here appear to be continuous radii. Perhaps the fact should be stated in this way, that there is no very clear evidence of discontinuity or of cycles of these ambulacral radii in this young example, and so far as this specimen alone is concerned the suggestion of Dr Jackson is corroborated (*see* plate 9, fig. 1).

It may be well here to direct attention to a very noteworthy resemblance between this young specimen and the Discophyllum peltatum Hall, a fossil described from the "Hudson river" slates at Troy N. Y., which has recently been refigured by C. D. Walcott in his *Monograph of the fossil medusae.* I can not however look on the two as identical in all structural features.

There is excellent reason for expecting from the Portage rocks which have supplied these specimens of Paropsonema, other material which will retain additional details of structure sufficient to elucidate farther the anatomy and taxonomic position of this peculiar organism.

Plate 5

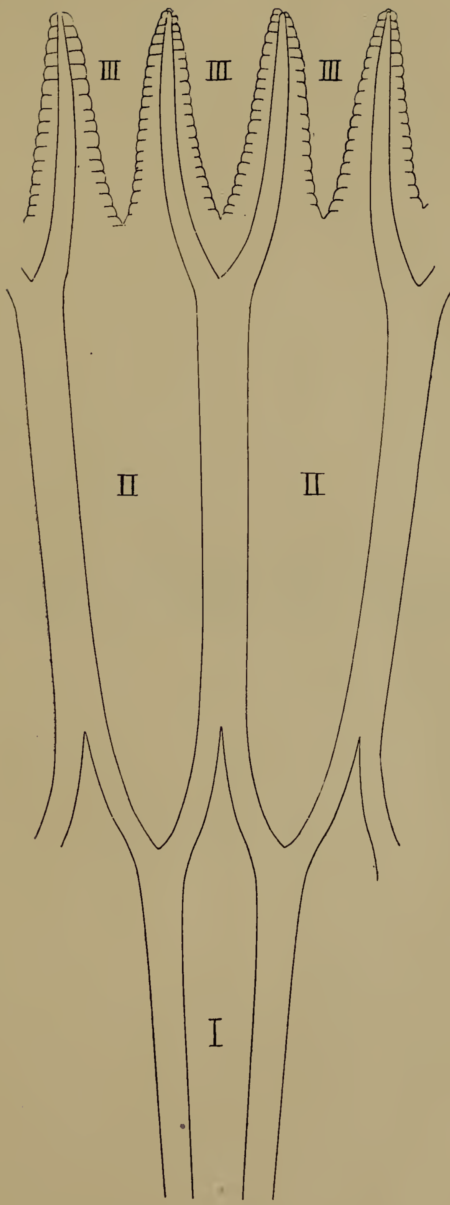


Diagram showing the 3 cycles of nonambulacral areas

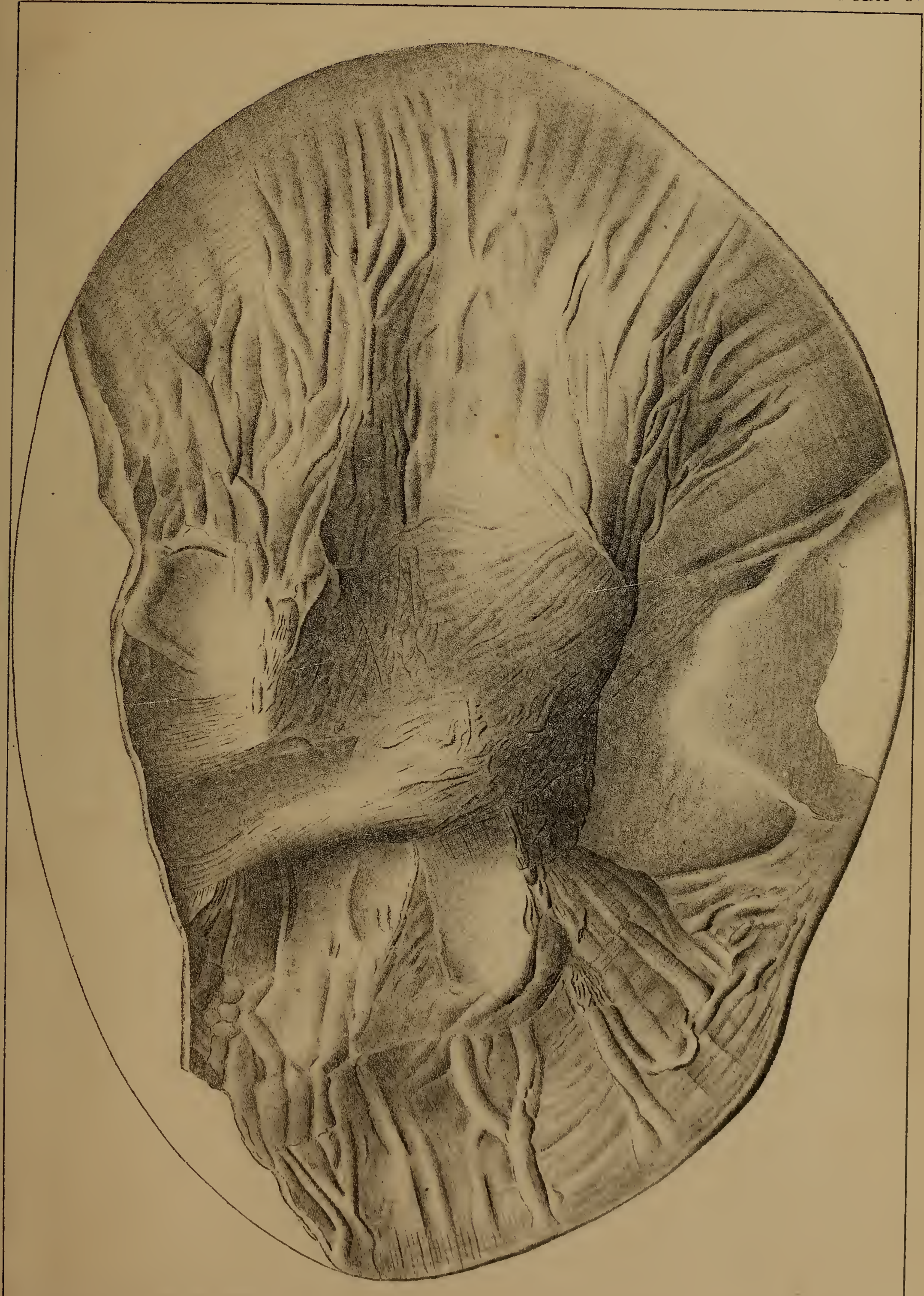
EXPLANATION OF PLATES

PLATE 6

Paropsonema cryptophya *Clarke*

The ~~ad~~nonambulacral surface of a nearly entire specimen with impressions of radial channels and integumental wrinkles.

Portage sandstone. Naples N. Y.



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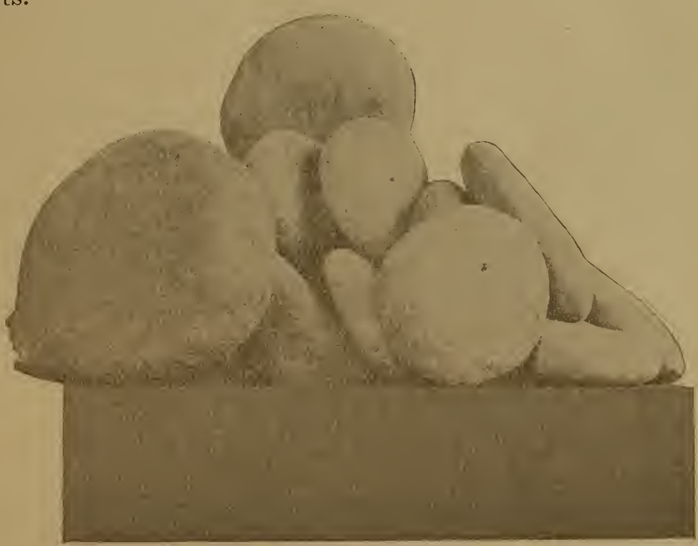
the form of the biscuit as to make it clear that the calcareous deposit has been permeated with the organic matter.

It is quite clear that the process of formation of these peculiar bodies has been the following. The beach shale and débris have become incrusted by a growth of algae, and the latter, stealing away for their requirements the excess of free carbon dioxid in the water necessary to keep the carbonate of lime in solution, have thus caused a precipitation of the lime salts. The process has been continuous, as when a new precipitation formed a concentric continuous deposit of lime carbonate, the new surface became coated with the algae and in consequence fresh precipitation followed. The whole forms a most interesting instance of the influence of plant growth on the formation of lime deposits.



A group of Squaw island water biscuit.

It is appropriate to note in this connection that European authors have recorded the occurrence of similar spheric masses of filamentous algae in various fresh and brackish lakes. Some of these bodies from the lochs of the Hebrides have been described and illustrated by Barclay, who designates them as *algoid lake balls*.[1]

1 G. W. W. Barclay, "On some algoid lake balls found in South Uist." Proceedings Royal soc. Edinburgh. 1886. 13: 845, pl. 30.

These masses are described as composed of "innumerable alga filaments so intertwined and matted together as to form an outer covering of almost felt-like consistency which could not however be torn open without difficulty. This outer coating varied from about $\frac{1}{20}$ to $\frac{2}{20}$ of an inch in thickness, and the interior of the balls consisted so far as the naked eye could see only of mud. . . A microscopic examination of the balls shows that they are composed of a filamentous alga, Cladophora glomerata. . . The interior is seen to be filled with diatoms and the decomposing inner ends of the radiating filaments". Similar bodies, it is stated, come from Ellesmere in Shropshire and from the lakes of Sweden, Norway, northern Germany, Austria and upper Italy. These so called lake balls while organically similar to the water biscuit of Canandaigua lake, are entirely without calcareous deposit or inorganic nucleus. They would seem to be comparable to the condition of this water biscuit after the removal of the calcareous matter. While no explanation has been offered for the peculiar glomerated mode of growth of the alga, it may be that the noncalcareous lake balls have formed in waters without excessive content of lime carbonate. That the deposition of this lime carbonate in the formation of the water biscuit has gone on *pari passu* with the growth of the alga, as above suggested, seems quite clear.

PRELIMINARY DESCRIPTIONS OF NEW GENERA OF PALEOZOIC RUGOSE CORALS

BY GEORGE B. SIMPSON

Prefatory note

The late Prof. James Hall had planned the preparation of a systematic treatise on the genera of the paleozoic corals, but during his life only the preliminary steps toward the execution of this important work were taken. The comprehensive purpose of the proposed treatise was actually the outcome and continuation of work done for volume 6 of the *Paleontology of New York* and for shorter papers in the annual reports, in the preparation of which the illustrations and analyses were essentially the work of George B. Simpson. Mr Simpson has continued these analyses for the execution, so far as seems practicable, of Prof. Hall's later plan, and in the course of his work has indicated several new types of generic structure, which are herewith made public in order to insure their claim to recognition, as some delay in the publication of the larger work is unavoidable. As these investigations were not reviewed by Prof. Hall, it is proper that the responsibility for their accuracy and stability should rest with Mr Simpson.

JOHN M. CLARKE
State paleontologist

MENISCOPHYLLUM, *gen. nov.*

Type: *Meniscophyllum minutum*, sp. nov.

Corallum minute, horn-shaped, regularly curved; calyx circular, deep; septal fovea conspicuous, situated on the side of the least curvature; septa apparently of the same size, but probably the smaller ones only rudimentary and, except in unusually well preserved specimens, obsolete. The extremities of the septa situated on the side of the greatest curvature become thickened and coalesce, forming in connection with a deposit of stereoplasma a thickened axis or pseudocolumella. In a longitudinal section this axis has the appearance of the columella of

Cyathaxonia. In a transverse section it is crescentiform; tabulae present; dissepiments not observed.

This genus most nearly resembles Menophyllum E. & H., but there is only one septal fovea, and the crescentiform thickening appears only in section and is formed in a different manner from that of Menophyllum.

Meniscophyllum minutum, *sp. nov.*

Corallum minute, horn-shaped, regularly curved; hight about 12 mm; diameter of calyx 7 mm; surface with wrinkles of growth and fine concentric striae; calyx oblique, walls thin; septa about 32 in number; the smaller ones rudimentary. The extremities of the septa of the cardinal and lateral aspects become thickened and coalesce, forming a pseudocolumella; septal fovea narrow; tabulae infrequent and very thin.

Formation and locality: Lower Carbonic, Missouri.

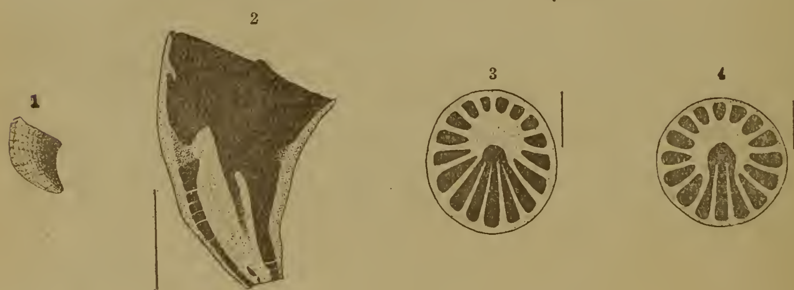


Fig. 1 Meniscophyllum minutum, nat. size
2 Longitudinal section, enlarged
3, 4 The crescentiform appearance of a transverse section of the pseudocolumella, enlarged

Ditoecholasma, *gen. nov.*

Type: *Petraia fanningana* Safford, Geology of Tennessee. 1869. p. 329. Helderbergian, Perry co. Tenn.

Corallum slender, attenuate, very gradually increasing in size; septa alternating in size, the larger ones continuing to or nearly to the center, becoming involved and forming a pseudocolumella, the smaller septa coalescing with the larger ones. The septa are arranged in pairs, each pair separated by a comparatively wide interspace; the septa of a pair separated by only a narrow interspace, and having somewhat the appearance of a single septum with double walls; tabulae numerous, subcystose; dissepiments infrequent or obsolete.

The pseudocolumella has very much the appearance of that of Enterolasma, but the very different and peculiar arrangement of the septa easily distinguishes it from that species.

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Fig. 5 Ditoecholasma fanninganum (*Safford*). A transverse section, showing the peculiar arrangement of the septa, enlarged
6 A longitudinal section showing the pseudocolumella and tabulae, enlarged

Laccophyllum, *gen. nov.*

Type: *Laccophyllum acuminatum*, sp. nov. Niagaran group, Perry co. Tenn.

Corallum small, simple, cylindrico-conical, sometimes slightly curved; septa strong, alternating in size, the larger ones continuing to within a short distance of the center, where their extremities become broadened and fused, forming a distinct inner wall, leaving a cylindric central space, the smaller septa, at about one third the distance to the center, coalescing with the larger ones; tabulae present, those of the inner space strong, horizontal; of the peripheral space, much thinner and ascending from the outer to the inner wall, sometimes subcystose.

This genus in the manner of the formation of the inner wall resembles Duncanella truncata, but differs from that species in its frequent tabulae, and in the presence of tabulae in the central cylindric space.

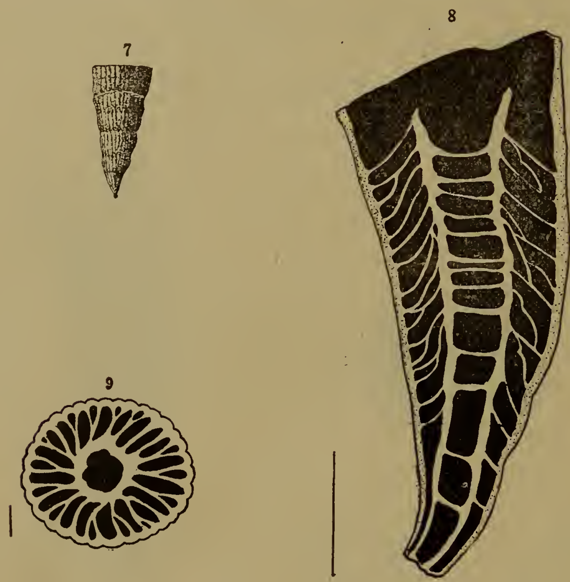

Fig. 7 Laccophyllum acuminatum. A lateral view, nat. size
8 A longitudinal section showing oblique tabulae, inner wall, and the horizontal tabulae of the central space, enlarged
9 Transverse section showing the septa and the inner wall, enlarged

Laccophyllum acuminatum, *sp. nov.*

Corallum small, cylindrico-conical, usually straight, but sometimes slightly curved; hight from 15 to 18 mm; diameter of the calyx from 6 to 9 mm; costae very prominent; septa alternating in size, the larger ones extending to within a short distance of the center, sometimes fasciculating, the extremities thickening, coalescing and forming an inner wall; tabulae frequent, curving abruptly upward, frequently presenting a cystose appearance. In the central space formed by the inner wall are frequent horizontal tabulae, somewhat stronger than the others, and apparently unconnected with them.

Formation and locality: Niagaran group, Perry co. Tenn.

HAPSIPHYLLUM, *gen. nov.*

Type: *Zaphrentis calcariformis* Hall. Fossil corals, Niagara and Upper Held. groups. 1882. p. 33, and 12th rep't of the state geologist of Indiana. pl. 21, fig. 10, 11. St Louis group, Washington co. Indiana.

Corallum small, simple, conical or horn-shaped; calyx circular, comparatively deep, with thin margins; biareal. The outer area is bounded by the external epitheca; the inner area by a subvertical wall of horseshoe shape, open on the side of the septal fovea. Two of the larger septa connect with this wall in such a manner as to be apparently a continuation of it, and form a very distinct pyriform septal fovea; septa alternating in size,

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Fig. 10 Hapsiphyllum calcariforme (*Hall*). A transverse section showing the coalescing septa, and the wall of the inner area, connecting with two of the septa.

the smaller ones continuing for a short distance into the cavity of the corallum, there coalescing with the larger ones, which continue to the inner wall, with which they coalesce, and in which they terminate. Tabulae and dissepiments are present.

The wall of the inner area, connecting with two of the septa and bounding a portion of the septal fovea, is similar to that of Agonophyllum, but that genus differs from this in several respects, principally in having carinations on the sides of the septa.

ENTEROLASMA, *gen. nov.*

Type: *Streptelasma strictum* Hall, 26th rep't N. Y. state museum nat. hist. 1874. Pal. N. Y. v. 6, pl. 1, fig. 1-10. Helderbergian, Clarksville, Albany co. N. Y.

Examples: *Streptelasma caliculum* Hall. Pal. N. Y. 1852. v. 2, p. 3, pl. 32, fig. 1*a-k*.

Streptelasma radicans Hall. 28th rep't N. Y. state mus. nat. hist. 1876. p. 106, pl. 5, fig. 1-4.

Petraia waynensis Safford. Geol. of Tennessee. 1869. p. 314.

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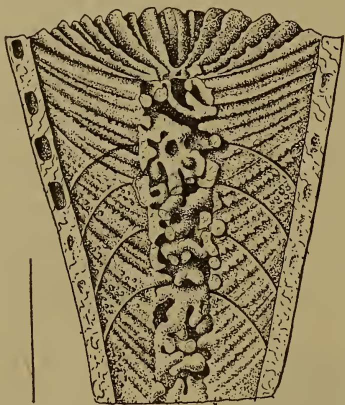

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Fig. 11 Enterolasma strictum (*Hall*). A natural longitudinal section showing the pseudocolumella, the papillated carinae on the sides of the septa, and the ascending tabulae, enlarged

12 An enlargement from the center of the calyx, showing the involved processes from the inner margins of the septa

13 Enterolasma waynense (*Safford*). A longitudinal section showing the subcystose tabulae and pseudocolumella; the upper portion showing the papillate carinae of the septa, enlarged

14 A transverse section showing the thickened walls and the crenulations caused by the septal carinae, enlarged

15 A transverse section, showing an individual growing from the calyx of another, enlarged

Corallum moderately small, cylindrico-conical, usually straight, but sometimes slightly curved; calyx circular, moderately deep, sides thin; septal fovea obscure, and in some species apparently obsolete; septa alternating in size, the larger ones continuing nearly to the center, having projections from their extremities which continue to the center, becoming much involved, forming a pseudocolumella of very peculiar appearance, somewhat resembling the convolutions of the intestines; sides of the septa with numerous papillate elevations or carinae, which in a transverse section give to the septa a crenulate or echinate appearance; tabulae and dissepiments present. The characteristic feature of this genus is the peculiar appearance of the pseudocolumella.

STEREOLASMA, *gen. nov.*

Strombodes? rectus Hall. Geol. rep't 4th district N. Y. 1843. p. 209, fig. 5.

Type: *Streptelasma rectum* (in part) Hall. Illus. Devonian fossils. 1876. pl. 19. Hamilton shales, western New York.

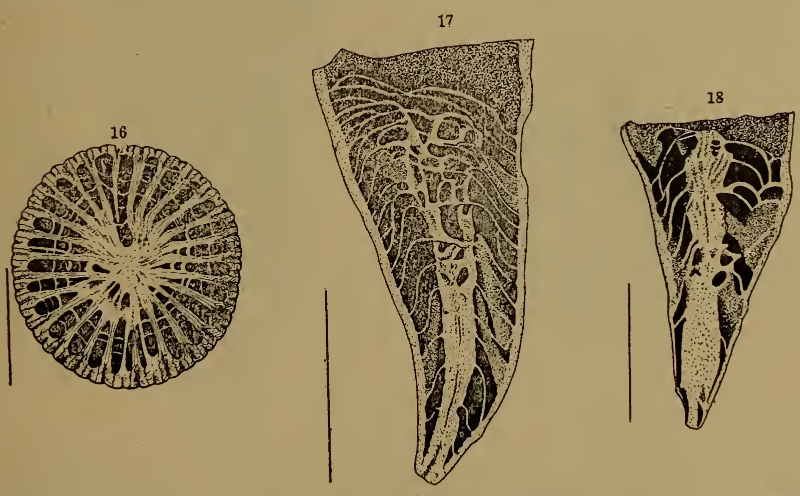

Fig. 16 Stereolasma rectum (*Hall*). A transverse section showing septa, dissepiments, and pseudocolumella
17 A longitudinal section showing tabulae and pseudocolumella
18 S. ungula (*Hall*). A longitudinal section

Example: *Streptelasma ungula* Hall. Illus. Devonian fossils. 1876. pl. 19. Hamilton shales, western New York.

Corallum varying in size, straight or curved, simple; calyx circular; septal fovea conspicuous; septa alternating in size, the larger ones continuing to the center, straight or very slightly twisted; between the septa at the center of the corallum a deposit of stereoplasma, which has the appearance of a columella; tabulae and dissepiments frequent.

The pseudocolumella distinguishes this genus from Zaphrentis.

Lopholasma, *gen. nov.*

Type: *Streptelasma rectum* (in part) Hall. Illus. Devonian fossils. 1876. pl. 19. Hamilton shales, western New York.

Corallum conical, straight, sometimes slightly curved at the apex, subrigid in appearance; surface with frequent annulations, and numerous concentric striae; costae distinct, flat or slightly rounded, the surface resembling that of Heliophyllum; septal fovea well defined; septa alternating in size, the larger ones

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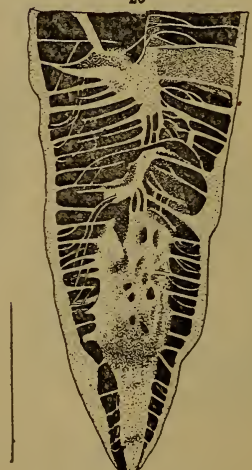

Fig. 19 Lopholasma carinatum (*nom. propos.*) A transverse section showing the pseudocolumella, the septa, dissepiments, and the spur-like processes from the septa

20 Longitudinal section showing the pseudocolumella, septal carinae and the delicate tabulae

continuing to the center, where there is a deposit of stereoplasma forming a pseudocolumella, which does not extend beyond the bottom of the calyx. On the sides of the septa are strong, essentially horizontal carinae, extending from the exterior wall to the extremity of the carina. In a transverse section, curved, spur-like processes are seen proceeding from the sides of the septa. The nature of these processes has not been satisfactorily determined. Tabulae are frequent, delicate; dissepiments frequent.

The type species of this genus closely resembles Stereolasma rectum, and from external characters alone they could not be separated, but by slightly grinding down the exterior, the difference can be at once seen.

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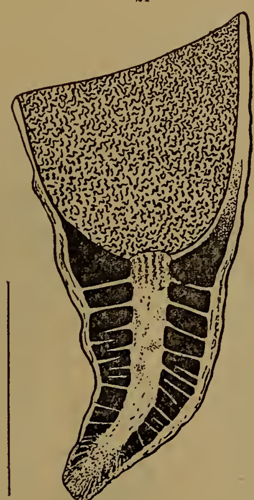

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Fig. 21 Longitudinal section of the same showing depth of the calyx, pseudocolumella and septal carinae

22 Longitudinal section near the margin, showing the edges of the septa and the width of the carinae

KIONELASMA, *gen. nov.*

Type: *Streptelasma mammiferum* Hall. Fossil corals of the Niagara and Upper Held. groups. 1882. p. 21, and 35th rep't N. Y. state mus. nat. hist. 1884. p. 425. Onondaga limestone, Falls of the Ohio.

Examples: *Cyathaxonia gainesi* Davis. Kentucky fossil corals. 1885. pl. 104, fig. 1-7.

Streptelasma spongaxis Rominger. Geol. sur. Michigan. 1876. pt 2, pl. 39.

Corallum variable in size, cylindrico-conical or horn-shaped; calyx circular or elliptic; septa alternating in size, the larger ones continuing to or nearly to the center, where they become thickened and some of them much involved or twisted, forming a central spongy axis or pseudocolumella, which becomes solidified and projects prominently from the bottom of the calyx; tabulae and dissepiments present, comparatively infrequent.

This genus resembles Cyathaxonia, Lophophyllum, Axophyllum and others in having a strong projection from the bottom of the calyx, but internally it differs from all of them.

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Fig. 23 Kionelasma mammiferum (*Hall*). A transverse section showing the septa and the pseudocolumella
24 A longitudinal section showing pseudocolumella and tabulae
25 Kionelasma herzeri (*Hall*). A longitudinal section showing the pseudocolumella and subcystose tabulae

Nicholson and Etheridge, in their *Monograph of the Silurian fossils of the Girvan district, Ayrshire*, pl. 5, fig. 2, illustrate the genus Lindströmia, the enlarged sections of which show a close resemblance to the structure of this genus. But the authors say the pseudocolumella is formed by "the amalgamation of the inner ends of a larger or smaller number of septa, without any twisting of the septa, and being accompanied by a more or less copious secondary deposition of sclerenchyma."

In Kionelasma the twisting of the septa is one of the most pronounced characteristics.

Triplophyllum, *gen. nov.*

Type: *Zaphrentis terebrata* Hall. 12th rep't, geol. Indiana. 1883. p. 316, pl. 23, fig. 5. Onondaga limestone, Falls of the Ohio.

Example: *Zaphrentis centralis* Edwards and Haime. Monographie des polypiers fossiles des terrains palaeozoiques. p. 328, pl. 3, fig. 6.

This genus has the same general appearance and mode of growth as Zaphrentis, but in addition to the septal fovea there are two lateral foveae. The microscopic character is also different. In Zaphrentis the calcareous fibers of the septa are arranged obliquely outward from the median plate: in this genus they are arranged obliquely inward or toward the center of the corallum.

26 27

Fig. 26-27 Triplophyllum dalii (*E. and H.*). Transverse sections of two specimens showing the three septal foveae and the arrangement of the septa

Charactophyllum, *gen. nov.*

Type: *Camptophyllum nanum* Hall and Whitfield. 23d ann. rep't N. Y. state mus. nat. hist. 1873. p. 232. Lower Carbonic Rockford Ind.

This genus has essentially the same structure as Camptophyllum, with the exception that the sides of the septa are carinated, the carinations forming serrations or denticulations on the margins of the septa.

It differs from that genus in the same manner that Heliophyllum differs from Cyathophyllum.

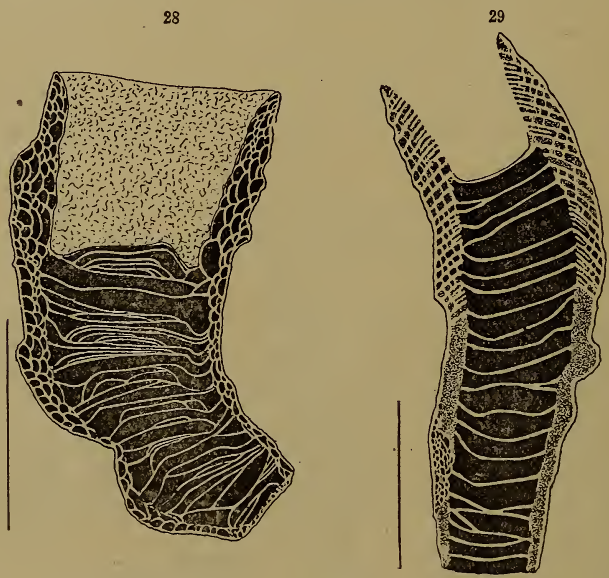

Fig. 28 Charactophyllum nanum *H. and W.* Longitudinal section

29 Charactophyllum radiculum *Rominger.* Longitudinal section showing oblique carinae, cysts, and strong tabulae

ODONTOPHYLLUM, *gen. nov.*

Type: *Aulacophyllum convergens* Hall. Fossil corals of the Niagara and Upper Held. groups. 1882. p. 22, and 12th rep't Indiana geologist. p. 281, pl. 17, fig. 1, 2. Onondaga limestone, Falls of the Ohio.

Forms having the same characters as Aulacophyllum, but with the sides of the septa carinate and their margins denticulate as in Heliophyllum.

SCENOPHYLLUM, *gen. nov.*

Type: *Zaphrentis conigera* Rominger. Geol. sur. of Michigan. pt 2, p. 149, pl. 40. Onondaga limestone.

This form would be excluded from Zaphrentis on account of its conical tabulae and spirally twisting septa. It is very similar to Clisiophyllum, but is without the peripheral zone of cysts, characteristic of that genus.

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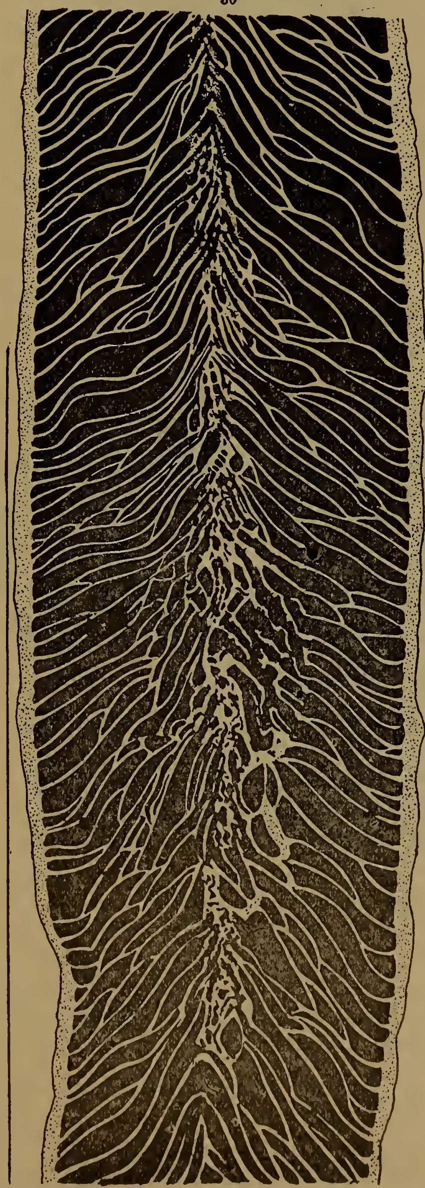

Fig. 30 Scenophyllum conigerum *Rominger*. A longitudinal section showing the conical subcystose tabulae, and pseudocolumella .

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Fig. 31 A transverse section of the same showing septa and dissepiments, and fragmentary edges of tabulae near the center

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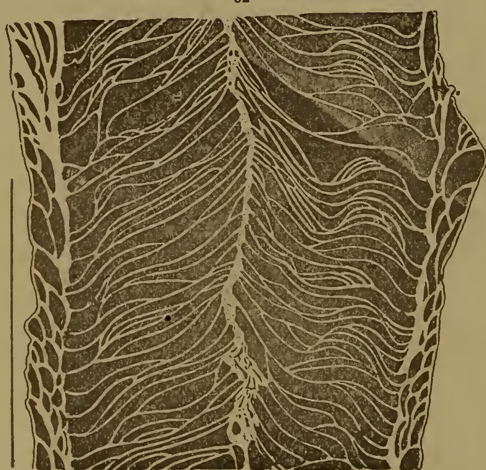

Fig. 32 Clisiophyllum oneidaense *Billings.* A longitudinal section for comparison with fig. 30

SYNAPTOPHYLLUM, *gen. nov.*

Type: *Eridophyllum arundinaceum* Billings, Can. jour. 1859. 4: 134. Onondaga limestone.

Examples: *Eridophyllum simcoense* Billings, Can. jour. 1859. 4: 131.

Eridophyllum stramineum Billings, Can. jour. 1859. 4: 135.

Corallum forming masses composed of slender, elongate, cylindric individuals, subparallel, and connected with each other by radiciform expansions; rapidly increasing by calicinal gemmation; septa alternating in size; the longer ones continuing nearly to the center; their sides carinated as in Heliophyllum; the margins slightly denticulated. Internally there are usually, in the peripheral region, a single row of small cysts, though in portions of the more robust forms there are occasionally two rows. The margins of this row of cysts, in a transverse section, give the appearance of a secondary wall. The tabulae are com-

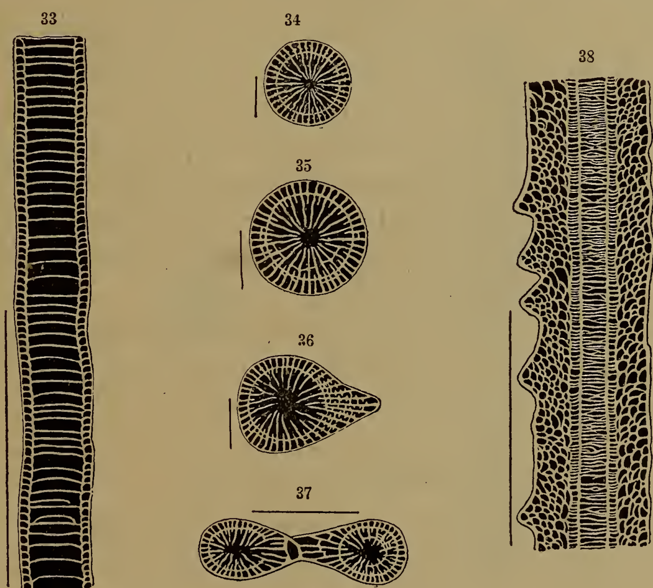

Fig. 33 Synaptophyllum simcoense (*Billings*). Longitudinal section showing single row of cysts, and wide tabulae, enlarged
34 Transverse section, showing crenulated septa, enlarged
35 S. baculoideum *sp. nov.* A transverse section showing septa, and vertical rows of cysts resembling an internal wall, enlarged
36 Transverse section showing radiciform expansion, enlarged
37 S. segregatum *sp. nov.* Transverse sections showing coalescing radiciform expansions, enlarged
38 Eridophyllum rugosum *E. and H.* A longitudinal section for comparison with Synaptophyllum

paratively strong, occupying the greater portion of the width of the interior.

There has been much confusion in regard to the forms now brought together in this genus. Billings (*loc. cit.*), Davis (*Ken-*

tucky fossil corals) and others, have included them in the genus Eridophyllum *E. and H.*; while Rominger (*Geol. sur. Michigan*, 1876) considers Eridophyllum a synonym of Diphyphyllum *Lonsdale*, and places these forms in the latter genus; but Frech in Roemer's *Lethaea Palaeozoica* p. 356, speaking of Eridophyllum, says: "Lonsdale's genus Diphyphyllum in fact embraces corals of the Carboniferous limestones of a very different structure."

The forms included in the genus Synaptophyllum have generally been considered of the same character as Eridophyllum verneuilianum, E. rugosum, E. huronicum, etc. Externally they have a superficial resemblance, but may easily be distinguished by the character of the radiciform expansions. In Eridophyllum these are flat, proceed from one side of the coral only, and are not connected with the interior of the adjacent coral; while in this genus they are cylindric, proceed from all portions of the coral, and usually the expansions of adjacent corals are opposite, meeting and coalescing midway between the corals.

Eridophyllum is a valid genus, including such forms as E. verneuilianum *E. and H.*, E. rugosum *E. and H.*, E. huronicum *Rominger*, etc.

SCHOENOPHYLLUM, *gen. nov.*

Corallum consisting of a large mass, formed by the close aggregation of very long cylindric stems; exterior with strong concentric wrinkles of growth and conspicuous costae. There are frequent slender processes from the coral, about 3 or 4 mm in length, regularly diminishing in size to the extremity, ascending, continuing to the adjacent corallum and serving as supports.

The gemmae spring from the margin of the calyx, the parent corallum continuing growth, thus giving to the younger corals the appearance of proceeding from the side of the parent corallum at a great distance from the calyx; septa comparatively few in number; alternate septa inconspicuous, often apparently obsolete; cardinal septum continuing a short distance beyond the center, usually becoming much enlarged at the extremity, which has the appearance of a solid, compressed columella, but sometimes the extremity of the septum is but slightly, if at all, enlarged. Internally in the peripheral region there is a single row of comparatively large cysts. In a transverse section the edges of the cysts give the appearance of a continuous inner wall. The tabulae are broad, usually ascending to the center.

In the collection of Prof. Hall this form has been labeled Lithostrotion harmodites. I have seen no authentic specimens of that species, but on comparison with the illustra-

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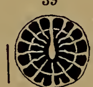

Fig. 39 Schoenophyllum aggregatum *sp. nov.* Transverse section showing the enlarged extremity of the cardinal septum, and apparently an inner wall, enlarged

40 Longitudinal section showing a single row of cysts, tabulae, and the enlarged extremity of the cardinal septum, enlarged

tions given by Edwards and Haime (*Monographie des polypiers fossiles.* pl. 15, fig. 1, 1[a]) it is evident that the identification is wrong. In that species the columella is solid, unconnected with the septa; while in this the so-called columella is formed by the enlargement of the extremity of the cardinal septum, as in Lophophyllum.

PLACOPHYLLUM, *gen. nov.*

Type: *Placophyllum tabulatum* sp. nov. Onondaga limestone.

Corallum consisting of large masses, composed of loosely aggregated, greatly elongate, cylindric stems, of rigid appearance, which in the type species have a diameter of from 8 to 10 mm; exterior with numerous wrinkles of growth; costae distinct.

At infrequent intervals there are slender lateral processes, which continue to the adjacent coral and serve the purpose of supports.

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Fig. 41 Placophyllum tabulatum *sp. nov.* A longitudinal section showing the tabulae occupying the whole of the internal cavity

Internally the cysts are absent, the whole interior being occupied by strong, broad tabulae.

The internal structure closely resembles that of Amplexus, but the entirely different manner of growth would separate it from that genus. The type species, externally, most closely resembles Cylindrophyllum elongatum. The manner of growth is similar, both consisting of an aggregation of elongate, cylindric stems, but in that species there are numerous cysts as well as tabulae, the structure being heliophylloid. From the other forms, which consist of an aggregation of cylindric stems, specially some forms of Synaptophyllum to which it has a resemblance, it may always be distinguished by its internal structure.

CYLINDROPHYLLUM, *gen. nov.*

Type: *Cylindrophyllum elongatum* sp. nov. Onondaga limestone.

Colonies forming masses composed of loosely aggregated, very

42

Fig. 42 Cylindrophyllum elongatum *sp. nov.* A longitudinal section showing internal structure

elongate, cylindric stems, in the type species having a diameter of from 12 to 14 mm; distance between the corallites variable;

they are sometimes in contact, at other times distant the diameter of an individual or more; exterior with annulations and wrinkles of growth; costae distinct; alternate septa very short; sides of septa carinated as in Heliophyllum, but their margins very seldom denticulate. Internally the peripheral region is occupied by cysts, which in a longitudinal section have the appearance of being arranged in vertical rows; tabulae strong, usually horizontal, and at varying distances apart.

In the type species the corallites are straight and rigid, and I have observed no lateral excrescences or expansions.

The internal structure of this genus is essentially the same as in Heliophyllum, but the manner of growth and general appearance is such that it could not be included in that genus.

In a longitudinal section the structure appears similar to that of the more robust forms of Synaptophyllum. In a transverse section the appearance is very different. Externally it may be easily distinguished from that genus by the absence of the lateral processes, which are a distinguishing feature of Synaptophyllum.

In exterior it resembles Placophyllum, but differs in internal structure.

Prismatophyllum, *gen. nov.*

Type: *Prismatophyllum rugosum*, E. and H. Monographie des polypiers fossiles. 1851. p. 387, pl. 12, fig. 1, 1^a, 1^b, and *Cyathophyllum rugosum*, Rominger, Fossil corals. 1876. p. 166.

Example, *Acervularia davidsoni* E. and H. Monographie des polypiers fossiles. 1851.

Colonies forming masses composed of prismatic corallites, in contact with each other, and of essentially the same diameter for their entire length. While the internal structure of the genus is very similar to that of Heliophyllum, the prismatic form, mode of growth and reproduction are so widely different from the typical forms of that genus that they should not be included in the same genus.

The typical species of this genus, P. rugosum, is the same as that described by Milne-Edwards and Haime and by Rominger as Cyathophyllum rugosum, they citing

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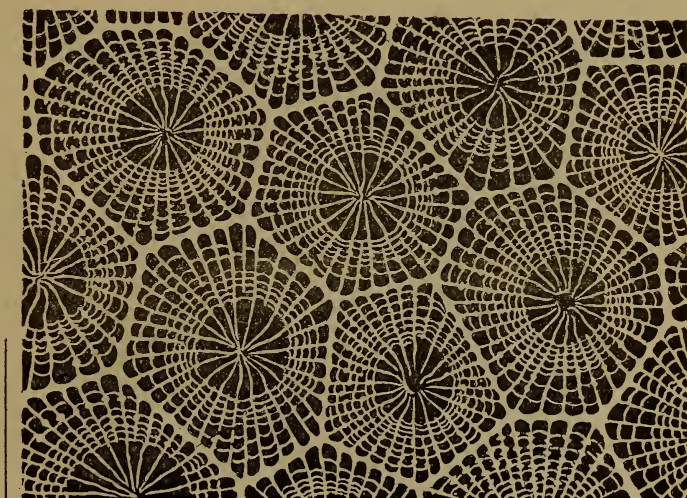

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Astrea rugosa *Hall*, as a synonym. I have before me the specimen of Astrea rugosa from which the original description and drawing were made, and it is very clearly a Phillipsastrea.

Edwards and Haime (*Monographie des polypiers fossiles.* 1851. p. 418), in the description of Acervularia davidsoni, speak of the interior wall, but those forms which in this country have been generally considered as A. davidsoni do not have

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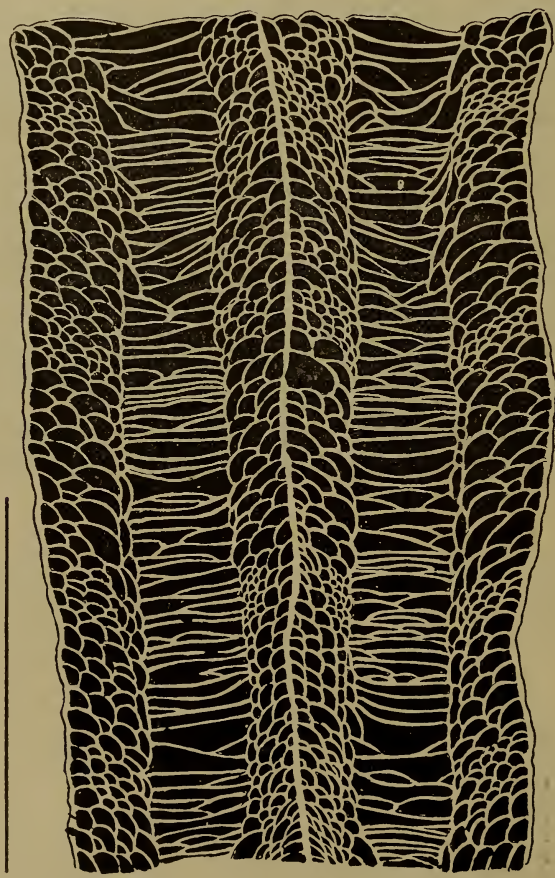

Fig. 43 Prismatophyllum (davidsoni) *E. and H.* Transverse section showing prismatic form, the septa, and the cut margins of cysts, enlarged

44 P. rugosum *E. and H.* Transverse section showing polygonal form of corallites and denticulated septa, enlarged

45 Longitudinal section showing internal structure

an interior wall, though in a transverse section the abrupt ending of the cysts, or dissepiments, coincidentally with the shorter septa gives the appearance of an interior wall. The continuation of alternate septa to the center proves that there is no secondary wall.

HOMALOPHYLLUM, *gen. nov.*

Type: *Zaphrentis ungula* Rominger, Fossil corals. 1876. p. 151. Onondaga limestone.

Example: *Zaphrentis herzeri* Hall. Fossil corals Niagara and Up. Held. groups. 1882. p. 35.

The above species have a decided characteristic in that they are flattened on the side of the greatest curvature; for some distance from the apex they are concave; calyx oval, with one side straighter than the opposite side. The form of the corallum is similar to that of Calceola. They make a natural group which differs from Zaphrentis and should be removed from that genus.

EDAPHOPHYLLUM, *gen. nov.*

Type: *Cystiphyllum bipartitum* Hall. Onondaga limestone.

In form and general appearance similar to Coleophyllum, though the calyx is much less oblique. The conspicuous septal of that genus is replaced by an abnormally developed cardinal septum, which is here the most conspicuous feature.

Internally the structure consists of a series of laminae usually separated by cysts. It also resembles that of Coleophyllum, but the cysts are more highly developed.

Etymology of generic terms

Charactophyllum. *Χἄρακτός*, toothed, saw edge, and *φύλλον*, a leaf, in allusion to the serrated margins of the septa.

Cylindrophyllum. *Κύλινδρος*, a cylinder, and *φύλλον*, a leaf, in allusion to the form of the corallites.

Ditoecholasma *Δίς*, double, *τοιχος*, a wall, and *φύλλον*, a leaf, in allusion to the outer and inner walls.

Edaphophyllum. *''Εδαφος*, a base, foundation, and *φύλλον*, a leaf, in allusion to the laminate base of the calyx.

Enterolasma. *''Εντερον*, intestine, and *''Ελασμα*, a plate, in allusion to the convoluted center of the coral.

Hapsiphyllum. *'Αψίς*, an arch, and *φύλλον*, a leaf, in allusion to the arched accessory wall.

Homalophyllum. *''Ομἄλός*, level, and *φύλλον*, a leaf, in allusion to the flattened portion of the coral.

Kionelasma. *Κίων*, a column, and *Ἔλασμα*, a plate, in allusion to the prominent pseudocolumella.

Laccophyllum. *Λάκκος*, a well, and *φύλλον*, a leaf, in allusion, to the appearance of the central area of the coral in longitudinal section.

Lopholasma. *Λόφος*, a crest, and *Ἔλασμα*, a plate, in allusion to the carinae of the septa.

Meniscophyllum. *Μηνίσκος*, a crescent, and *φύλλον*, a leaf, in allusion to the form of the pseudocolumella.

Odontophyllum. *Ὀδόντος*, a tooth, and *φύλλον*, a leaf, in allusion to the denticulate margins of the septa.

Placophyllum. *Πλάξ*, anything flat or broad, *φύλλον*, a leaf, in allusion to the broad tabulae.

Scenophyllum. *Σκῆνος*, a tent, and *φύλλον*, a leaf, in allusion to the tent-like appearance of the tabulae.

Schoenophyllum. *Σχοινος*, a rush, and *φύλλον*, a leaf, from the appearance of the corallites.

Sterelasma. *Στερεός*, firm, solid, and *ἔλασμα*, a plate, in allusion to the filling of the central area of the coral with stereoplasma.

Synaptophyllum. *Συναπτός*, joined together, *φύλλον*, a leaf, in allusion to the lateral processes connecting the corallites.

Triplophyllum. *Τριπλόος*, triple, and *φύλλον*, a leaf, in allusion to the three septal foveae.

SILURIC FUNGI FROM WESTERN NEW YORK

BY FREDERIC B. LOOMIS (Amherst Mass.)

Plate 16

At about the middle of the Clinton group as it is developed at Rochester N. Y., occurs a band of hemate containing numerous fossils, which give evidence of having been deposited in a moderate depth of water. In thin sections many of these fossils are found to be more or less perforated by fine tubules entering from their surfaces. The borings are of interest as additional testimony of the presence of plants during Clinton time, a period when plants were very sparsely represented.[1] The borings, as will be seen from the figures, enter from the surface and are believed to represent plants which grew on the shells and sent only a part of their filaments into the shell. The tubules penetrate a little way into or occasionally riddle the whole shell. The borings are uniform in size, there being no tendency to irregular swellings in places where the host material was softer. At the ends of certain tubules are spherical swellings, in most cases of uniform shape and size. These swellings may represent sporangia, though I have no conclusive evidence to that effect. The borings doubtless represent the work of the mycelium of a fungus, probably some member of the Phycomycetes. I regard them as due to fungi rather than to algae for the following reasons: the tubules are quite uniform in size and shape; while those of algae, under the same conditions, are more or less irregular; there is also in these fossils no evidence of septa, in which respect they are more like fungi than algae. The tubules are very small, $\frac{1}{400}$ to $\frac{1}{500}$ mm in diameter, which is smaller than is usual for algae, but quite normal for the mycelia of fungi. The spherical inflations at the ends of some filaments are very like sporangia, or other fungous swellings; but not at all like

---

[1] Bythotrephis, which is common in the rocks of this age and has usually been looked on as algous, is regarded by Rothpletz and others as a sponge.

swellings of algae, which are usually quite irregular in size and shape. Such spherical swellings as I have figured on the ends of various hyphae have been frequently described[1] on hyphae which had penetrated into the wood or leaves of fossil plants. Indeed, the appearance of the large number of filaments, entering from the surface and penetrating a short distance into the calcareous shells, is very like that produced by the mycelium of a lichen in penetrating a limestone or other rock on which it grows.

It is difficult to refer these marine fungi to modern families, as such recent fungi have not been extensively studied except so far as they affect food fish, etc. The mycelia from the Clinton group may be safely called Phycomycetes, and are probably to be placed near the genus Saprolegnia. Duncan[2] has described similar borings under the name Palaeachlya perforans, referring them also as "unicellular algae" to the family Saprolegniae.[3] These were obtained from Lower Siluric foraminifera, the Upper Siluric coral, Goniophyllum pyramidale, the Devonic coral, Calceola sandalina, and a Miocene Thamnastraea. This author did not distinguish species, referring to one species mycelia both coarse and fine from Siluric to Tertiary. In the material under present consideration I find three forms distinguishable both by the character of the mycelium and the spherical swellings. So far as the mycelium is concerned, the Clinton fungi resemble Duncan's Palaeachlya; but the spherical swellings closely resemble those described by Kölliker[4], found in both recent and fossil corals and shells, which fungi Kölliker described but left unnamed. They are also very like the Carbonic genus, Peronosporites,[5] whose hyphae, however, enter plant tissue and would therefore seem to be either fresh-water or aerial fungi. Peronosporites has just such swellings as the Clinton fungi at the ends of small hyphae, both hyphae and swellings being unmodi-

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[1] *See* Seward. Fossil plants. 1898. p. 217.
[2] Quart. jour. geol. soc. Lond. 1876, p. 205.
[3] At the time Duncan wrote Saprolegniae were considered algae, but are now classed with fungi.
[4] Zeitsch. Wiss. Zool. 1859. 10: 215.
[5] *See* Seward. Fossil plants. 1898. p. 217.

fied as to shape or size whether in the cell walls or open cell spaces. In spite of the difference of host, for the present I prefer to assign these Clinton fungi to the genus Peronosporites rather than to propose a new generic name on a very inadequate botanical basis. The following three species are based on variations of the mycelium and hyphal swellings. The drawings are made with a camera lucida.

Peronosporites ramosus *sp. nov.*

Plate 16, fig. 1-3

This species is characterized by a mycelium about $\frac{1}{420}$ mm in diameter, which gives off branches freely. All parts of the mycelium are uniform in size. Some hyphae are swollen at their ends into a globular sac. These sacs vary in size from $\frac{1}{75}$ to $\frac{1}{30}$ mm in diameter, and are globular in form, though they may be more or less ovate or even asymmetrical. Rarely a hypha, after enlarging into a sac, continues farther; though in one case a hypha has expanded into a second sac. These more or less irregular swellings probably do not represent sporangia or resting spores, which would be more regular in size and shape.

Peronosporites globosus *sp. nov.*

Plate 16, fig. 4

The mycelium is $\frac{1}{500}$ mm in diameter, enters from the outer surface and branches but very seldom. At the ends of certain short hyphae are spherical swellings about $\frac{1}{35}$ mm in diameter, quite uniform in size and shape. Being uniformly on short hyphae, the swellings are near the surface of the host, and may represent sporangia though no spores are present. This is a common species.

Peronosporites minutus *sp. nov.*

Plate 16, fig. 5, 6

The mycelium, about $\frac{1}{500}$ mm in diameter, entering from the surface, penetrates straight downward into the shell without giving off branches. Frequently on the ends of long hyphae are spherical swellings $\frac{1}{100}$ mm in diameter. These are very regular, and have the smallest swelling belonging to any species, though the mycelium has a diameter about the same as the foregoing species.

All of the above are found on sectioning the firmer parts of the Clinton hematite layer, which is an aggregation of rolled bits of bryozoa, corals, brachiopod shells and crustacea, each fragment being coated by concentric layers of hematite, making an oolitic structure. If one accepts the theory that all oolites are formed by concentric coatings precipitated by algae, then these oolites must indicate the presence of other plants in the Clinton sea. This oolitic formation is described by C. H. Smyth jr,[1] who carefully describes the process of concentric precipitations, but does not assign algae as a cause. This author describes the conditions prevailing at the time the hematite layer was deposited as a swampy shore of an inland sea.

Such fungi as those above described are common through Mesozoic and Cenozoic time, and have been found at least once before in Siluric beds.[2]

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[1]Zeitsch. f. Praktische geologie. August 1894. *See also* Amer. jour. sci. (3) 43, p. 487.

[2]Kölliker (*loc. cit.*) says he found his Palaeachlya in an Upper Siluric Cyathophyllum and a Lower Siluric foraminifer from Europe, but he does not figure either.

EXPLANATION OF PLATE

Peronosporites ramosus *sp. nov.*

Fig.

1 A transverse section of a punctate brachiopod shell inhabited by P. ramosus. *a*=shell punctae. x150

2 Branch *b* of fig. 1. x625

3 A shell cut parallel to the surface, showing an advanced stage of disintegration caused by P. ramosus

Peronosporites globosus *sp. nov.*

4 An impunctate brachiopod shell inhabited by P. globosus. x250

Peronosporites minutus *sp. nov.*

5 An impunctate brachiopod shell penetrated on one side only by P. minutus. x125

6 *a*, a spherical swelling on a hypha, x500; *b*, a hypha. x500

PLATE 7

Paropsonema cryptophya *Clarke*

The ambulacral surface with impressions of the radial channels belonging to the opposite surface of the test. This and the figure on plate 6 pertain to the same specimen.

Bull. 37 N. Y. State Museum

Plate 7.

G. B. Simpson del.

James B. Lyon State Printer

Philip Ast lith.

PLATE 8

Paropsonema cryptophya *Clarke*

Fig.

1 The half of a specimen, showing the three cycles of ambulacral bands and the smooth peripheral surface.

2 An infolded and imperfect specimen which preserves some of the detail with clearness.

PAROPSONEMA.

1

2

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PLATE 9

Paropsonema cryptophya *Clarke*

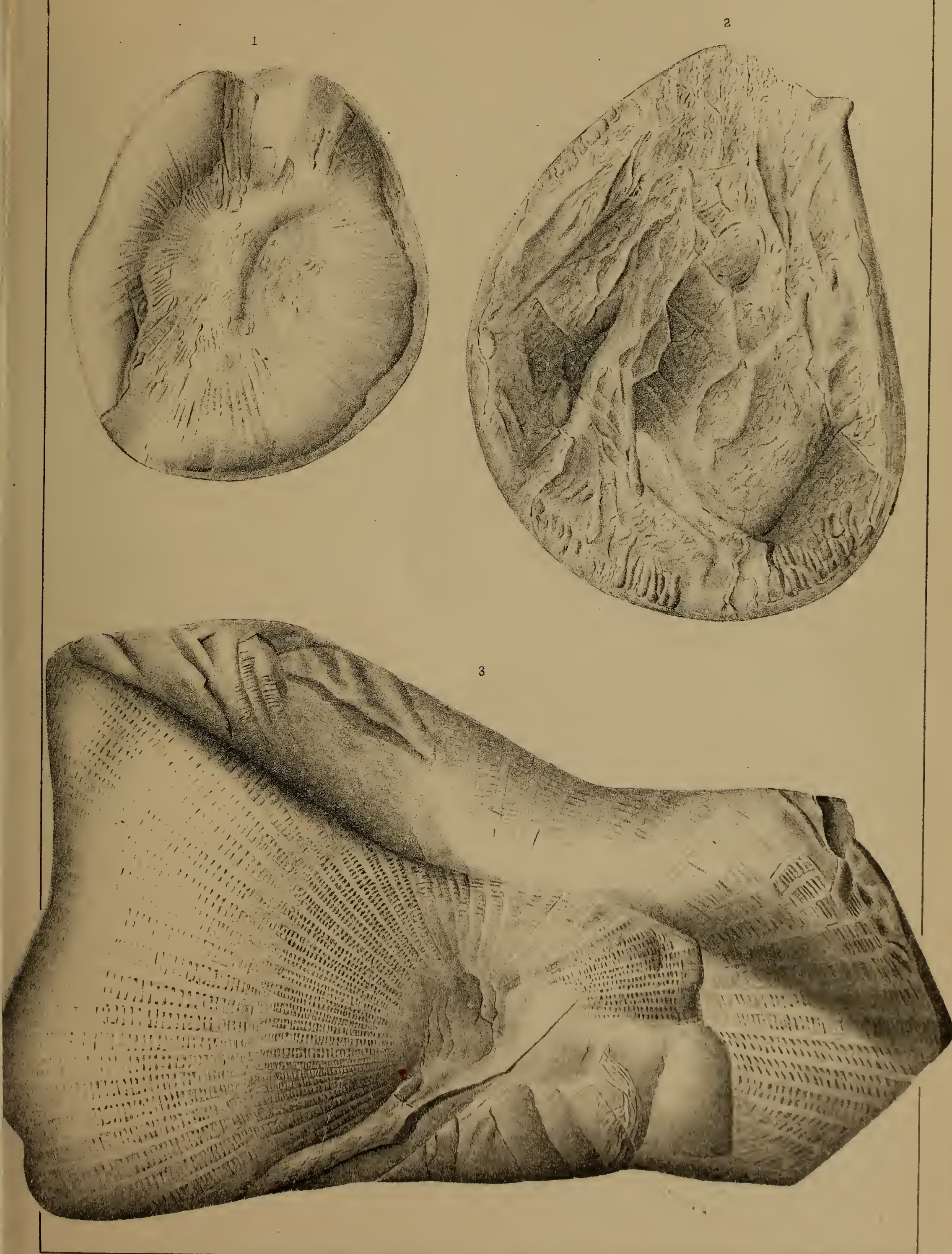
Fig.

1 A young specimen in which the detail is not very clear, but indicates no evidence of the second cycle of bands.

2 The ~~ad~~ambulacral side of another young specimen.

3 The ambulacral side of an infolded and distorted example with the structure of the ambulacral and interambulacral areas quite clearly shown.

PAROPSONEMA.



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DICTYONINE HEXACTINELLID SPONGES FROM THE UPPER DEVONIC OF NEW YORK

BY JOHN M. CLARKE

(Plates 10-11)

A most striking characteristic of the shallow water fauna of the Chemung beds of the middle Upper Devonic is its great development of Hexactinellida, or silicious reticulate sponges. The evidence of the fruitfulness and multiplicity of these organisms at that time is of comparatively recent date. By the publication of Memoir no. 2, of the State museum (*The paleozoic hexactinellid sponges constituting the family Dictyospongidae*, 1899) more than 70 species of the fossils, assigned to 16 genera, have been made known from this formation. The demonstration of such an extensive development could have been possible only with the assistance of very large collections, and while these have shown that such fossils abound in a most unforeseen profusion, yet it is clear that they are more or less localized in their distribution. At present they appear to have multiplied most rapidly and varied most in the Chemung rocks of the central and southwestern parts of the state of New York, particularly in southern Ontario, Steuben, Allegany and Cattaraugus counties. In these regions various well defined plantations have been located, some of which have already yielded, and others doubtless would yield on exploitation, thousands of individuals. Eastward in the outcrops of this formation, these sponges become of rare occurrence, and outside of this state but very few have been found in rocks of this age. All of the forms hitherto described have been embraced within the somewhat conventional limits of the family Dictyospongidae, and have been shown to belong to the hexactinellid suborder, Lyssacina.

In the species of this suborder the skeleton is distinguished by the independence of the spicular elements. Whatever the modification which the fundamental hexactin may have undergone, however unlike in its various expressions, yet each spicule is independent of all its neighbors in the skeletal complex, each leads an individual existence. In the suborder Dictyonina, however, the skeleton becomes continuous and, indeed, complicated by the fusion of the spicules. The arms or rays of one unite with the corresponding parts of those adjoining, and instead of having to deal with a structure whose elements retain the typical hexactine form, we find a skeleton divided into series of cubical meshes. While there is generally a close adherence to this type form, yet by the modification of the spicular elements there often results an irregularly meshed skeleton whose derivation from the hexactin is not always clear.

The silicious sponges of the Chemung fauna have in all cases yet brought under observation had their original silica replaced, first by iron pyrites, which in the porous, sandy matrix has changed to the peroxid of iron, and this salt for the most part deoxidized and thus removed by solution or carried away in the insoluble slate in suspension. There is not, thus, any way of eliciting the complete spicular structure of such bodies. We find their reticulate structure well exhibited on casts of exterior and interior in cases where the network was strong and the bundles of rod-like spicules well defined. In other cases we may observe rusty traces of the original network, which manifest themselves most clearly when the specimen is moistened. At the present most of the large mass of material representing these fossils, which has come under observation, has been obtained from surface exposures and loose blocks. Possibly fresh rock from a sufficient depth may eventually afford sponges from this fauna in which the pyrite of the skeleton will not have been decomposed. For our present interpretation of many details of structure observable in these fossils from the sandstone, we are largely dependent on correlations with the pyritized skeletons of dictyosponges found in the calcareous shales of the Keokuk beds, at Crawfordsville Ind.

The specimens which we here bring forward as representatives of ancient dictyonine sponges of Chemung age, present evidence of a skeleton whose meshes are small and irregularly polygonal.

In one of the two species described these meshes are somewhat larger in vertical diameter and many retain a rectangular form, but the branches freely inosculate and the quadrate form is not long maintained. An examination of the accompanying figures will show that these bodies present an aspect somewhat similar to that of a Dictyonema, which is however purely simulative. Found among dictyosponges, their skeleton is preserved in like manner to those.

Order HEXACTINELLIDA

Suborder Dictyonina

Family **Nepheliospongidae**, *fam. nov.*

Vase-shaped sponges, moderately thick-walled as indicated by the incurvature of the aperture. The tissue of inosculating spicules divides the surface into small, irregular polygons.

Genus NEPHELIOSPONGIA, *gen. nov.*

With the characters above specified. Surface smooth, free of ornamental protuberances or prostalia; in one species apparently corrugated horizontally. Apertural edge rounded and broad.

Type: *Nepheliospongia typica*, sp. nov.

Nepheliospongia typica, *sp. nov.*

Plate 10, fig. 1-3

This species takes on the form of a rather small, obconic cup, expanding with apparent regularity and evenly convex surface. The meshes of the surface are not all so polygonal as represented in the figure, but some show a more distinctly quadrate outline. Though the cups of two specimens have been somewhat compressed, one shows the aperture complete, and the fact that the sponge wall appears to have possessed a somewhat greater thickness than in the dictyosponges. The specimens of this species found have the following dimensions. One has a length from aperture to near the original base of 41 mm; its apertural width is 34 mm. The other is about 25 mm long, having been broken near the base; its aperture is 33 mm in greatest diameter. This species is from the sandstone of the lower part of the Chemung beds, at Deyo basin in the town of Naples N. Y., where it is associated with many characteristic species of the Chemung marine fauna together with the following lyssacine sponges: Hydnoceras variabile H. and C., Hydriodictya cylix H. and C., Ceratodictya annulata (Conrad).

Nepheliospongia avocensis, *sp. nov.*

Plate 10, fig. 4; plate 11, fig. 1

This is a much larger sponge, of more funnel-shaped aspect, and with rather coarser but not different reticulation. Its surface presents a series of low, transverse corrugations which may, perhaps, arise from oblique compression but appear to be normal, as they occur in both of the examples observed. One of these examples, though slightly defective at each extremity, has a length of 105 mm and the same width at the apertural end; the other, which is more complete, has a length and apertural width of 140 mm. Both are from a high level in the Chemung strata, near Avoca, Steuben co. More precisely, their locality is the sponge plantation on the Cotton farm, about 1 mile north of the village, a colony located by D. D. Luther and the writer, which has produced a considerable number of interesting dictyosponges. Hydnoceras tuberosum Conrad and H. avoca H. and C. are there by hundreds, and in addition to these may be mentioned the species Aristodictya typica, A. nodifera and Hallodictya cottoniana, H. and C.

EXPLANATION OF PLATES

PLATE 10

Nepheliospongia typica *Clarke*

Fig.

1 Lateral view of an elongate cup

2 A smaller specimen

3 The aperture of the same, showing the incurvature and thickness of wall

Lowest beds of the Chemung formation. Deyo basin, Naples N. Y.

Nepheliospongia avocensis *Clarke*

(*See* plate 11)

Fig.

4 Specimen with somewhat undulated surface, showing the character of the reticulum

Chemung beds at Cotton hill, near Avoca N. Y.

SPONGES.

Bull. 37. N.Y. State Museum. Plate 10.

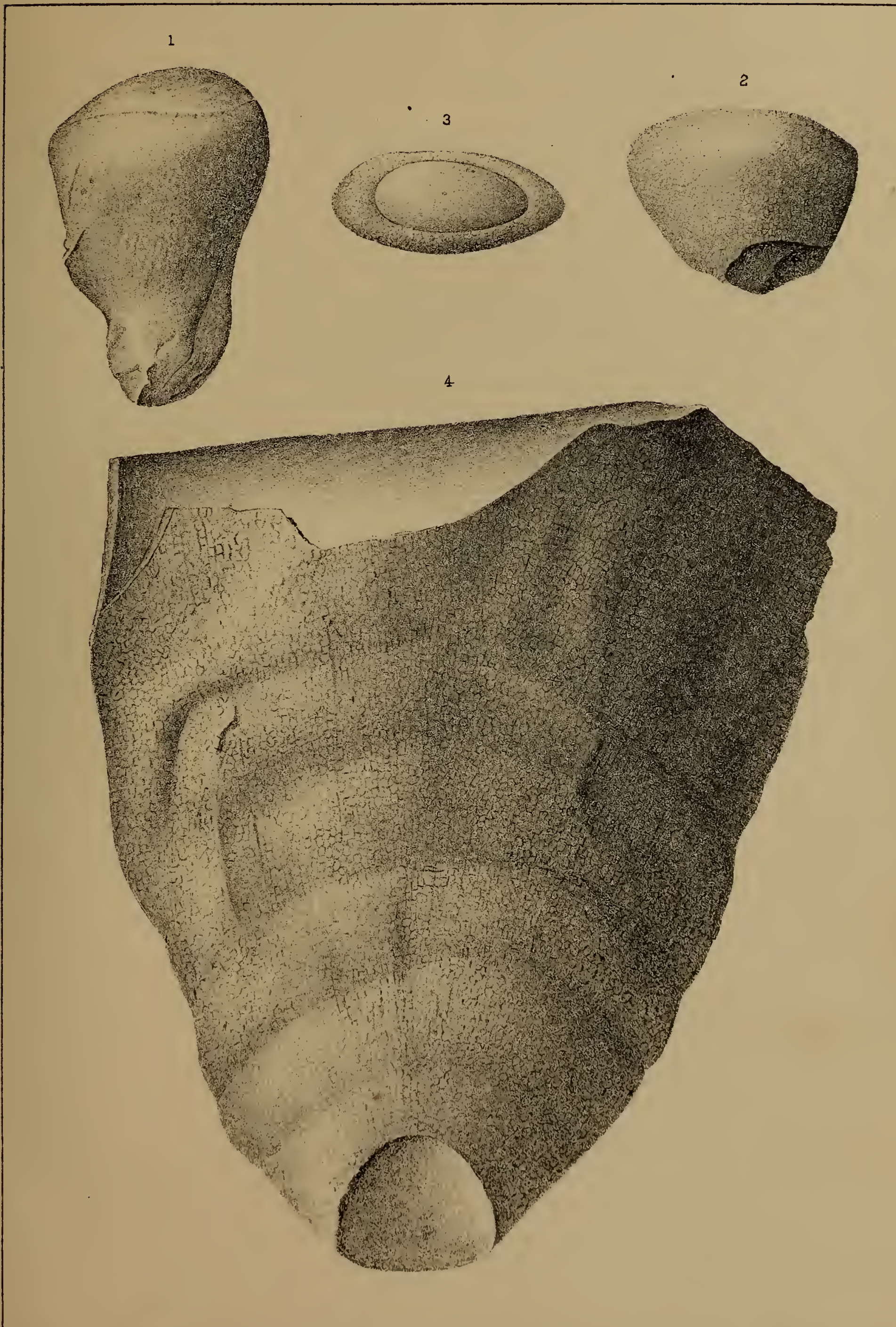

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PLATE 11

Nepheliospongia avocensis *Clarke*

(*See* plate 10)

Fig.

1 A large turbinate specimen with undulated or cinctured surface. Small patches of matrix are irregularly scattered over the wall.

Chemung beds at Cotten hill, near Avoca N. Y.

THE WATER BISCUIT OF SQUAW ISLAND, CANANDAIGUA LAKE, N. Y.

BY JOHN M. CLARKE

(Plates 12-15)

Canandaigua lake is one of the well-known chain of Finger lakes in western New York which hang like pendants from below the south shore of Lake Ontario. This pretty sheet of water, about 14 miles long in its gently sinuous course, is a short section of an ancient waterway impounded by a dam of drift at its southern end. Near the lower or northern end of the lake, where its waters touch the village of Canandaigua, is its single island, a little spot of gravel and sand which the counter currents have piled up. Ever since Gen. Sullivan in 1779 carried firebrand and death among the Indians of this section, this bit of land has been known as Squaw island, and according to local tradition, here the women of the fighting braves took refuge from their burning villages. The adjoining sketch map shows the position of this island with reference to the shores of the lake. It will be seen that it lies west of the axis of the lake and opposite the *embouchure* of a little inlet. Its form is slightly elongated north and south, and from its northern end to the east side of the reedy cove, where the inlet comes in, a sand bar extends, along which at low water one can wade to the mainland. The inlet, which is known as Sucker brook, is a little stream which has grown smaller as the boys who played about it have grown to manhood. It heads in the northern part of the township of Canandaigua and in the upper reaches of its brief, meandering course of 8 or 10 miles it passes over a region of limestone and calcereous shales, cuts, kames and till piles where limestone boulders abound. In this way its waters have become well impregnated with lime. The north shores of Squaw island and the lake bottom about it and over its northward sand bar are covered with flat, whitish calcareous cakes of circular or oval shape, in size ranging from a dime to a half dollar. To pick up one of these, well dried on the surface of the island and break it in half, seems enough to convince the reflective mind at once of their nature and mode of formation. It often contains as a central nucleus a beach pebble of shale or limestone, a twig, or a bit of charcoal from some youngsters' camp fire. About this a white or greenish travertine has been deposited in concentric layers which show themselves with distinctness. Often the interior of the cake is soft and powdery. Frequently the cake shows an imperfect fibrous structure. There is little doubt that this calcareous matter is constantly supplied by the influx of the lime-charged waters of Sucker brook. The little island and its bar lie directly in the course of this stream and receive the charge of carbonate of lime before these waters have diffused themselves over the wider surface and through the greater depths of the lake to the south. It is only on the north side of Squaw island that this water biscuit is found in abundance, and there almost every pebble is a biscuit. This apparently simple mode of concentric deposition in the formation of these bodies is of itself sufficiently interesting for record, and it would not be easy for the writer to cite a parallel. Here is actually a coarse, uncemented oolite forming under peculiar but very simple conditions.

This however is not the whole story. On picking one of the water biscuits from the lake bottom its surface is found to be smooth, slimy and often greenish; exposure on the shore bleaches it white. The calc-carbonate being dissolved in dilute acid and entirely removed, there remains a soft, spongy, organic residuum of precisely the volume of the original biscuit. From within will drop out the nucleus, rupturing the side of the soft mass. On examination, this organic matter proves to be a felted mass of filaments of fresh-water algae, which have been examined for me by Prof. C. H. Peck, the state botanist, and one of the species identified as probably Isatis fluviatilis. In the judgment of Prof. Peck there are several such species, and entangled among them are to be found diatoms, the whole so reproducing

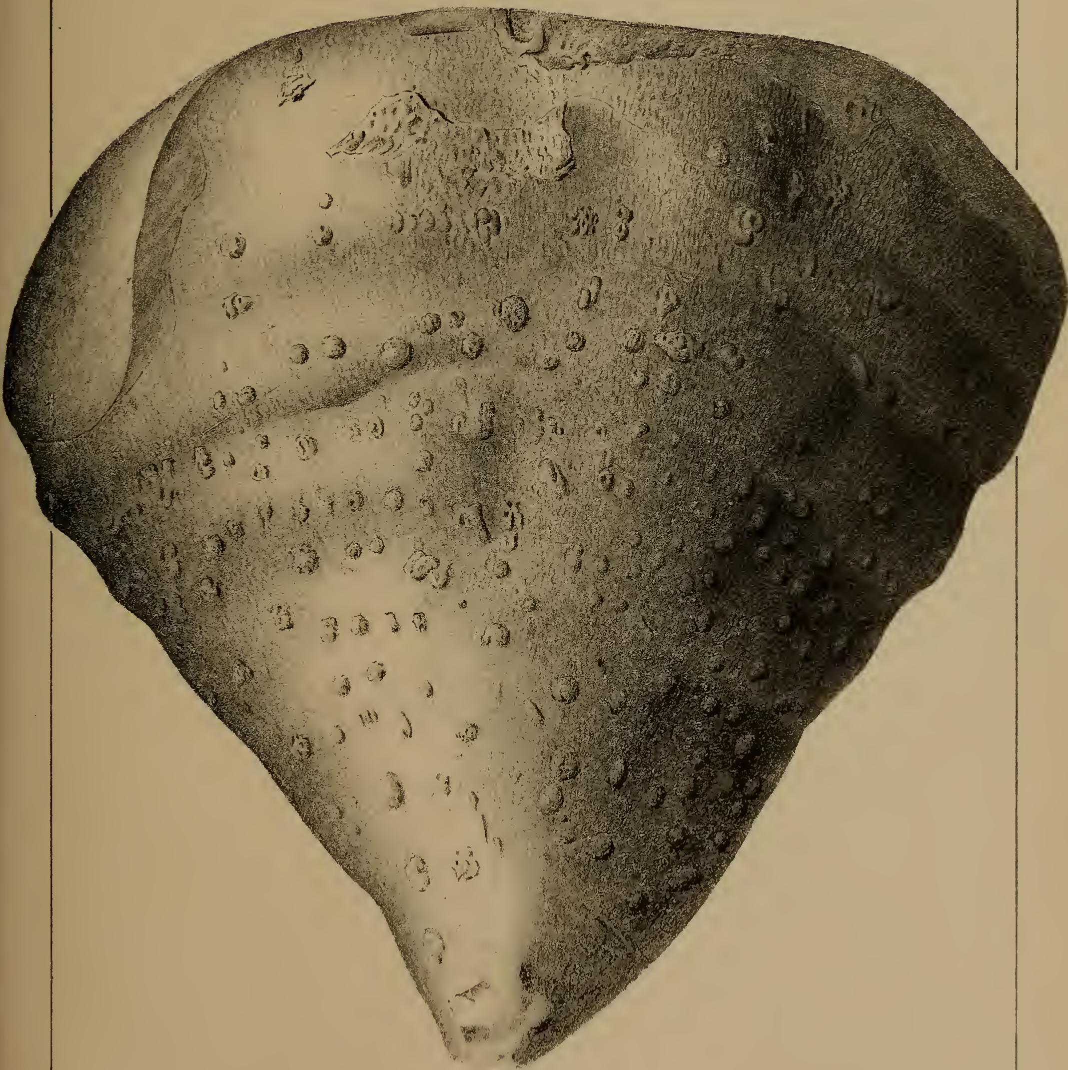

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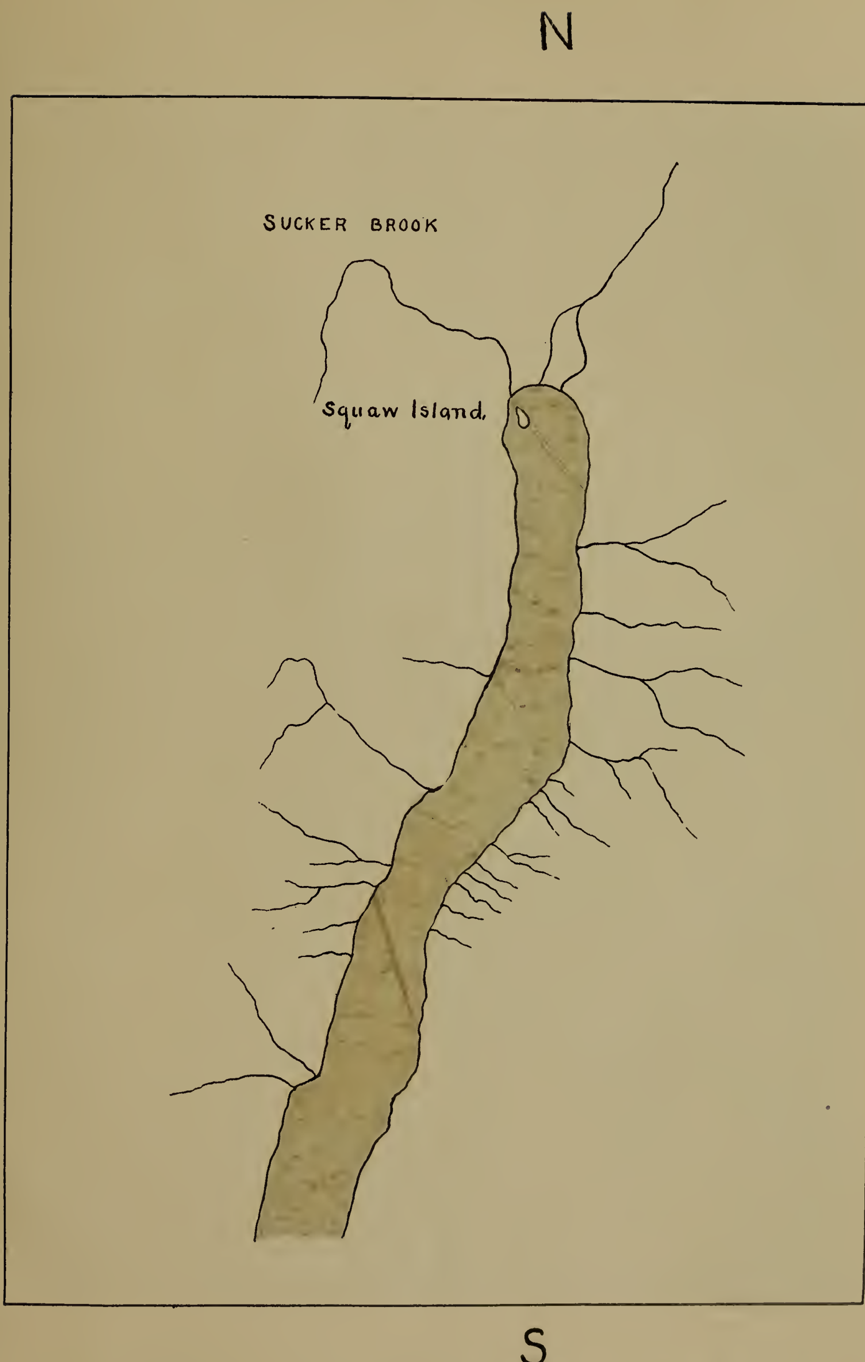
Plate 12



Map of the northern part of Canandaigua lake showing Squaw island and its relation to Sucker brook

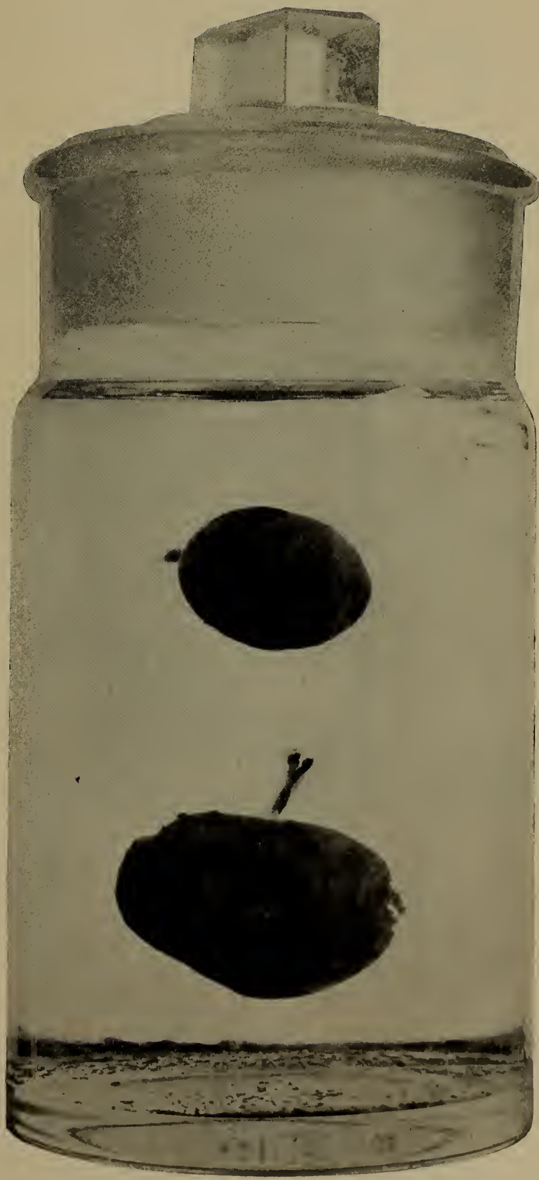
Plate 13

Squaw island, Canandaigua lake, viewed from the mouth of Sucker brook and showing the sand spit and beach largely composed of water biscuit

Plate 14

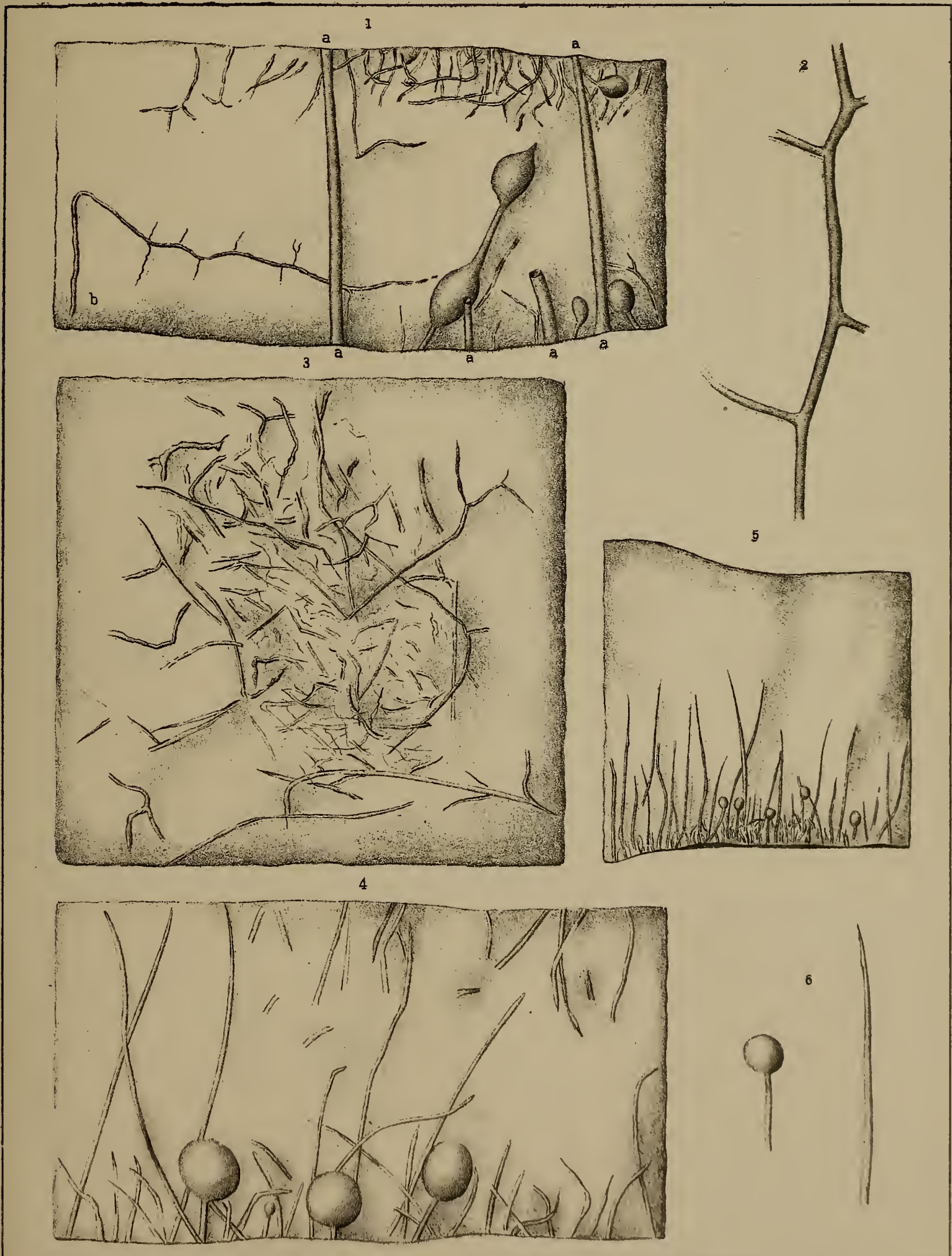
A group of water biscuit showing the concentric calcareous layers and the nuclei

Plate 15



Water biscuit from which all calcareous matter has been dissolved leaving a mass of algous filaments

FOSSIL FUNGI.



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