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TWELFTH ANNUAL REPORT

OF THE

UNITED STATES

GEOLOGICAL AND GEOGRAPHICAL SURVEY

OF

THE TERRITORIES:

A REPORT OF PROGRESS OF THE EXPLORATION IN

WYOMING AND IDAHO

FOR THE YEAR 1878.

IN TWO PARTS.

PART I.

BY F. V. HAYDEN,
UNITED STATES GEOLOGIST.

CONDUCTED UNDER THE AUTHORITY OF THE SECRETARY OF THE INTERIOR.

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TWELFTH ANNUAL REPORT OF THE UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY.

PART I.

GEOLOGY, PALEONTOLOGY, AND ZOÖLOGY.

CONTRIBUTIONS TO INVERTEBRATE PALEONTOLOGY NO. 8: FOSSILS FROM THE CARBONIFEROUS ROCKS OF THE INTERIOR STATES.

By C. A. White, M. D.

The fossils which form the subject of this article have been collected by different persons, and at various localities, from both the lower and upper Carboniferous rocks. A part of them were collected by Prof. G. C. Broadhead, late State geologist of Missouri, at different localities in that State, and the type specimens belong to his private cabinet. A part belong to the private cabinet of Mr. William Gurley, and were collected by him at different localities in Illinois and Indiana; a part to Mr. Charles Wachsmuth, of Burlington, Iowa; and the remainder were collected by myself in Iowa.

A large proportion of all these species are new, and none of them except *Lithostiotion mamillare* have before been illustrated. A part of them, however, were described by myself at different times in the Proceedings of the Academy of Natural Sciences of Philadelphia, and of the Boston Society of Natural History.

The close relationship of the Carboniferous fauna of the Interior States with that of the western portion of the national domain makes a full knowledge of the former desirable in the investigation of the latter. Therefore, the illustration of these species is regarded as properly pertaining to the elucidation of the geology of the Western Territories.

RADIATA.

ACTINARIA.

Genus ZAPHRENTIS Rafinesque.

Zaphrentis elliptica White.

Plate 39, figs. 4 *a* and *b*.

Zaphrentis elliptica White, 1862, Proc. Bost. Soc. Nat. Hist., vol. ix, p. 31.

Corallum rather small, gently curved, laterally compressed, more so below the middle than near the calyx; sometimes this compression is slight, but sometimes so great as to produce a distinct carina along the lower portion of the outer curve; calyx moderately deep, its margin subcircular or sometimes subelliptical; septal fossett moderately large, situated upon the concave side of the corallum; rays well developed, numbering at the margin from thirty-two to forty. Surface marked by the usual lines of growth, but seldom by such distinct wrinkles as often mark species of this genus.

Length, 21 millimeters; diameter of calyx, 14 millimeters.

This form is characterized by the lateral compression of the lower portion of the corallum, a feature not possessed by any other *Zaphrentis* so far as I am aware.

Position and locality.—Burlington limestone division of the Subcarboniferous series, Burlington, Iowa, its position being at the base of that division, in strata which contain several invertebrate species which are common to the Kinderhook strata beneath.

ZAPHRENTIS CALCEOLA White & Whitfield.

Plate 39, figs. 6 *a*, *b*, *c*, and *d*.

Lophophyllum calceola White & Whitfield, 1862, Proc. Bost. Soc. Nat. Hist., vol. viii, p. 305.

Corallum small, subturbinate, more or less curved, moderately but irregularly expanding from the base or apex upward, flattened on the outer side of the curvature, especially at the lower portion, but elsewhere somewhat regularly rounded; apex small, pointed; exterior surface rugose from unequal growth; calyx moderately deep; fossett situated subcentrally, but extending towards the side of the convex curve of the corallum; principal rays about thirty; secondary rays about equal in number with the principal ones, but they are usually very small and inconspicuous.

Extreme length of an average example, 18 millimeters; diameter of calyx, about 9 millimeters.

The flattening of the corallum upon the outer surface is more conspicuous upon some examples than upon others, but is always sufficient to serve as a ready means of recognizing the species. When the original description of this species was written it was referred to *Lophophyllum*, but more careful examination of other and more perfect examples shows that it does not possess the characteristics of that genus.

Position and locality.—The original type specimens of this species were obtained from the very base of the Burlington limestone division of the Subcarboniferous series, where it is associated with the preceding species, and where also it is found to range down into the underlying strata of the Kinderhook division. It is also among the collections sent to the United States National Museum by Professor Broadhead, who obtained it from the top of the Chouteau limestone (Kinderhook division of the Subcarboniferous) at Sedalia, Mo. (See remarks following description of *Lithostiotion microstylum*, on a subsequent page.)

Genus HADROPHYLLUM Edwards & Haime.

HADROPHYLLUM GLANS White.

Plate 39, figs. 5 *a* and *b*.

Zaphrentis glans White, 1862, Proc. Bost. Soc. Nat. Hist., vol. ix, p. 32.

Corallum small, general form depressed-subglobose; apex small, prominent; calyx never distinctly concave, but often convex, with a receding but distinct margin, which is short-oval in outline and very oblique to the axis of the corallum; septal fossett moderately large but not deep, ranging with the long diameter of the calyx, its outer end reaching nearly to the distal calycular border; rays well developed, the principal ones being from thirty to forty in number, besides numerous rudimentary rays alternating with the former.

Extreme length of an average-sized example, 17 millimeters; long diameter of the calyx, 14 millimeters; short diameter of the same, 12½ millimeters.

Position and locality.—This species is quite a common one in the upper portion of the Burlington limestone division of the Subcarboniferous series at and in the vicinity of Burlington, Iowa.

Genus LOPHOPHYLLUM Edwards & Haime.

LOPHOPHYLLUM EXPANSUM White.

Plate 39, figs. 4 *a* and *b*.

Lophophyllum expansum White, 1876, Proc. Acad. Nat. Sci. Philad., p. 27.

Corallum broadly conical, slightly curved, transverse section subcircular; calyx broad, not deep; rays numerous; septal fossett not very distinct, situated at the convex side of the corallum; columella prominent but not large, laterally flattened so as to form a more or less sharp edge along its crest. Surface more or less rugose.

Height of corallum and diameter of its calyx each about 20 millimeters.

This species is proportionally much broader than *L. proliferum* McChesney sp. of the Coal Measures, but not much more so than the typical forms of *Lophophyllum*. It has somewhat the aspect of certain forms of *Axophyllum*, but as its internal structure is not yet fully known, it is referred to *Lophophyllum* because of its apparent external characters.

Position and locality.—Keokuk limestone division of the Subcarboniferous series, Henry County, Iowa.

Genus CHONOPHYLLUM Edwards & Haime.

CHONOPHYLLUM SEDALIENSE (sp. nov.).

Plate 39, fig. 1 *a*.

Corallum moderately large, approximately straight, the angle of divergence of its sides being quite small; calyx apparently rather shallow; rays numerous; surface rough by the presence of numerous projecting successive calyx-borders, and by coarse, irregular longitudinal striæ. Only one example has been obtained, and that has been broken off at the lower end, and also somewhat crushed. Its full length was probably about 130 millimeters, and the diameter of the calyx about 30 millimeters.

Position and locality.—Near the top of the Chouteau limestone (Kinderhook division of the Subcarboniferous series), Sedalia, Mo., where it was obtained by Prof. G. C. Broadhead. See remarks on this coral-horizon following description of *Lithostiotion microstylum*, on a subsequent page.

Genus MICHILINIA de Koninck.

MICHILINIA ? PLACENTA (sp. nov.).

Plate 39, figs. 1 *a*, *b*, *c*, and *d*.

Corallum depressed or flattened, broadly convex above, flat or slightly concave below, free, or attached only in the young condition; corallites moderately large, subequal in size, nearly regularly hexagonal; calyces

shallow, the bottom of each being slightly convex; the whole surface of the calyx coarsely granulate; rays numerous but slightly developed, consisting only of granular raised radiating striæ, apparently existing only upon the sides of the shallow calyx and not upon its rather broad bottom; transverse plates or tabulæ few, and all of them appear to have extended all the way across the corallite. Under surface of the corallum covered with a distinct epitheca, and marked by strong concentric wrinkles. The largest example collected contains about forty corallites, and the smallest nineteen. Diameter of the larger calyces of the former about 12 millimeters; of the latter about 9 millimeters.

This species is known only by silicified examples, which do not show very clearly the details of internal structure, and it is probable that it does not strictly belong to the genus *Michilinia;* but I am not acquainted with any published genus to which it can be more satisfactorily referred. The tabulæ are few, and they seem to extend all the way across the corallites in all cases, without a tendency to form vescicles in the central space, as is common in the genus *Michilinia.* The communicating pores are numerous, as indicated by the silicious casts of the spaces between the tabulæ. It is probably congeneric with the *Favosites divergens* of White & Whitfield, and it seems also to be congeneric with the next described species, all three of which belong to the same geological horizon. Remarks upon this interesting coral horizon are made in connection with the description of *Lithostrotion microstylum*, on a following page.

Position and locality.—Top of the Chouteau limestone (Kinderhook division of the Subcarboniferous series) at Sedalia, Mo. where it was obtained by Prof. G. C. Broadhead.

MICHILINIA EXPANSA (sp. nov.).

Plate 39, figs. 2 *a* and *b*.

Corallum forming broadly expanded masses, which are less symmetrical than those of the last described species; upper surface irregular, but flattened; under surface unknown; corallites moderately large, more or less irregular in shape in consequence of some inequality in size; calyces averaging 8 or 9 millimeters in diameter, moderately deep; rays numerous, but not prominent; walls well developed; tabulæ having the usual character of those of this genus.

This species, like the last described, is known only by silicified specimens, all of which are more imperfect than those of the last described form. The walls appear to be unusually thick for a *Michilinia*, but this is probably due to their silicified condition. This condition has also obscured the radiate markings of the calyces, and also rendered the tabulæ somewhat obscure. It differs from the last described species, with which it is associated, in the greater irregularity of the corallum and of the corallites, in the greater depth of the calyces and the less granular character of the calycular surfaces. The largest example discovered measures more than a hundred millimeters across the top of the corallum.

Position and locality.—Top of the Chouteau limestone (Kinderhook division of the Subcarboniferous series), Sedalia, Mo., where it was obtained by Professor Broadhead, and where it is associated with several other coral species. See remarks following description of the next species.

Genus LITHOSTROTION Fleming.

LITHOSTROTION MICROSTYLUM (sp. nov.).

Plate 40, fig. 7 *a*.

Among the fossils obtained by Professor Broadhead from the top of the Chouteau limestone, a member of the Kinderhook division of the Subcarboniferous series, at Sedalia, Mo., are five species of corals, four of which are new. Four of them have just been herein described, and the remaining one is here noticed. Only one example of this species was obtained, which is silicified, and otherwise too imperfect for complete description, but it evidently belongs to the genus *Lithostrotion*, and is evidently a new form. The corallum is ten or twelve centimeters across the top, and in general aspect and in size and shallowness of the corallites resembles examples of the well-known Devonian coral *Acervularia davidsoni*. The calyces have, however, in the bottom of the small central pit, a very small prominent columella. The example is too imperfect for a full specific description, but it is found to differ materially from any other species of *Lithostrotion* with which it is in any danger of being confounded in the flatness or shallowness of the calyces, the smallness of the central pit, and of the columella.

Corals have hitherto been frequently met with in the Burlington, Keokuk, and Saint Louis divisions of the Subcarboniferous series of the Mississippi Valley, but with the exception of *Lithostrotion mamillare*, which is in some places plentiful, and found only in the Saint Louis division, they have been confined mainly to the Zaphrentidæ. In the upper and lower members of the Subcarboniferous series, however, namely in the Kinderhook and Chester divisions, Actinoid corals of any kind have hitherto been rarely found. The discovery, therefore, of four new forms in the Kinderhook division is a matter of much interest. This interest is also increased by the fact that they are all of types which are unusual in at least American Carboniferous strata; and although there is no *a priori* reason why the presence of these types might not be expected in Carboniferous strata, according to our present knowledge such a group of corals is not without a certain Devonian facies. It is also an interesting fact that these corals occupy a very narrow horizon at the top of the Kinderhook division, just beneath the Burlington limestone, and that in all the remainder of the Kinderhook division corals are rare, if not altogether absent. This coral horizon seems to be a well-marked one; and from the fact that the only corals which have yet been found in that division in Iowa and Illinois occupy an exactly similar horizon with that here referred to in Missouri, it will probably prove to be one of considerable geographical extent. Up to this time the following ten species of corals have been found in that horizon in Missouri, Iowa, and Illinois: *Zaphrentis calceola* and *Z. acuta* White & Whitfield; *Z. elliptica* White; *Chonophyllum sedaliense* n. s.; *Syringopora harveyi* White; *Favosites* (*Michilinia?*) *divergens* White & Whitfield; *Michilinia placenta* n. s.; *M. expansa* n. s.; *Lepidopora typa* Winchell; and *Lithostrotion microstylum* n. s.

LITHOSTROTION MAMILLARE Castelnau.

Plate 40, figs. 6 *a* and *b*.

An example of this well-known coral from the Saint Louis division of the Subcarboniferous series in Monroe County, Indiana, contains three

or four double corallites. In each of the double calyces there are two columellæ, from which the rays diverge as usual, the border of the calyx being elongate or suboblong, and having only a slight constriction at the middle to indicate its double character. Upon the calycular side of the corallum these double corallites appear to have been cases of spontaneous fission, and they possibly were such; but the under side of the example (which contains about 60 millimeters length of the distal portion of the corallites and not the earliest or basal portions) shows them to have possessed the same general character at that stage of their growth which they do at their termination. In other words, they seem to have made no progress in separation into two distinct corallites while they were growing 60 millimeters in length. Figs. 6*a* and 6*b* show the upper and under sides, respectively, of that portion of the example in question which contains the three double corallites.

ECHINODERMATA.

Genus PLATYCRINUS Miller.

PLATYCRINUS BONOENSIS White.

Plate 40, fig. 5*a*.

Platycrinus bonoensis White, 1878, Proc. Acad. Nat. Sci. Philad., p. 30.

Body of the ordinary cup-shape, moderately deep; base shallow basin-shaped, concave at the middle of the under side, or appearing to be so in consequence of the presence of a moderately broad and strong circular ridge which surrounds the central portion of the base, but which does not extend outward quite to the borders of the base. First radial pieces about as long as wide, having the shape and characteristics of outline usual in cup-shaped bodies of this genus, scarcely more convex than the general convexity of the body; facet for the articulation of the second radial pieces shallow; second radial pieces very small, and transversely subrhombic in outline. Upon the second radial pieces the rays divide into two secondary rays, the first piece of each secondary ray articulating upon the second radial, but also abutting in part upon the upper border of the first radial. The secondary rays consist of two pieces each, upon the upper one of which they again divide, the outer arms of each division from that point upward continuing simple to the end, while the two minor subdivisions of the ray again divide into two arms each upon the second piece above the first division, beyond which all the arms of the whole ray, six in number, are simple, making thirty arms for the whole body. The arms are moderately slender, comparatively short, and for the first two or three pieces above the last bifurcation they consist of single wedge-shaped pieces. The only examples yet discovered have their arms so closely folded together that the pinnules are hidden from view. With the arms thus folded the whole animal had an obovate form. The stem, near the body, is moderately strong and slightly elliptical in outline of transverse section; surface nearly smooth, or faintly corrugated; the part of the body above the calyx and within the arms unknown.

Height of calyx to the top of the first radial pieces, 8 millimeters; greatest breadth of the same, 10 millimeters; height from the base of the calyx to the top of the arms, 26 millimeters.

This species resembles *P. æqualis* Hall, as figured by Meek & Worthen

in vol. v, Illinois Geological Reports; but it differs from that species in having the base of the calyx concave instead of protuberant, in the proportions of the calyx, the comparative shortness of the arms, and in wanting the peculiar geniculation of the pieces of the double series composing the arms of that species. It resembles *P. lævis* Miller, as figured by de Koninck & Le Hon on plate vi, Recherches sur les Crinoïdes du Terraine Carbonifère de la Belgique, but it differs in having only two instead of three primary radial pieces to each ray, and also in other details of structure.

Position and locality.—Subcarboniferous strata; probably equivalent with those of the Keokuk division, Bono, Lawrence County, Ind.

Genus SCAPHIOCRINUS Hall.

SCAPHIOCRINUS GIBSONI White.

Plate 40, fig. 4 *a*.

Scaphiocrinus gibsoni White, 1878, Proc. Acad. Nat. Sci. Philad., p. 31.

Body small or not above medium size for a species of this genus; calyx roughly cup-shaped, the pieces composing it moderately thick and protuberant, especially the first radial, subradial, and first anal pieces; base small, nearly or quite covered by the first joint of the column; subradial pieces comparatively large, tumid; first radial pieces broader, but scarcely larger than the subradials; sutures between the pieces of the calyx impressed, especially at the points where the angles meet, and where there are pit-like depressions, which increase the tumid appearance of the pieces and give the calyx a somewhat shriveled aspect; anal space comparatively large. The postero-lateral rays consist of three pieces, including the first radials, and upon each of the third radials the first bifurcation of the ray takes place, and above this the posterior secondary division of the ray only bifurcates, this third bifurcation taking place on the eighth piece above the second bifurcation, giving five simple arms for each of the postero-lateral rays beyond all the bifurcations. All the pieces of the rays, including those of both the primary and subordinate divisions, have a tendency to become angular upon the back, especially at the upper side of each. This, together with the apparent corrugation of the calyx and the zigzag articulation of the joints of the arms near their upper ends, gives the whole specimen a good degree of asperity of aspect, which, however, the artist has not fully represented in the figure on plate 40. Pinnules strong and somewhat angular, one arising from each joint of the arms and subordinate divisions of the rays, upon alternate sides of the joints. The other rays are not fully known, but they apparently bifurcate in nearly the same manner as the postero-lateral ones. Column moderately large, composed of irregularly alternating larger and smaller pieces. The whole surface of body, arms, and column minutely but distinctly granular, as seen under a lens.

Breadth of body, 7 millimeters; height of the same from base to top of the first radial pieces, 4 millimeters; height from base of the calyx to the extremities of the arms, 35 millimeters.

This species resembles *S. æqualis* Hall, as figured in volume v of the Illinois Geological Reports, more nearly than any other known to me, but it differs from that species in the much greater proportionate length of the arms, as well as their number and the manner of their bifurcation, besides the difference in the character of the surface. A conspicuous dif-

ference is also seen in the divisions of the rays, *S. æqualis* having eight arms by the ultimate division of each postero-lateral ray, while *S. gibsoni* has only five. In the former species also the joints of the upper part of the arms lack that zigzag arrangement which they have in the latter; and the general asperity of aspect of the latter is wanting in the former.

Position and locality.—Subcarboniferous strata, probably equivalent with those of the Keokuk division, Crawfordsville, Ind.

SCAPHIOCRINUS GURLEYI White.

Plate 40, fig. 3 *a*.

Scaphiocrinus gurleyi White, 1878, Proc. Acad. Nat. Sci. Philad., p. 32.

Body of medium size, or somewhat less; calyx roughly cup-shaped; subradial, first anal, and first radial pieces prominent, the sutures being deeply impressed; base nearly covered by the last joint of the column; subradial and first anal pieces as large as, or a little larger than, the first radials; the anterior and the two antero-lateral rays only are known. These rays consist of three pieces each, including the first radials, already mentioned as a part of the calyx, and upon the third ray the first bifurcation takes place, each secondary division being once more bifurcated at varying distances from the first. In the anterior ray the second bifurcation takes place upon the eleventh piece from the first. In the antero-lateral rays the second bifurcation takes place upon the ninth piece of the anterior branch of each of those rays above the first bifurcation; and upon the seventh piece in the case of the posterior branches of the same, respectively. Near the tips of some of the arms there is still another bifurcation, the division of which, being very small, may be easily overlooked or confounded with the coarse pinnules. The pinnules are large, long, angular, and alternately arranged upon each side of the arms; each piece of all the divisions of the arms above the first bifurcation of the rays bearing only one pinnule. The backs of all the divisions of the rays are rounded, and have little or no tendency to become angular, except perhaps toward the extremities of the arms. Column composed of irregularly alternating larger and smaller pieces. Surface finely granular.

Height of calyx, from base to top of the first radials, 3 millimeters; breadth of the same at the top of the first radials, 4 millimeters; height of the type specimen from the base to the extremities of the arms, 28 millimeters.

The calyx of this species closely resembles that of *S. gibsoni*, especially in the tumidity of the subradial and first anal pieces and in the character of the column, but it differs conspicuously from it in the number of arms and the character of their bifurcations, as well as in the surface markings and other details.

Position and locality.—Subcarboniferous strata, probably equivalent with those of the Keokuk division Crawfordsville, Ind.*

Genus ACTINOCRINUS Miller.

ACTINOCRINUS WACHSMUTHI (sp. nov.).

Plate 40, figs. 1 *a* and *b*.

Body rudely subturbinate below the arms, the sides expanding gradually and with slight convexity up to near the arm-bases, where there is a more abrupt expansion; base broader than high, rather deeply notched

* In the original description the locality was inadvertently given as Illinois instead of Indiana.

at the sutures by the prominence of the middle portion of each basal piece; column-facet large; first radial pieces nearly equal in size with the basals, and, with that exception, they are the largest pieces in the body; second and third radials about equal to each other in size, and not more than half as large as the first radials; each third radial piece bearing two secondary rays consisting of two pieces each, both of which are smaller than the second and third radials; each second secondary radial piece bearing two brachial pieces, and each brachial piece giving origin to an arm, making twenty arms in all.* Arms long and slender, and above the first four or five brachial pieces, which are single, they are composed of a double series of minute pieces which meet along the median line of the arm, forming there a zigzag suture. Anal pieces eight or nine; the first one being of about the same size as the first radials; the next three pieces above are about half as large as the first, and above these the other pieces are quite small; interradial pieces three or four, the first one being somewhat larger than the second radials, and occupying about half the interradial space. Vault convex or subconical, more than half as high as the height of the body below the arms, composed of irregular pieces of moderate size, all of which are more or less sharply tumid in the middle, and ending at the summit in a long, strong proboscis, which is composed of similar sharply tumid pieces. All the body plates are strongly tumid, the lower ones bearing each a strong transverse projection.

The specific name is given in honor of Mr. Charles Wachsmuth, whose excellent labors among the Crinoidea are well known.

Position and locality.—Subcarboniferous strata probably equivalent with those of the Keokuk division, Crawfordsville, Ind., where it was obtained by Mr. William Gurley.

Genus LEPIDESTHES Meek & Worthem.

LEPIDESTHES COLLETTI White.

Plate 40, figs. 2 *a* and *b*.

Lepidesthes colletti White, 1878, Proc. Acad. Nat. Sci. Philad., p. 33.

General form apparently ovate. Interambulacral areas very narrow, linear, slightly convex from side to side, composed of four or five rows of small pieces, which rows do not apparently decrease in number, except perhaps near each extremity. Ambulacral areas broad, partaking of the convexity of the body, lance-oval in outline, and five or six times as broad as the interambulacral areas are. Ambulacral areas made up of very numerous small rhombic pieces, the transverse diameter of which is a little greater than the vertical; their lateral angles moderately acute, and interlocking so that they appear to be arranged in oblique rows; size of the pieces nearly uniform throughout the field, except that they all become a little smaller near both the upper and lower extremities. The number of vertical rows of pieces in each field is apparently 18 or 20. Each ambulacral piece has two distinct round pores near each other and near the upper angle of the piece; but they are sometimes obscured by the overlapping of adjacent pieces. Surface granules small, more distinct upon the interambulacral than upon the ambulacral pieces.

Two examples of this species have been discovered, both of which are

* The example represented by fig. 1 *b* on plate 40 has an extra arm-base immediately over the center of the anal space, and it also has an extra basal piece about one-third as large as each of the other three basal pieces.

crushed and otherwise in a much damaged condition. The best example, which is represented by fig. 2 *a* on plate 40, shows that the original height of the body was about 45 millimeters, and its transverse diameter probably considerably less.

The crushed condition of the specimens causes some doubt as to the true number of longitudinal rows of interambulacral pieces, but they evidently do not exceed five. There seems to be only four rows to each area, one row of comparatively large pieces, with two smaller rows upon the right-hand side of it, and one row on the left. This want of bilateral symmetry of the best preserved area in the example figured suggests the possibility that one row of smaller pieces on the left-hand side of the row of larger ones has been forced beneath the others by pressure, but a careful examination fails to demonstrate it.

This species is clearly distinguished from *L. coreyi* M. & W., the only other known species of the genus, by the very much narrower interambulacral areas, the different and varying proportions of the pieces composing those areas, as well as some other important but less conspicuous differences.

Position and locality.—Subcarboniferous strata, probably equivalent with those of the Keokuk division, Salem, Washington County, Ind.

MOLLUSCA.

(MOLLUSCOIDEA.)

BRACHIOPODA.

(Genus ORTHIS Dalman.)

ORTHIS THIEMEI White.

Plate 41, figs. 4 *a*, *b*, *c*, and *d*.

Orthis thiemei White, 1860, Jour. Bost. Soc. Nat. Hist., vol. vii, p. 231.

Shell depressed, orbicular, usually a little wider than long, widest in front of the middle; hinge line short. Dorsal valve deeper than the ventral valve, regularly convex, with the general exception of a very shallow median sinus which extends from front to about midlength of the shell where it becomes obsolete; beak projecting a little beyond the hinge line and slightly curving towards the beak of the opposite valve; cardinal process strong, with a strong blunt-edged median septum extending from it nearly half the length of the valve; brachial processes strong, slightly notched at the ends; margin crenulate in front.

Ventral valve convex near the umbo, depressed in front, which, with the depression on the opposite valve, considerably flattens the front border; beak short, elevated and incurved, leaving but little space between the two beaks when both valves are in position; width and height of foramen about equal, nearly filled by the strong cardinal process of the dorsal valve; muscular cavity large, heart-shaped, with a more or less distinct forked septum occupying its middle.

Surface marked with fine raised striæ, which have occasional minute tubular openings upon them; the striæ increasing in number by implantation, and traversed by the ordinary striæ of growth and a few coarser imbricating lines.

Length from 10 to 14 millimeters.

This shell is somewhat variable in the convexity of the dorsal valve, the distinctness of the dorsal sinus, and the strength of the cardinal and brachial processes.

Position and locality.—The upper portion of the Kinderhook division of the Subcarboniferous series at Burlington, Iowa. A closely similar form exists in the upper portion of the Burlington limestone, and another in the Keokuk division, but they are at present regarded as distinct.

Genus RHYNCHONELLA Fischer.

Rhynchonella ottumwa White.

Plate 41, figs. 5 *a*, *b*, and *c*.

Rynchonella ottumwa White, 1862, Proc. Bost. Soc. Nat. Hist., vol. ix, p. 23.

Shell rather small, variable in outline from subtriangular to subovoid; valves nearly equally convex. Ventral valve regularly convex along the middle from beak to front, broadly convex across the middle from side to side; beak prominent, projecting backward and with an upward curve; the space beneath it a little flattened, which gives it somewhat the appearance of an area; deltidial pieces occupying a rather large equilateral triangular space, with a moderately large, oval foramen. Dorsal valve broadly convex, umbo depressed. Surface marked by from nine to eleven somewhat angular plications on each valve, which are absent or become obsolete on the posterior third of the shell; two of these plications occupy the mesial sinus of the ventral valve and three of them the mesial fold of the dorsal valve; the mesial sinus is deep, and forms a more conspicuous feature than the mesial fold. Young examples of this shell are nearly plain, but the plications on the older ones are well marked.

Length from ventral beak to front, 12 millimeters; greatest breadth, which is in front of the middle, about the same.

Position and locality.—Saint Louis division of the Subcarboniferous series, Ottumwa, Iowa, and various other localities in Iowa, Illinois, and Missouri.

Genus SPIRIFER Sowerby.

Spirifer subcardiiformis Hall.

Plate 41, figs. 2 *a*, *b*, and *c*.

Spirifer subcardiiformis Hall, 1858, Iowa Geol. Rep., vol. i, part ii, p. 660.

Shell subelliptical in marginal outline, a little wider than long; hinge line shorter than the greatest width of the shell. Dorsal valve a little less convex than the ventral, its beak somewhat prominent and projecting beyond the hinge line; mesial fold rather broad in front, slightly elevated, marked by four plications which all coalesce at the beak; a very slight elevation appears in the bottom of the groove which separates the two middle plications of the fold, and the two grooves which separate the fold from the lateral portions of the valve are broader than any of the others; from seven to nine simple, rounded plications mark the space on each side of the fold, the inner ones being strong and the outer ones becoming obsolete. Ventral valve having its beak prominent, incurved, and projecting back further than that of the dorsal valve; mesial sinus broad, not deep, bearing three plications; from seven to

ten plications on each side of the mesial sinus, which correspond in character with those upon the other valve; the postero-lateral portions of the valve rounded into the area, which is very short and its limits ill-defined; foramen moderately large, triangular, and nearly equilateral.

Length from ventral beak to front, 28 millimeters; greatest breadth, 32 millimeters; greatest thickness, both valves together, 18 millimeters.

This species was originally described from an imperfect example which was obtained from the Warsaw limestone near Alton, Ill. Among a collection of fossils obtained by Mr. William Gurley, from equivalent strata at Spergen Hill, Ind., is a more perfect example, which has served as the basis for the description and illustrations herein given.

Position and locality.—Subcarboniferous strata, Warsaw division, Alton, Ill., and Spergen Hill, Monroe County, Indiana.

(MOLLUSCA VERA.)

CONCHIFERA.

Genus ANTHRACOPTERA Salter.

ANTHRACOPTERA POLITA (sp. nov.).

Plate 42, figs. 5 *a* and *b*.

Shell rather small, aviculoid, moderately gibbous, height greater than the breadth from front to rear; test thin; valves subequal; hinge margin short, straight, terminating posteriorly in a somewhat obtusely angular wing, but not extending in front of the beaks; basal and front margins forming a nearly regular curve from beneath the beaks to the postero-basal extremity, which is more narrowly rounded; between that extremity and the posterior angle of the wing the margin is slightly concave; umbo prominent, or having the appearance of being somewhat inflated; beak elevated a little above the hinge line; the ear is distinct, but no well-defined auricular groove separates it from the body of the shell in either valve. Surface having a smooth aspect, but it is marked by numerous fine lines of growth, which are plainly visible under a lens.

Height from base to hinge line, 20 millimeters; length from umbo to posterior basal extremity, 24 millimeters.

This shell seems evidently referable to *Anthracoptera* of Salter, although nothing is known of the character of its hinge or of its interior markings. It differs too materially from any known species to need detailed comparison.

Position and locality.—Coal-measure strata, Major's Mill, Vermillion County, Ill., where it was discovered by Mr. William Gurley.

Genus ASTARTELLA Hall.

ASTARTELLA GURLEYI White.

Plate 42, figs. 6 *a* and *b*.

Astartella gurleyi White, 1878, Proc. Acad. Nat. Sci. Philad., p. 35.

Shell small, not very gibbous, subtetrahedral in outline; anterior end truncated from the beaks obliquely downward and forward to about

midheight of the shell, where the front is sharply rounded to the somewhat broadly rounded basal margin; posterior margin broadly convex or sometimes almost straight and perpendicular, and joining both the basal and dorsal margins by abrupt curves; dorsal margin comparatively short, nearly straight; beaks small; umbones not elevated nor very prominent. An indistinctly defined umbonal ridge extends from each of the umbones to the postero-basal margin, behind which ridge the shell is slightly compressed. Surface marked by concentric furrows, which are separated by sharp linear ridges.

Length of an average-sized example, 7 millimeters; height from base to beaks, 4½ millimeters.

This species differs from *A. vera* Hall, from the same formation, in its smaller size, in the slight prominence and want of elevation of the umbones, the greater proportional projection of the front beyond the beaks, and in being wider behind than in front, the reverse being the case with *A. vera*.

Position and locality.—Coal-measure strata, Danville, Ill., where it was obtained by Mr. William Gurley.

Genus ALLORISMA King.

ALLORISMA MARIONENSIS White.

Plate 41, figs. 3 *a* and *b*.

Allorisma marionensis White, 1876, Proc. Acad. Nat. Sci. Philad., p. 31.

Shell small, elongate, ventricose anteriorly, and laterally flattened behind, where it is usually a little broader from base to dorsal margin than the anterior portion is; umbones prominent, elevated; beaks incurved, placed far forward; dorsal margin straight or slightly concave; postero-dorsal margin sloping backward to the posterior extremity, the greatest prominence of which is at, or a little below, midheight of the adult shell; base broadly rounded or straightened about midway, where the slight umbonal flattening of each valve meets it. Surface marked by the ordinary concentric lines and undulations of growth.

Length, 28 millimeters; height, 13 millimeters. A few examples have been obtained which are about one-third larger than that of which the dimensions are here given, but it is an unusually small species.

Position and locality.—Saint Louis division of the Subcarboniferous series, Marion and Mahaska Counties, Iowa, where it sometimes occurs quite plentifully in both the calcareous and magnesian layers of that formation.

GASTEROPODA.

Genus EUOMPHALUS Sowerby.

EUOMPHALUS SPRINGVALENSIS White.

Plate 41, figs. 1 *a* and *b*.

Euomphalus springvalensis White, 1876, Proc. Acad. Nat. Sci. Philad., p. 32.

Shell rather large; spire much extended for a species of this genus; volutions six or seven, gradually increasing in size from the apex to the aperture; moderately flattened upon the distal or upper side, regularly

and continuously rounded from that side all the way around to the contact with the next volution; aperture therefore nearly circular, its outline being modified only by the slight flattening of the distal side of the volutions and their short contact with each other.

Length, or height, about 55 millimeters; breadth of coil of last volution, 70 millimeters; diameter of aperture, 23 millimeters.

Position and locality.—Kinderhook division of the Subcarboniferous series, Springvale, Humboldt County, Iowa.

Genus PLATYCERAS Conrad.

PLATYCERAS TRIBULOSUM (sp. nov.).

Plate 41, figs. 6 *a* and *b*.

Shell of medium size, very obliquely and rudely conical, curved but not coiled; apex free, slender, pointed, incurved, and turned a little to the left side; body expanded; aperture very irregular in marginal outline, expanded in front, narrower behind, and having a prominent double lobe beneath the umbonal portion of the shell. Surface marked by the ordinary lines of growth, and also by three longitudinal rows of hollow spines arranged upon the dorsal aspect of the shell, the rows extending back more than half the length of the shell and containing five or six spines each.

Length of the shell from beak to front margin, 28 millimeters; breadth of its aperture, 21 millimeters.

This species is especially characterized by its spines, arranged in three rows, and the irregular character of its margin. It differs too much from any described species to need detailed comparison, but it may be compared with the two spinous species, *P. biserialis* Hall, from the same formation, and *P. dumosum* Conrad, from the Devonian rocks of New York.

Position and locality.—Burlington limestone division of the Subcarboniferous series, Burlington, Iowa, where it was obtained by Mr. Charles Wachsmuth.

Genus NATICOPSIS McCoy.

NATICOPSIS MONILIFERA (sp. nov.).

Plate 42, figs. 3 *a*, *b*, and *c*.

Shell small, subglobose; spire short, obtuse, and its immediate apex flattened; volutions about six, but the apical ones are very small, the last one constituting the greater part of the shell, broadest upon its basal or proximal portion, the proximal side of which is somewhat abruptly rounded inward to the aperture; the small volutions of the apex are plain, but upon the distal border of the two last ones, adjacent to the suture, there is a conspicuous row of small nodes, constituting a pretty ornamentation of the shell; the remainder of the surface is smooth and has a polished aspect, upon which a good lens reveals fine striæ of growth; aperture suboval in outline; inner lip having a distinct callus, especially in front; outer lip thin, its border sinuate, having an almost distinct notch just in front of the row of nodes.

Extreme length, 10 millimeters; extreme diameter of the last volution nearly the same.

Position and locality.—Upper Coal Measures, Pleasant Hill, Cass County Mo., where it was obtained by Prof. G. C. Broadhead.

Genus PLEUROTOMARIA Defrance

PLEUROTOMARIA BROADHEADI (sp. nov.).

Plate 42, figs. 1 *a* and *b*.

Shell large, narrowly umbilicated; spire somewhat extended, its length not quite half the full length of the shell; volutions about seven, strongly convex from suture to suture, gradually increasing in size; last volution large, somewhat produced on its proximal side, especially near the aperture, and abruptly rounded in to the umbilicus, but otherwise regularly convex; aperture subovate in outline, angular at its proximal end, straight upon its inner side; the straight inner lip thin, its edge ranging in line with the axis of the shell, so curved laterally as to give continuity to the narrow umbilicus almost to the proximal extremity of the last volution; outer lip sinuous, its notch small and shallow, situated at about the middle of the prominent convexity of the lip; revolving band narrow and somewhat obscure. Surface marked by numerous slightly impressed revolving lines, which are more distinct upon the proximal than upon the distal side of the spiral band, and still more distinct within and upon the borders of the umbilicus; spaces between the depressed lines narrow, plain, and somewhat unequal in width.

Full length, 88 millimeters; length of aperture, 50 millimeters; breadth of the same, 49 millimeters; full diameter of the last volution, including aperture, 75 millimeters.

This large, fine shell differs too materially from any of the numerous forms of *Pleurotomaria* that have been obtained from the Carboniferous strata to need detailed comparison.

Position and locality.—Coal Measure limestone, Kansas City, Mo., where it was obtained by Prof. G. C. Broadhead, and in whose honor the specific name is given.

PLEUROTOMARIA NEWPORTENSIS (sp. nov.).

Plate 42, figs. 2 *a* and *b*.

Shell of medium size; spire moderately short, less in height than the vertical diameter of the aperture; volutions about five, regularly and prominently convex from suture to suture, gradually increasing in size; the last volution continuously rounded from the suture to the axial center; aperture subcircular in outline, its margin oblique; outer lip having a broad notch a little above its middle, at the bottom of which the spiral band ends; inner lip apparently thickened; spiral band consisting of an elevated, narrow, roughened ridge, which is either wholly or partly obscured upon the volutions of the spire by the subsequent volutions. Surface marked with numerous, somewhat irregular, raised revolving lines, the concave spaces between which are somewhat wider than the lines.

Extreme height of the shell, 39 millimeters; height of aperture, about 25 millimeters; transverse diameter about the same; extreme transverse diameter of the shell, 39 millimeters.

This shell resembles *P. carbonaria* Norwood & Pratten, but it differs in having its revolving band simple and raised instead of concave, with revolving lines within it, as in that species; and also in having its aperture subcircular instead of nearly semicircular.

Position and locality.—Coal Measure strata, Newport, Ind., where it was obtained by Mr. William Gurley.

PTEROPODA.

Genus CONULARIA Miller.

CONULARIA CRUSTULA (sp. nov.).

Plate 42, fig. 4 *a*.

Shell rather small, having the usual four-sided pyramidal form; the four sides being equal, and flat or nearly so near the apex, but slightly convex towards the aperture; the four angles distinctly furrowed, and a slender furrow also marks the median line of each side, which furrow is more distinct upon the cast of the interior of the shell than upon the external surface of the test. Surface marked by the numerous transverse raised striæ common to this genus, which arch gently forward from each of the four angles; the majority of the striæ are continuous across the median line of the sides, and also across the angle-furrows, in crossing which they bend slightly backward.

Length, 31 millimeters; diameter of aperture, about 16 millimeters.

This shell is closely like several other known forms, but it possesses peculiar interest from the fact that it is the only species known to me to occur in the Coal Measure strata of the Mississippi Valley, although several species are known in the Subcarboniferous strata of that region. It is, therefore, the most recent known American species, and adds to our knowledge another feature of close relationship between the faunæ of the upper and lower Carboniferous series.

Position and locality.—Coal Measure strata near Kansas City, where it was obtained by Professor Broadhead. Among some Carboniferous fossils brought by Prof. E. D. Cope from near Taos, New Mexico, are a couple of fragments apparently of this species.

CEPHALOPODA.

Genus NAUTILUS Breynius.

NAUTILUS DANVILLENSIS White.

Plate 42, fig. 7 *a*.

Nautilus danvillensis White, 1878, Proc. Acad. Nat. Sci. Philad., p. 36.

Shell moderately large; umbilicus deep but not very broad, showing all the volutions, at least in large part; volutions apparently four, increasing rapidly in size, very slightly embracing, subtrihedral in cross-section, the two sides of the volution forming two sides of that outline, while the inner side of the volution forms its third principal side; sides of the volution plain, nearly flat or slightly convex; peripheral side very narrow, concave, and marked at either edge, where it joins the side, by a row of longitudinally compressed nodes. The sides are rounded abruptly into the umbilicus, which is unusually deepened by the transverse diameter of the volutions being greater at the inner side than elsewhere. Septa plain, somewhat deeply concave dorso-ventrally, but less so transversely; siphuncle subcentral, a little nearer to the peripheral than to the inner side. Surface smooth except the ordinary lines of growth and the two rows of dorsal nodes before referred to. Test thin.

The only discovered specimens of this species being crushed or otherwise imperfect, it has not been practicable to illustrate it by any other figures than the transverse section given on plate 42, although the characters above given have been well ascertained. The exact form of the aperture, however, is not accurately known, but the lines of growth show the lateral margins to have been sigmoid or sinuous, and the peripheral margin concave. These lines also indicate that the aperture was oblique to the diameter of the plane of the shell, the peripheral portion retreating and the inner projecting.

Transverse diameter of a volution of less than full adult size from edge to edge of the umbilicus, 40 millimeters; width of its sides, 50 millimeters; breadth of peripheral side, 16 millimeters; the full diameter of the plane of the largest example discovered, about 130 millimeters.

The narrow concave periphery, with its two marginal rows of compressed nodes, and the plain, flattened sides of the volutions, which expand towards the umbilicus, are characters which distinguish this species from all others known to me.

Position and locality.—Coal Measure strata, Danville, Ill., where it was obtained by Mr. William Gurley.

ARTICULATA.

VERMES.

Genus SERPULA Linnæus.

SERPULA INSITA White.

Plate 42, fig. 8 *a*.

Serpula insita White, 1878, Proc. Acad. Nat. Sci. Philad., p. 37.

Scattered through an earthy, Carbonaceous layer of Coal Measure strata at Newport, Vermillion County, Ind., are abundant examples and fragments of a very small *Serpula*, which evidently burrowed in the mass when it was in the condition of mud. Also sessile upon some imbedded molluscan shells are found occasional nearly perfect examples of the same species. The species of the genus *Serpula* are so devoid of distinguishing characteristics that a specific diagnosis is often difficult or impossible. This species, however, is not likely to be mistaken for any other, because of its very small size, and because no other form has been recognized in the strata of that age in that region. It is here named, mainly, for the purpose of aiding in the classification of the rich fauna of the Carboniferous rocks. The species may be characterized as minute, sessile or free, tortuous, and subcylindrical.

PLATE 39.

Page.

FIG. 1. MICHILINIA? PLACENTA 157

a. Calycular view of a large example; natural size.
b. Lateral view of the same.
c. Calycular view of a small example; natural size.
d. Under side of the same, showing the concentrically wrinkled epitheca.

FIG. 2. MICHILINIA EXPANSA 158

a. Calycular view of a small, imperfect, silicified example; natural size.
b. Lateral view of the same.

FIG. 3. CHONOPHYLLUM SEDALIENSE 157

a. Side view of a partially crushed and broken example; natural size.

FIG. 4. LOPHOPHYLLUM EXPANSUM 157

a. Side view of a type specimen; natural size.
b. Calycular view of the same.
The spots near the columella are accidental; and the figure does not show the full prominence of the columella.

FIG. 5. HADROPHYLLUM GLANS 156

a. Calycular view; natural size.
b. Lateral view of the same.

FIG. 6. ZAPHRENTIS CALCEOLA 156

a. Lateral view of a specimen from Sedalia, Mo.; natural size; showing a minimum degree of flattening upon the lower portion of the convex side.
b. Calycular view of the same. The edge of the calyx of this specimen is constricted, giving it the appearance of being thickened. It is usually thin and sharp.
c. View of the convex side of another example, from Burlington, Iowa, showing a maximum degree of flattening of the lower portion of the convex side.
d. Calycular view of the same, showing the border of the usual character, except that its lower portion has been broken away.

FIG. 7. ZAPHRENTIS ELLIPTICA 155

a. Side view; natural size.
b. Calycular view of the same.

SUBCARBONIFEROUS.

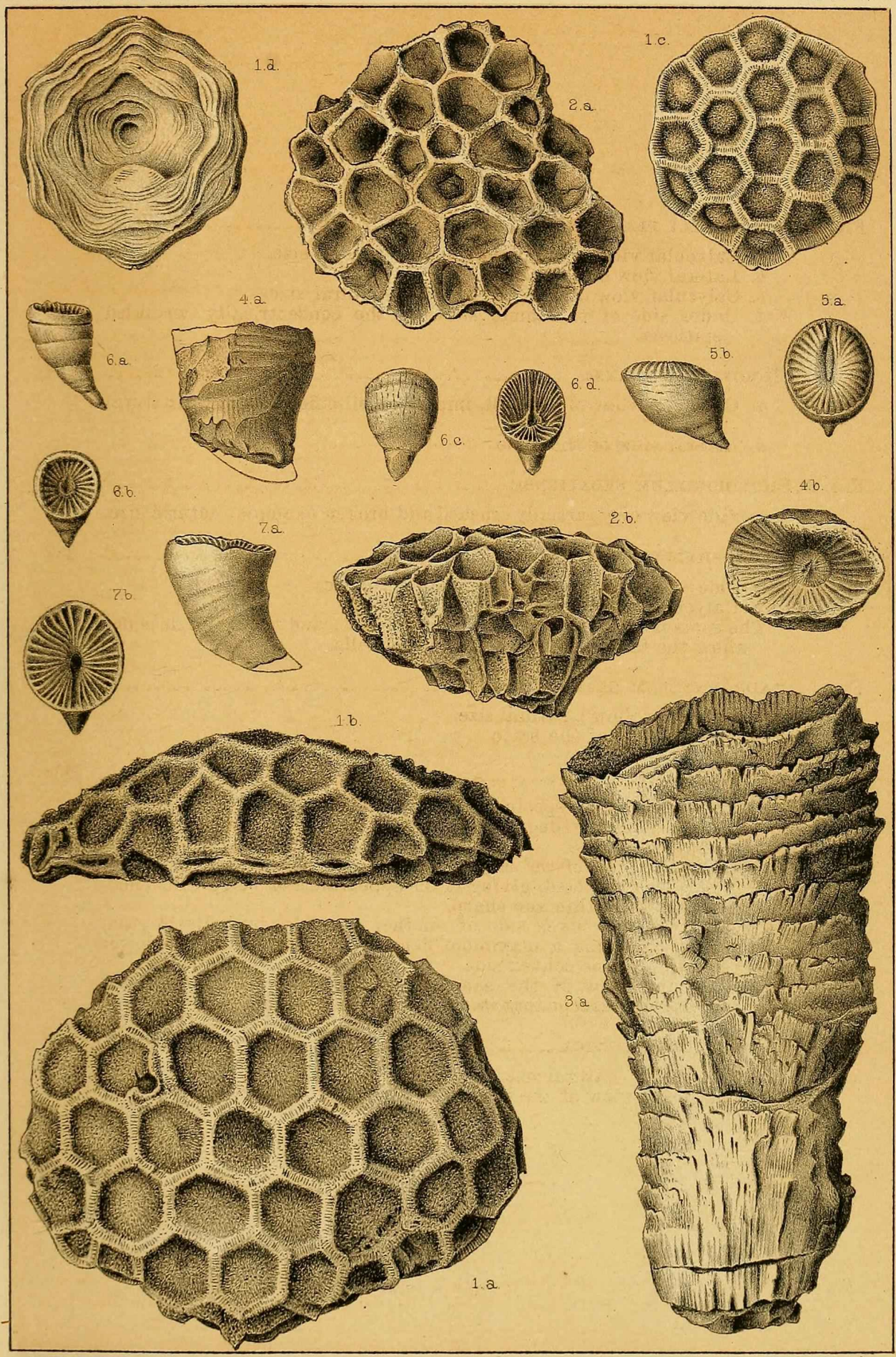

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PLATE 40.

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FIG. 1. ACTINOCRINUS WACHSMUTHI 162

a. Side view of a crushed example, showing the proboscis and a part of the arms; natural size.
b. Side view of the body of another example, only slightly distorted by pressure.

FIG. 2. LEPIDESTHES COLLETTI 163

a. Side view of a specimen somewhat smaller than the type; natural size.
b. Diagram of a single piece of the ambulacral series, with adjacent borders of others, showing the two pores; enlarged.

FIG. 3. SCAPHIOCRINUS GURLEYI 162

a. Side view of the type specimen; natural size.
The black spots at the junction of the column with the body are accidental.

FIG. 4. SCAPHIOCRINUS GIBSONI 161

a. Side view of the type specimen; natural size. The slight zigzag arrangement of the smaller divisions of the arms is not distinctly shown in the figure, and it does not quite clearly represent the angular aspect of all the small pieces composing the arms.

FIG. 5. PLATYCRINUS BONOENSIS 160

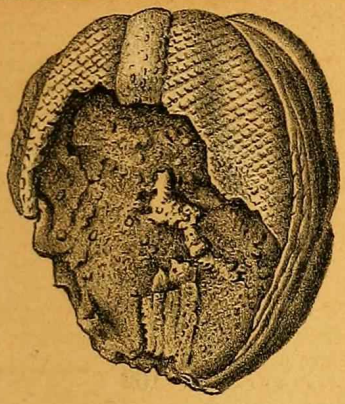
a. Side view of the type specimen; natural size.

FIG. 6. LITHOSTROTION MAMILLARE 159

a. Calycular view of a portion of a large corallum, showing three double corallites.
b. Under view of the same, showing that portion of the same double corallites.

FIG. 7. LITHOSTROTION MICROSTYLUM 159

a. Calycular view of two or three corallites; natural size. The details are partially obscured by the bad state of preservation of the specimen.



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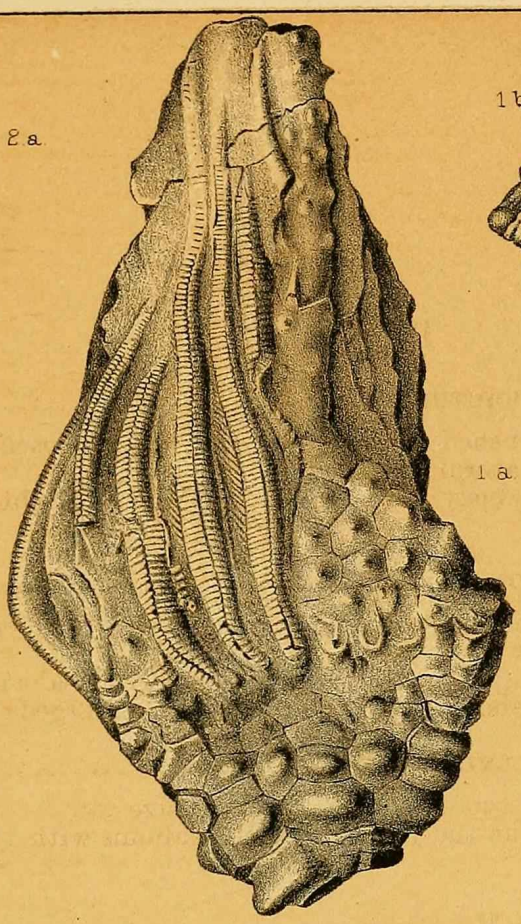

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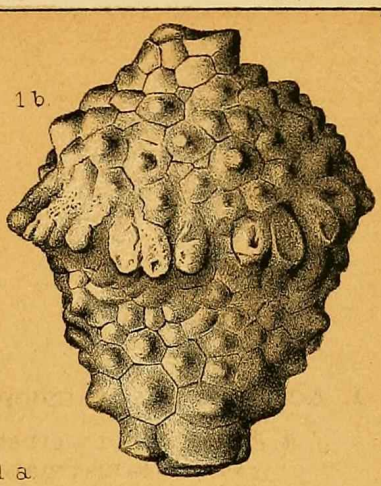

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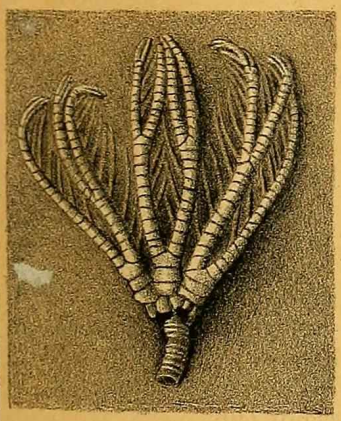

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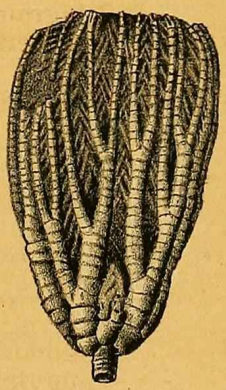

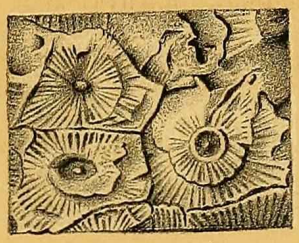

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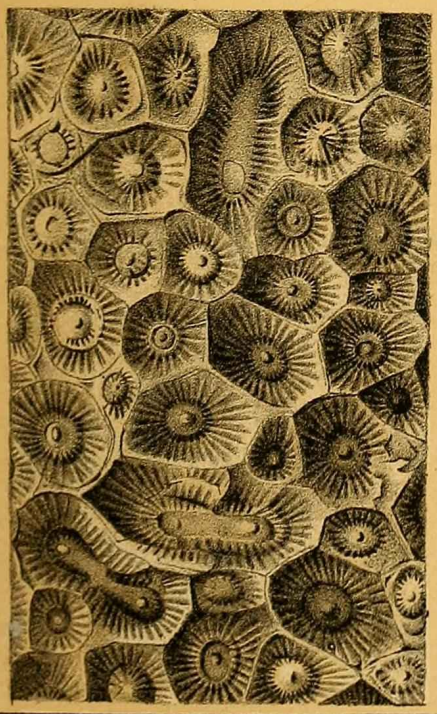

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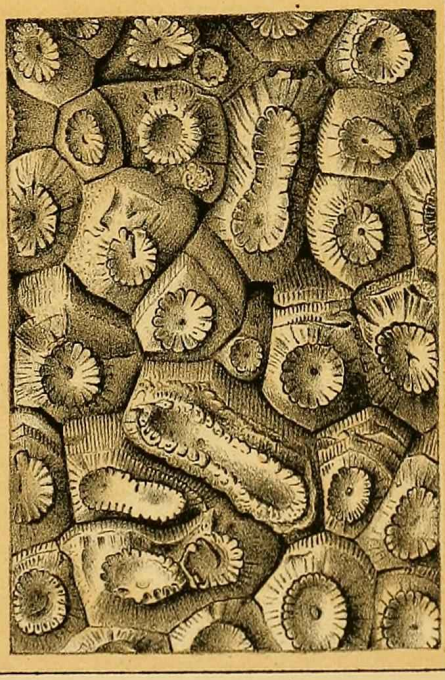

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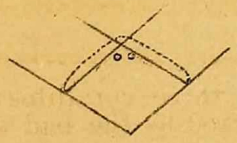

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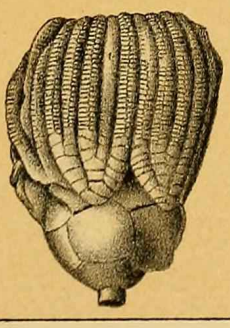

PLATE 41.

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FIG. 1. EUOMPHALUS SPRINGVALENSIS 167

a. Lateral view of the type specimen; natural size; the outer portion of the spire being imperfect by erosion.
b. Umbilical view of the same.

FIG. 2. SPIRIFER SUBCARDIIFORMIS 165

a. Ventral view of an example from Spergen Hill, Ind.; natural size.
b. Dorsal view of the same.
c. Lateral view of the same.

FIG. 3. ALLORISMA MARIONENSIS 167

a. Lateral view; natural size.
b. Dorsal view of another example.

FIG. 4. ORTHIS THILMEI 164

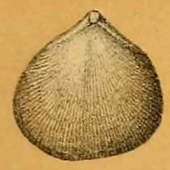
a. Ventral view of an example from Mr. Wachsmuth's collection; natural size.
b. Dorsal view of the same.
c. Lateral view of the same.
d. Interior view of the ventral valve of another example, showing the large muscular scar.

FIG. 5.. RHYNCHONELLA OTTUMWA 165

a. Ventral view; natural size.
b. Dorsal view of the same.
c. Lateral view of the same.

FIG. 6. PLATYCERAS TRIBULOSUM 168

a. Dorsal view of the type specimen; from Mr. Wachsmuth's collection; natural size.
b. Lateral view of the same.



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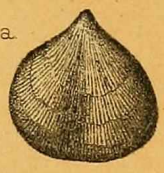

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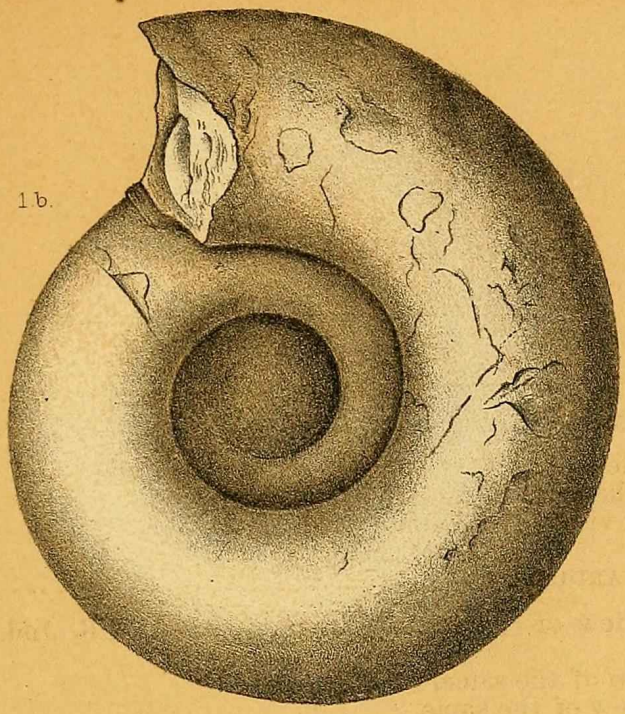


1b.

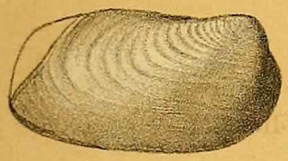
4c.

4d.

5b.

5c.

3a.



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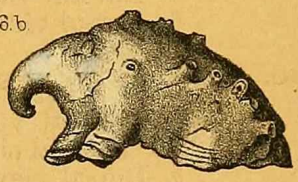

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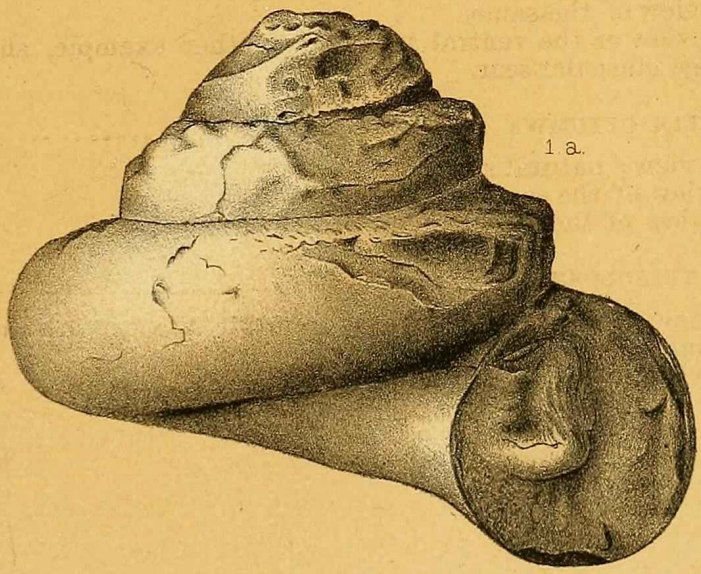

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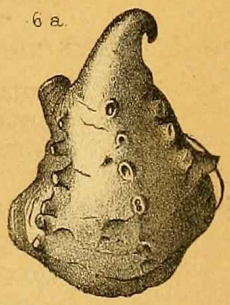

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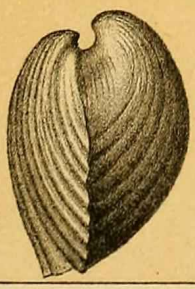

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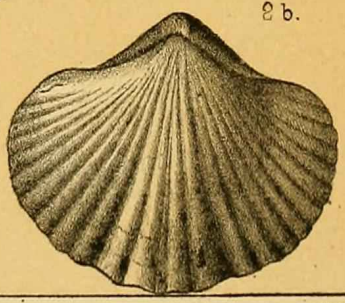

PLATE 42.

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FIG. 1. PLEUROTOMARIA BROADHEADI 169

a. Lateral view; natural size.
b. View of the opposite side of the same, showing the aperture. Portions of the shell on this side have been a little crushed by pressure. Fragments have also been broken out of both sides, as shown by the outlines upon both the figures.

FIG. 2. PLEUROTOMARIA NEWPORTENSIS 169

a. Lateral view; natural size.
b. Apertural view of the same.

FIG. 3. NATICOPSIS MONILIFERA 168

a. Lateral view; enlarged.
b. Apical view of the same.
c. Portion of the surface enlarged; the striæ of growth showing the character of the border of the outer lip.

FIG. 4. CONULARIA CRUSTULA 170

a. Lateral view; natural size.

FIG. 5. ANTHRACOPTERA POLITA 166

a. Right valve; natural size.
b. Left valve. Both valves have been slightly distorted by pressure.
c. Diagram showing convexity of the valves.

FIG. 6. ASTARTELLA GURLEYI 166

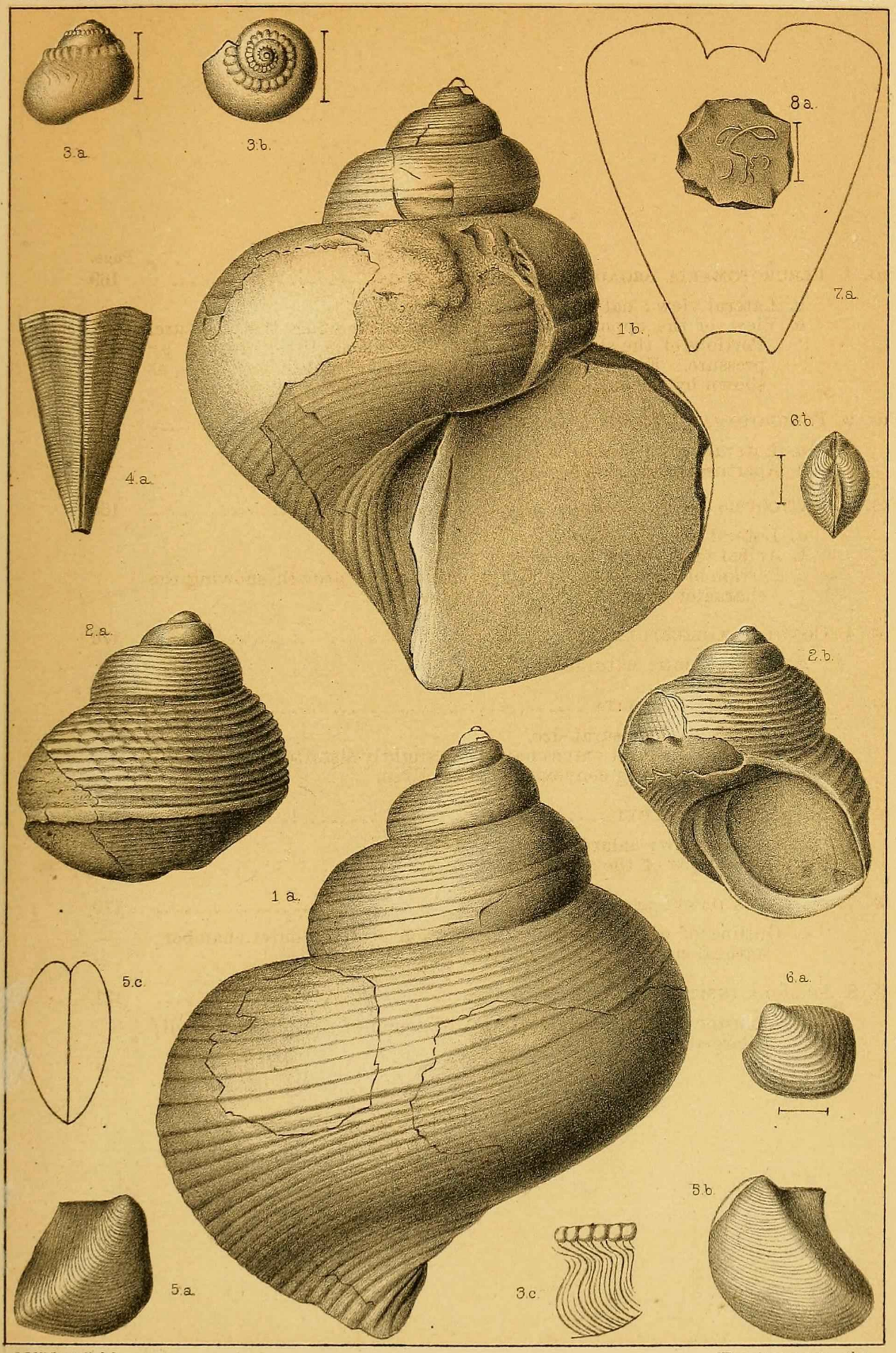
a. Lateral view; enlarged.
b. Dorsal view of the same.

FIG. 7. NAUTILUS DANVILLENSIS 170

a. Outline of a cross-section of a volution near the outer chamber; natural size.

FIG. 8. SERPULA INSITA 171

a. A cluster of shells, attached to a fragment of a molluscan shell; enlarged.



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