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NEW AND LITTLE KNOWN AMERICAN PALEOZOIC OSTRACODA.

By E. O. Ulrich.

(Read February 4, 1890.)

INTRODUCTION.

In offering the following extensive additions to the known forms of American Paleozoic *Ostracoda*, it may be in place to explain how it happens that my cabinet is so rich in a class of fossils that is usually but meagerly represented in even the best of our public and private collections. The last fact is no doubt due, primarily, to the small size of most of the forms, some of the species of *Leperditia* and *Isochilina*, only, being large enough to come within the observing powers of the average collector. By their mere abundance, some of the smaller forms have long ago forced themselves upon him, but the more modest majority require great care and more laborious methods than are now in common use, to obtain.

Most of the smaller species so far published and illustrated have been described by English authors, of whom Holl, Kirkby, Brady and Jones, the last particularly, have made the study of the *Ostracoda* a specialty.

The American material at their command was unfortunately rarely very ample, consisting only, in most cases, of specimens attached to slabs of shale and rock. Being unwieldy, these are often difficult to study, while important characters also may be hidden by the matrix. Their work, however, is as good as it was possible to make it under the circumstances, their descriptions being fortified by good illustrations, enabling the student to identify their species and varieties with comparative ease in nearly every case.

Good figures are an absolute necessity in the study of this interesting though difficult group of organisms. Where so much depends, as in these fossils, upon outward form and other peculiarities that must be expressed by terms having, perhaps, quite different values with different authors, and where there is often no little

uncertainty respecting the determination of the anterior and posterior ends, and, in some cases, even of the dorsal and ventral edges, it stands to reason that a single good figure is a more potent aid in the work of identification than a whole page of description.

But it requires no mean knowledge of the subject to make *correct* and *reliable* illustrations of the species, and as the English authors mentioned above were much more experienced than those American authors who have occasionally described species of *Ostracoda*, the obvious difference in the reliability of their respective illustrations is explained. This remark applies to my own early work as much as to that of others.

Two factors, then, may be said to have held the progress of the study of the *Ostracoda* of American rocks in check: the absence of interest and experience on the one hand, and a lack of sufficiently good and abundant material on the other. In my own case, I hope I may say truthfully that the, at least partial, removal of the first difficulty, resulted naturally from overcoming the second.

In my work on the *Bryozoa*, I have had occasion to institute washings of shaly and other soft or friable strata, that I might obtain the smaller forms in a free condition. In many cases the residue contained not only the desired *Bryozoa*, but numerous other small organisms, chief among them the separated valves, and often complete carapaces of *Ostracoda*. The task of picking the minute valves out of the material containing them is very laborious and trying to the eyes, the work having to be done under a lens. In each instance, therefore, only a small portion of the material was picked over, so as to furnish, as it were, a sample of the contents of each.

I had, besides, the advantage of benefiting from similar washings carried on by Prof. J. M. Nickles, Mr. Charles Schuckert and Mr. Ernst Vaupel, who very kindly turned small samples of their results over to me. Many of these remain as yet unpicked.

To Mr. Victor Lyon, of Jeffersonville, Ind., I am also indebted for a small quantity of fine residue from his extensive washings in the noted Devonian *Bryozoa* bed of the Falls of the Ohio. This proved quite rich, and went far to complete my own collections from that interesting locality. It is unfortunate, however, that Mr. Lyon and others who have made washings there did not save the fine sand left after picking out the *Bryozoa* and other fossils. Thousands of beautifully preserved *Ostracoda* were no doubt thrown

away with it. The small parcel received by me had been fortuituously overlooked, or it, too, would have shared the fate of the rest. Mr. G. K. Greene, of Albany, Ind., who also washed for *Bryozoa* at the Falls, saved some of the fine residue. He kindly picked out some of the *Ostracoda* and sent them to me for examination, but I found nothing among them not already known to me.

In this manner I succeeded in gathering a large series of these small fossils, and the supply of the apparently new forms is not by any means exhausted with the present memoir. No; many remain unworked, while another paper, on Minnesota species mainly, is almost ready for publication. And yet, the tide has probably only just begun to set in. Nearly every locality affords one or more forms not before noticed. Most of the species so far known, including those of this paper, are from the Trenton, Cincinnati, Hamilton and Chester Groups, with very few from below the Trenton, and not many from the Clinton and Niagara, the latter the equivalent of the English Wenlock that has proven so prolific in *Ostracoda*. Nor does the number known from our Carboniferous rocks at all compare with that described from European deposits of the same age. Here are numerous chances for the ambitious collector.

The accompanying plates are reproduced from pen drawings by the photo engraving process. With the exception of Plate XI, on which the outlines were obtained by means of dividers and measurements, all were drawn with the aid of a *camera-lucida*. No effort was made to produce either artistic or mechanical triumphs, but in every *essential* respect the figures are reliable.

The specimens used in the descriptions belong in every case to the author's cabinet.

The descriptions are grouped geologically, and under that zoologically as near as possible, into three parts as follows:

Part I.—Lower Silurian Species.

Part II.—Upper Silurian and Devonian Species.

Part III.—Carboniferous Species.

Part I.

Descriptions of Lower Silurian Species.

ENTOMIS MADISONENSIS, n. sp.

Plate VII, Figs. 12 *a*, 12 *b*.

Valves oblong-ovate, the back straight but short, the ends subequal and curved almost uniformly into the much more gently convex ventral edge. Sulcus deep, nearly central, extending from the dorsal edge fully two-thirds across the valve, bending forward a little at its lower extremity. Anterior half of valve moderately convex; posterior half more so, and rising abruptly from the sulcus. Surface smooth.

Size: Length, 1.3 mm.; height, 0.78 mm.

This, and a much larger form from the Niagara of Indiana, are the only species of *Entomis* at present known to me from American rocks. Though apparently a true species of the genus, *E. madisonensis* does not seem to be very closely related to any of the European forms.*

The strong sulcus will distinguish it from species of *Primitia*.

Position and locality: Rare in the uppermost beds of the Cincinnati Group, near Madison, Ind. It is associated with *Leperditia cæcigena*, S. A. Miller, and *Eurychilina striato-marginata*, S. A. Miller.

PONTOCYPRIS (?) ILLINOISENSIS, n. sp.

Plate X, Figs. 16 *a*, *b*, *c*.

Valves depressed triangular, with the angles rounded. Extremities subequal, but the anterior a little the widest. Ventral edge nearly straight, curving upward at the ends. Dorsal edge convex, most prominent a little in front of the center. Surface smooth, with point of greatest convexity a little in front of the middle, where a small spot differing in color from the remainder of the test is distinguishable.

Size: Length, 1.0 mm.; height, 0.5 mm.

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* The recently described *Entomis rhomboidea*, Jones (*Quart. Jour. Geol. Soc.*, February, 1890), from the Hamilton Shales, of New York, seems to me to be quite different from true *Entomis*, and probably congeneric with certain forms from the Devonian of the Falls of the Ohio, for which I shall propose a new genus.

This species belongs to a group of *Ostracoda* whose generic relations are exceedingly doubtful. I follow Prof. T. Rupert Jones' suggestion in referring this one to *Pontocypris*. My collection contains at least six others from the Trenton and Cincinnati rocks of Kentucky, Tennessee, Illinois and Minnesota, having, apparently, close relations to the form here described. One is a form like *Macrocypris vinei*, Jones, and two of the others are more like species that are referred to *Bythocypris*. I should have liked to work them out at this time, but as it was impossible to do them justice in the limited time at my disposal, I have thought it best to postpone their publication till the next opportunity.

Position and locality: The types of *Pontocypris* (*?*) *illinoisensis* were collected at Savannah, Ill., where they occurred in strata of the Cincinnati Group associated with *Primitia impressa* and numerous small *Bryozoa*.

CTENOBOLBINA, n. gen.

Carapace small, elongate-sub-oval, strongly convex, the posterior two-fifths more or less decidedly bulbous or subglobular, and separated from the remainder by a deep, narrow sulcus extending in a gentle curve from the dorsal margin more than half the distance across the valves toward the postero-ventral border. The anterior three-fifths often with another oblique but less impressed sulcus. Valves equal, the dorsal margin straight, hingement simple, the ventral edge thick, and the true contact margins generally with a row of small spines on each side; in a lateral view both are concealed by a "frill" or flattened border, usually mistaken for the true contact edges.

Surface generally granulose.

Type, BEYRICHIA CILIATA, Emmons (*B. tumifrons*, Hall). *Plate VII, Figs.* 1 *a and* 1 *b.*

This genus is proposed for the reception of several new species and two others that have been described as *Beyrichia*. The latter are *B. ciliata*, Emmons, and the closely related *B. duryi*, S. A. Miller, both from the Cincinnati Group. They are not, however, congeneric with *B. klœdeni*, McCoy's type of *Beyrichia*. True species of that genus have three lobes on each valve. These are variously modified, but usually consist of a small central one, and two, more ridge-like and often united, enclosing it. The posterior

lobe or ridge may be thickened, but this end of the carapace is never bulbous as in *Ctenobolbina*. Jones' and Kirkby's *Beyrichiopsis*, including Carboniferous species, agrees more closely, but is distinguished by a peculiar round lobe on the anterior half. *Beyrichiella* of the same authors, and likewise founded upon Carboniferous forms, resembles *Primitia* more than *Ctenobolbina*. Prof. T. Rupert Jones, of England, who is beyond question the best authority on fossil *Ostracoda*, agrees with me in regarding this as a good generic group, distinguished from allied genera by the bulbous character of the posterior end.

CTENOBOLBINA CILIATA, VAR CURTA, n. var.

Plate VII, Fig. 2.

This variety differs from the typical form of the species (see Plate VII, Figs. 1 *a* and 1 *b*) in being shorter, in having the posterior or principal furrow much narrower, and the central lobe produced above into a hollow, blunt spine. The flange or frill also is generally absent.

Size: Length, 1.19 mm.; height, 0.82 mm.

Position and locality: Found associated with *C. alata*, Ulr., in the lower shales of the Cincinnati Group, at Cincinnati, Ohio, about one hundred and fifty feet above the Ohio River.

CTENOBOLBINA CILIATA, VAR EMACIATA, n. var.

Plate VII, Figs. 3 *a, b, c.*

This is a strongly marked variety, differing from the more typical phases of the species principally in the ventral obsolescence of the anterior lobe, the greater obliquity and prominence of the central lobe, and the emaciated appearance of the valve between this and the rounded posterior lobe. The posterior sulcus is deep and very wide, and divided above by a slight elevation at the dorsal border. The surface granulations are also more minute, and arranged in crowded series. The flange is wide and smooth except at the edge, where there is a row of small spines.

Size: Length, 2.05 mm.; height, 1.24 mm.

Position and locality: Cincinnati Group, at Savannah, Ill.

CTENOBOLBINA ALATA, n. sp.

Plate VII, Figs. 4 *a, b, c.*

Carapace strongly convex, sub-oblong, obliquely ovate, straight on the back, elliptically rounded below, the ends strongly rounded, with the anterior one much the narrowest. Sulci very oblique, the posterior one well marked, the anterior scarcely perceptible. A strong wing-like process developed from the ventral prolongation of the anterior lobe. Flange well developed only in the older examples. Ventral and posterior edges very thick and concave beneath the flange; bordering the contact edges a series of blunt spines. Surface strongly granulose.

Size— { Length, 1.32 mm.; Height, 0.71 mm.; Thickness, 0.48 mm.
" 2.0 " " 1.15 " " 0.72 "
" 2.15 " " 1.2 " " 1.0 "

The alate processes, when fully developed, impart a rather grotesque appearance to this species. They are, however, easily worn away or broken, and, moreover, seem to be a rather variable feature, since in some examples, apparently in a good state of preservation, they are considerably smaller, and more spine-like than in those figured. In such cases the species is distinguished from *C. ciliata* and the closely related *C. duryi*, by the narrower anterior end, and greater obliquity of the valves. They are also more convex.

Position and locality: Lower shales of the Cincinnati Group, at Cincinnati, Ohio. The best examples were obtained from excavations along Brown Street.

CTENOBOLBINA BISPINOSA, n. sp.

Plate VII, Fig. 6.

Carapace rather strongly convex, sub-oblong, obliquely ovate, elliptically rounded below and straight at the dorsal edge. Posterior end wider and more abruptly curved into the ventral edge than the anterior. Free margins spinous, without flange, or with same very narrow. Surface of valves papillose. Anterior sulcus usually obsolete, the posterior one narrow, well defined, extending from the center of the dorsal margin in a slightly curved direction about two-thirds across the valve. Posterior lobe rounded; median and anterior lobes confluent. These conditions impart to the

carapace a decided resemblance to *Primitia*. Two long and delicate spines, one in the antero-dorsal fourth, the other near the ventral edge, a little in front of the center, suggest the specific name.

Size: Length, 0.91 mm.; height, 0.52 mm. Other specimens are one-third larger.

When typical, this species resembles certain forms of *Primitia* and *Beyrichiella* very greatly, but specimens in which the anterior sulcus is faintly developed are not uncommon. These, then, are very much like the young of *C. alata*, which species I regard as closely related. Indeed, I would not be surprised should a more complete series than is now in my collection show them to be but varieties of one and the same species.

Position and locality: Associated with *C. alata* in the lower shales of the Cincinnati Group, at Cincinnati, Ohio.

CTENOBOLBINA TUMIDA, n. sp.

Plate VII, Figs. 5a, 5b.

Carapace sub-oblong, erect, dorsal edge straight, three-fourths as long as the valves; ends subequal, the anterior often a little the narrowest, almost uniformly curving into the less convex, ventral edge. A narrow crenulated flange around the free margins. Posterior half of valves taken up by the remarkably tumid or subglobular posterior lobe. In front of this a strong depression cut off below by a narrow low ridge, the postero-ventral prolongation of the anterior lobe. In the depression between this ridge and lobe and the much more prominent posterior lobe, a small, narrow vertical lobe. Surface sloping rapidly down to the free margins. The test is not very well preserved on any of the numerous valves before me, but the best present evidence of granulations as in *C. ciliata* and other species of the genus.

Size: Length, 1.15 mm.; height, 0.7 mm.; greatest convexity of posterior half of single valve, 0.38 mm.; thickness of anterior half of same, 0.28 mm.

In the isolation of the small mesial lobe, this species approaches *Beyrichia*, but the posterior lobe is so decidedly "bulbous" that the generic reference can scarcely be questioned. The point referred to will at once distinguish the species from *C. ciliata*, its nearest known relative.

It should be mentioned also that in some examples the posterior lobe appears to be a little flattened on top, and the ventral prolongation of the anterior lobe forms occasionally a more pronounced ridge than shown in fig. 5*a*.

Position and locality: Middle beds of the Cincinnati Group, at McKinney's Station, Lincoln County, Ky.

TETRADELLA, n. gen.

Syn. *Beyrichia*, of authors (in part); *Strepula*, Ulrich (non Jones and Holl.)

This genus as now constituted comprises two distinguishable groups of species. The first and typical section may be defined as follows:

Carapaces somewhat oblong, often subquadrate, never tumid, with the hinge line straight. Surface depressed, with a semi-circular, narrow ridge rising abruptly from the free margins and running close to and nearly parallel with them, terminating at the posterior and anterior dorsal angles. In the enclosed space, two often slightly modified narrow ridges traverse the valves in a vertical or oblique direction from the dorsal edge, or from points near it, to the posterior half of the ventral portion of the sub-marginal ridge, uniting with it. The four vertical ridges of the dorsal half of the valves have suggested the name, but the fact that they all unite below is perhaps the most significant character of the genus.

Types: *Beyrichia quadrilirata*, Hall and Whitfield, Pal. Ohio, Vol. II, p. 105, Plate IV, figs. 6 and 7, 1875,* and *T. subquadrans*, n. sp.

Other species that should be placed here are *Strepula quadrilirata*, var. *simplex*, Ulrich, described from Manitoba, which proves to be a constant form, having lately been observed in considerable abundance on slabs from the upper beds of the Cincinnati Group, at Weisburg, Ind.; *Strepula lunatifera*, Ulr., and the following European species: *Beyrichia complicata*, Salter; *B. bussacensis*, Jones; *B. ribeiriana*, J., and *B. affinis*, J.

The second section, of which *Beyrichia oculifera*, Hall, and *B. chambersi*, S. A. Miller, are to be regarded as the types, differs

* More correctly figured and described in Contri. to the Micro-Pal. of the Cambro-Sil. Rocks of Canada, Pt. II, p. 54, Pl. IX, fig. 12. 1889. The author here erroneously refers the species to *Strepula*, Jones and Holl.

from the first in one respect only: The postero-dorsal extremity of the marginal ridge rises into a strong spine-like or otherwise shaped process. This process is always flattened either vertically or laterally, generally directed a little forward, and beaded on the edge. The postero-median ridge, though inclined to be variable, is, however, always present. And yet, in all the figures of *Beyrichia oculifera*, or *Tetradella oculifera* as it should now be called, so far published, the narrow sulcus separating it from the base of the high process is not represented. Even so experienced an observer as Prof. T. Rupert Jones, who lately published figures of the species (Quart. Jour. Geol. Soc., Vol. XLVI., Pl. IV., 1890), failed to see it. This may be due to the fact that the sulcus is usually filled with remains of the shaly matrix; or it may have been obscured by the shadow of the prominence just above it.

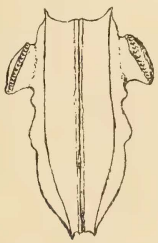

Fig. 1. Ventral edge of a complete carapace of *Tetradella oculifera*, (Hall). x 18.

The classificatory value of the elevated process that characterizes the second section of this genus is questionable. It is scarcely a feature of generic importance, yet, as its peculiarities in each of a number of species or varieties are remarkably constant, we are not justified in viewing it as a "mere ornament." At one time I thought of distinguishing the species generically as *Ceratella*, but further study has convinced me that such a division is unwarranted at the present time.

Taking the genus as a whole, its relations are perhaps nearest *Ctenobolbina*, the anterior half of the valves being sometimes much alike in the two. The posterior halves, however, are quite different, the bulbous character of that part of the carapace in *Ctenobolbina* having no representation in *Tetradella*. The ridges also are always more clearly defined in species of the latter.

In true species of *Beyrichia* there is no sub-marginal ridge, the

valves have a more tumid aspect, and the two or three lobes appear more like rounded prominences than ridges.

The "tri-sulcate" species of *Beyrichia*, the majority of which I believe ought to go with *Bollia*, are also related, but not so closely as may appear at first sight. In those species it seems to me the sub-centrally situated horse-shoe ridge characterizing the true *Bollia* is simply no longer fully developed, the definition of the sulci having gradually disappeared in the ventral half of the valves. In all species of *Bollia*, including the aberrant forms just alluded to, the central sulcus is approximately vertical, while the two lateral ones curve away from the center. In *Tetradella*, however, such a bilateral arrangement is not evident, since it is generally the case that *all* the sulci curve more or less anteriorly.

Species of this genus have a greater vertical range than is usual. Thus, specimens apparently identical with *T. chambersi* occur already in the Birdseye, at which horizon I collected them in Minnesota. I have not yet seen the typical form in the Trenton proper, but a variety in which the process is less spine-like and its fringed edge semi-circular, occurs in the upper beds of the Trenton and in the lower or Utica horizon of the Cincinnati Group

This variety probably foreshadows the *T. oculifera*, a form that is so far as known restricted to the uppermost one hundred feet of the strata exposed in the Cincinnati hills. Another variety of *T. chambersi*, differing from the typical Cincinnati specimens in having the two anterior ridges or lobes fuller, and the third or postero median one much larger than usual, occurs in the upper beds of the group at numerous localities. This form was illustrated by Hall and Whitfield, from Waynesville, Ohio (Pal. Ohio, Vol. II., Pl. IV, figs. 11, 12).

T. quadrilirata and *T. simplex* also occur in the Birdseye limestone of Kentucky and Minnesota, but appear to be absent in the beds intervening between that horizon and the upper two or three hundred feet of the Cincinnati Group.

TETRADELLA SUBQUADRANS, n. sp. or var.

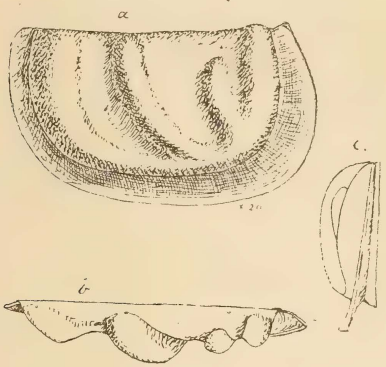

Fig. 2. *Tetradella subquadrans*, n. sp. or var. Trenton Group, Trenton Falls, N. Y.; *a*, left valve, x 20; *b*, dorsal view of same; *c*, posterior view of same.

Valves oppressed, slightly elongate, sub-quadrate, the dorsal edge straight, long, the posterior end vertical in the upper half, below bending rather sharply into the somewhat straightened or gently convex ventral margin. Anterior end oblique, rounding with a gentle uniform curve from the antero-dorsal angle to the center of the ventral edge. A wide concave border or "frill" around the free margins. The four ridges sharply defined, all connected, and seeming to spring from the postero-ventral region of the valve; the first or anterior ridge follows the curve of the ventral and anterior ends; the antero-median ridge, which is the most prominent portion of the valve, crosses it in a course nearly parallel with the first, terminating at the dorsal edge a little in front of the middle; the post-median ridge is short, directed only a little forward, and does not reach the dorsal margin the posterior ridge follows the posterior edge, thus completing the semi-circle begun by the anterior ridge.

Size: Length, including frill, 2.05 mm.; height, with same, 1.15 mm.; without frill, length, 1.65 mm; height, 1.0 mm.

This species is clearly distinct from all forms known from American deposits, but may be only a variety of the English Bala species, *Beyrichia complicata*, Salter. The American specimens differ in being more nearly quadrate, and in having the post-median ridge longer and farther separated from the posterior ridge. In any event the two forms must be closely related.

BOLLIA PERSULCATA, (Ulrich).

Beyrichia persulcata, Ulrich, Jour. Cin. Soc. Nat. Hist., Vol. II., No. 1, p. 12, Pl. VII, fig. 6, 1879.

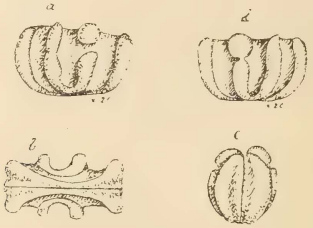

Fig. 3. *Bollia persulcata*, Ulrich ; lower beds of the Cincinnati Group, Covington, Ky. *a*, left valve of the usual form, x 20 ; *b* and *c*, ventral and posterior views of same ; *d*, right side of another carapace presenting slight differences, x 20.

This specimen is a true member of the group of *Ostracoda* distinguished in 1886 by Jones and Holl as *Bollia*. The posterior half of the horse-shoe ridge has its dorsal extremity separated as a rounded node projecting, like the other ridges, a little beyond the dorsal edge. Its bent ventral portion is thin and depressed, so that when the valves are attached to slabs, as is the case with the original examples, they usually appear as simply traversed by four slightly curved vertical ridges. In free examples, however, the true characters and forms of the ridges are shown as in the above figures.

Size: Length, 0.77 mm.; height, 0.45 mm.; thickness of closed carapace, 0.43 mm.

Prof. T. Rupert Jones lately referred an incomplete valve of this species to his *Beyrichia buchiana*, adding an interrogation point.* He admits that his specimen is "not well preserved," but overlooked, what I am confident he will find to be a fact, that the posterior lobe or ridge is broken away. Adding this ridge the valve would be identical in every particular with ordinary specimens of *Bollia persulcata*. His example, when complete, must have been more elongate than my original figure of the species (*loc. cit.*), and this fact probably misled him. But that figure is incorrect in its proportions, the height being too great, causing the valve to appear semi-circular, when it is really sub-oblong.

* Quart. Jour. Geol. Soc., Vol. XLVI., p. 16, Feb., 1890.

BOLLIA PUMILA, n. sp.

Plate XII, Figs. 1*a*, 1*b*.

Valves oblong-subelliptical, the anterior end somewhat narrower than the posterior, and with the point of greatest extension near the antero-dorsal angle; from here the edge curves backward into the uniformly convex ventral portion; posterior end rounded, nearly vertical, forming an obtuse angle where it joins the dorsal margin; the latter is never quite straight, but protrudes more or less in the central third of its length. A narrow ridge runs nearly parallel with the free edges, the abruptness with which it rises above them varying slightly. The ends of the inner or horse-shoe shaped ridge characterizing the genus, are bulbous and project a little beyond the dorsal margin; the curved portion thin, generally a little oblique, and well separated from the marginal ridge.

Size: Length, 0.86 mm.; height, 0.52 mm.

This species is smaller than usual in this genus. Its chief peculiarity is the bulbous enlargement of the ends of the horse-shoe ridge. It is too clearly distinct from *B. persulcata*, Ulr., to require comparisons.

Position and locality: Upper beds of the Cincinnati Group, near Weisburg, Ind., and other localities in Indiana and Ohio where equivalent strata are exposed.

DEPRANELLA, n. gen.

Carapace small, averaging 2.5 mm. long by 1.5 mm. high; subelliptical in outline; dorsal border straight, terminating abruptly at each end; ventral border nearly straight or gently convex, rounding almost evenly into the ends.

Running nearly parallel with the posterior and ventral edges, a sharply-elevated sickle-shaped ridge, often produced spine-like beyond the postero-dorsal border. Dorsal slope with two or more strong tubercles or ridges. At the ventral edge the two valves meet equally.

Type, D. CRASSINODA, n. sp.

The nodes on the dorsal slope and the greater size of the species referred to this genus distinguishes them from *Jonesella*.

Of described species, I know of only one having the characters of *Depranella*. This is the *Beyrichia richardsoni*, S. A. Miller, occurring in the upper beds of the Cincinnati Group. It has two

dorsal nodes or short, vertical ridges, and the sickle-shaped marginal ridge, which I regard as characteristic of the genus. A variety of *D richardsoni*, differing from the typical form of the species mainly in the more regular character of the superficial reticulation of the test, occurs at Oakville, Ontario, in purple shales, referred by the Canadian geologists to the Hudson River Group. It might be called var. *canadensis*.

The species of this genus are either few and very variable, or they are numerous and distinguished by slight differences. According to the view adopted, the forms named *ampla*, *elongata*, *nitida*, and *macer* will be regarded either as distinct species or all as varieties of *D. crassinoda*. A moderate and perhaps the proper view would be to place *D. nitida* and *D. macer* as varieties of *D. crassinoda*, and *D. elongata* as a variety of *D. ampla*.

Another species occurs in the Trenton shales of Minnesota. In this the marginal ridge is developed only along the ventral border. It will be described shortly, with other *Ostracoda* from the Northwest, in a bulletin of the Minnesota Academy of Sciences.

DEPRANELLA CRASSINODA, n. sp.

Plate VIII, Figs. 1a, b, c.

Valves sub-elliptical, dorsal edge straight, one-fifth shorter than the greatest length of the valves. Ends equally convex, rounding gently into the less convex outline of the ventral margin. Posterior and ventral margins very thick, rising at once into the strongly elevated, narrow marginal ridge. Four nodes rise above the general level of the but little convex space included between the dorsal edge and the marginal ridge. Three of these are on the anterior half of the valve; one small one, situated near the antero-dorsal angle, projects slightly beyond the dorsal margin. A second, much larger and very prominent node or ridge, extends from the dorsal margin half the distance to the ventral or marginal ridge. It has two apices, one of them projecting dorsally over the margin. Between this and the ventral ridge is another, crescent-shaped and only moderately high, but sharply defined, that extends from near the middle of the valve in a course nearly parallel with the antero-ventral margin. The fourth node, situated within the posterior half of the valve, is, more properly speaking, a strong ridge,

crowned with three small eminences. This ridge extends from the hinge line a little more than half the height of the valve toward the postero-ventral border. Surface smooth.

Dimensions of a complete carapace of the ordinary size: Greatest length, 2.55 mm.; greatest height, 1.6 mm.; greatest thickness of body, 0.6 mm.; thickness from summit to summit of marginal ridges near postero-ventral angle, 1.0 mm.

This fine species is represented by a number of specimens obtained from the Birdseye limestone at High Bridge, Ky. The next described is probably only a more tumid variety, and occurs at the same locality, but is from beds 275 feet lower, supposed to represent the Chazy limestone of New York.

DEPRANELLA NITIDA, n. sp. or var.

Plate VIII, Figs. 3a, 3b.

This species or variety of *D. crassinoda* differs from the typical form of that species principally in the plumpness of the valves and the great reduction in prominence and size of the nodes and ridges. The valves are so much deeper that we are forced to believe that there was some corresponding difference in the animals they contained. It may be noticed further that the carapace is shorter and not so high, and that the ventral edge is straighter than in the form called *D. crassinoda*. A well-preserved example has the entire surface between the nodes covered with an irregular delicate reticulation.

Position and locality: Chazy limestone, bottom of Kentucky River gorge at High Bridge, Ky.

DEPRANELLA MACER, n. sp.

Plate VIII, Figs. 4a, b, c.

This is another form that should perhaps be regarded as only a variety of *D. crassinoda*. However, comparison of the figures will show at once that it marks a sufficiently striking departure from the typical form of that species to deserve description and naming. Its characters are briefly as follows: Valves subquadrate, about 2.0 mm. long and 1.25 mm. high, with the body very thin and shallow, the thickness of the entire carapace at a point near the

middle being only about 0.3 mm. Ventral margin straight or sinnate; ends subequal, the posterior a little the most curved; postero and antero-dorsal regions angular, the angles ten or fifteen degrees greater than a right angle. Ventral edge slightly thickened. Marginal or sickle-shaped ridge high, projecting beyond the dorsal edge, running parallel with and very close to the abrupt posterior margin; then curving more rapidly than does the outline of the valve into the ventral margin, it gradually increases its distance from the ventral edge, and in a slightly flexuous manner traverses the valve for almost its entire length, terminating at a point near the middle of the anterior margin. Postero-median ridge consisting of three prominently confluent nodes, the uppermost projecting considerably beyond the dorsal margin. Antero-median node large, prominent and of triangular form. Antero-dorsal node projecting prominently beyond the edge, but not as high, and only about half as large as the antero-median one.

Position and locality: Safford's "Glade" limestone near Lavergne, Tenn. These beds may represent the Birdseye of New York.

DEPRANELLA AMPLA, n. sp.

Plate VIII, Fig. 2.

Valves subelliptical, comparatively ventricose, 2.5 mm. long by 1.5 mm. high. Ventral and dorsal margins sub-parallel, the latter straight, forming an angle with the posterior margin and rounding into the anterior end, which in its turn rounds with a somewhat more gentle curve into the gently convex ventral margin. Antero and postero-ventral regions equally curved. Dorsal end of the sickle-shaped marginal ridge projecting beyond the margin. From here it runs nearly parallel with the posterior and ventral margins of the valve. Two strong nodes on the dorsal slopes. The anterior one is very prominent and pointed, and projects obliquely outward and dorsally beyond the edge. The posterior tubercle is a little smaller and not so high, but otherwise similar. Between them a slight depression. Surface smooth.

In being rather ventricose this species resembles *D. nitida*, but differs in having only two strong nodes where that form has six to eight small ones.

Position and locality: Chazy limestone, bottom of Kentucky River gorge, at High Bridge, Ky.

DEPRANELLA ELONGATA, n. var.

Plate VIII, Figs. 5a, b.

This form differs from typical *D. ampla* in its outline, the dorsal margin not being terminated by an angle at its posterior end, and the whole carapace being longer in its proportion to its height. The length is 2.75 mm.; the greatest height, 1.36 mm. The dorsal nodes are also much less prominent, being, in fact, almost obsolete. On the other hand, the depression between them is better defined. The sickle-shaped ridge is also situated farther within the edge of the valves, and not quite as much elevated.

Position and locality: Chazy limestone bottom of Kentucky River gorge at High Bridge, Ky.; associated with *D. ampla* and *D. nitida.*

JONESELLA, n. gen.

Carapace small, ovate, moderately convex. Valves equal, their outline and general aspect much as in *Primitia*, Jones and Holl, but differing in having a simple or more or less divided prominent ridge on the posterior two-thirds. This ridge may be variously modified, but usually is bent like a horse-shoe, or the anterior half is straight and runs lengthwise across the valve.

Type, J. CREPIDIFORMIS (*Leperditia crepiformis*, Ulrich, Jour. Cin. Soc. Nat. Hist., Vol. II, p. 10, Pl. VII, Fig. 3, 3 *a*, 1879).

The relations of this genus, which includes, so far as known, only Lower Silurian species, appear to be with *Bollia*, Jones and Hall, rather than with *Primitia* on the one hand and *Beyrichia* on the other. In *Bollia* the horse-shoe shaped ridge is centrally situated, while in *Jonesella* it occurs in the posterior half. In true species of *Bollia* there are also two vertical ridges running parallel with the ends of the valve. These are not represented in the new genus.

The generic name is given as a small compliment to Prof. T. Rupert Jones, of England. While paleontology is indebted to his careful and long-continued labors for the bulk of our present knowledge of fossil *Ostracoda*, I, personally, owe him much for kind advice and valuable suggestions.

JONESELLA CREPIDIFORMIS, Ulrich.

Plate VII, Figs. 8 *a, b, c.*

The illustrations on Plate VII. represent different views of a complete example obtained from washings of the lower shales of the Cincinnati Group made at Covington, Ky.

JONESELLA PEDIGERA, n. sp.

Plate VII, Figs. 9 *a, b.*

Carapace oblong, subquadrangular; ends rounded, usually subequal, but the anterior often a little the widest; dorsal edge straight, the extremities of same angular; ventral margin straightened in the middle, but curving neatly upward into the anterior and posterior edges. A very narrow flange all around. Surface of valves slightly flattened centrally, the slope being most abrupt near the margins. A faint depression is sometimes to be observed near the middle of the dorsal slope. The ridge is shaped like the head of a shepherd's crook, the bent portion being on the posterior half of the valve. It begins with a small, rounded knob a short distance in front of the center of the postero-dorsal fourth of the valve, then bending backward and downward proceeds toward the postero-ventral region, where with an abrupt curve it turns to proceed in nearly a straight line toward the center of the lower half of the anterior margin. The extremity of the ridge is often liberated, and projects as a blunt spine over the anterior slope.

Size of average specimen: Length, 1.05 mm.; height, 0.63 mm. Another valve, differing slightly in its outline, afforded the following measurements: Length, 1.15 mm.; height of anterior third, 0.65 mm.; height of posterior third, 0.73 mm.; length of hinge line, 0.8 mm.; thickness, 0.26.

The peculiar shape of the ridge in this species serves well in distinguishing it from all other *Ostracoda* known to me.

Position and locality: Rather rare in the lower shales of the Cincinnati Group, at Covington, Ky.

JONESELLA DIGITATA, n. sp.

Plate VII, Figs. 10*a, b, c.*

Carapace oblong, the length and height respectively as seven is to four; anterior half just appreciably wider than the posterior, or

with the dorsal and ventral margins sub-parallel. Dorsal edge straight and long, terminating abruptly, the antero-dorsal angle perhaps a little the most acute; ends uniformly and nearly equally convex; ventral edge very gently convex. Edges without a flange. Ridge large, peculiarly modified, digitate, and occupying nearly two-thirds of the surface of the valve. The posterior half is divided so as to appear like two fingers separated by a sulcus nearly as profound as the median one. The anterior half is wide and swollen on the outer side, while the ventral portion is thick and surmounted by a thin longitudinal crest.

Size: Length, 1.46 mm.; height, 0.82 mm.; thickness, 0.33 mm.

The outline of this species is not unlike that of *J. pedigera*, but the ridge in the two species is totally different. Indeed, some may be inclined to question that the two are congeneric, but I do not think such a doubt can prevail, since the next species is clearly intermediate in character.

Position and locality: I have seen only the example figured which I collected in Marion County, Ky., from the upper beds of the Cincinnati Group. The specimen is attached to a fragment of *Heterospongia*.

JONESELLA CRASSA, n. sp.

Plate VII, Figs. 11*a*, *b*, *c*.

Carapace oblong, widest posteriorly, slightly oblique, the anterior margin being most produced above the middle. Dorsal margin straight, the junction with the ends obtusely angular. Posterior edge uniformly convex, the ventral straightened in the middle. A well-developed flange around the free edges. Ridge loop- or horseshoe-shaped, oblique, very thick, the ventral portion overhanging the edge of the valve, the anterior arm very prominent below, bifurcating above, one division vertical and terminating knob-like on the dorsal border just in front of the center, while the other division soon becomes obsolete. The posterior arm, situated close to the margin of the valve, appears to consist of two parts toward its upper extremity, or as though one ridge was planted upon another, with the lower one extending almost to the dorsal margin.

Size: Length, 1.15 mm.; height, 0.72 mm.; thickness, 0.45 mm.

This well-marked species is intermediate in character between *J. crepidiformis* and *J. digitata*, the loop-like form of the ridge suggesting the former, while in the duplex character of the posterior arm it approaches the latter.

Position and locality: Trenton shales, Minneapolis, Minn.

PLACENTULA MARGINATA, n. sp.

Plate X, Figs. 13*a*, *b*, *c*.

Carapace small, vertically semi-ovate, very slightly oblique, with the dorsal margin nearly straight and about three-fourths as long as the valve. Cardinal extremities angular; ends of carapace subequal, curving neatly into the but little less convex ventral edge. A wide and sharply-defined flange forms the free margin; within this a thin, abruptly-elevated, wall-like ridge, nearly parallel with the outer edge. Body of valve with a faint, semi-circular elevation a little to one side of the center of the dorsal margin, enclosing the, in this species, undefined depression characterizing the genus. Around this elevation (beneath and on each side of it) the surface is slightly concave.

Size: Length, 0.52 mm.; height, 0.37 mm.

This and the succeeding species differ from the typical species of the genus in having the loop-like elevation or ridge and enclosed depression of the dorsal slope less developed. It is, however, scarcely to be doubted that they are true species of the genus.

The thin sub-marginal ridge and flat border of *P. marginata* are such distinctive features that the species is not likely to be confounded with any other known to me from the Cincinnati rocks.

Position and locality: Cincinnati Group; rare at Cincinnati, Ohio, where it occurs at the top of the hills.

PLACENTULA INORNATA, n. sp.

Plate X, Figs. 14*a*, *b*.

This species is in many respects like the preceding, but is longer, has the anterior end narrower than the posterior, and is without the thin sub-marginal ridge and flange. Instead, the mar-

ginal region is simply swollen and rounded off. The loop-like dorsal elevation also is situated a little farther forward.

Size: Length, 0.7 mm.; height, 0.4 mm.

Position and locality: Rare in the lower shales of the Cincinnati Group at Covington, Ky.

BEYRICHIA (? PRIMITIA) PARALLELA, Ulrich.

Plate X, Figs. 15a, b, c and d.

Primitia (? Beyrichia) parallela, Ulrich, Contr. to the Micro. Pal. of the Cambro-Silurian Rocks of Canada, Plate II, p. 51, 1889.

This species having been incorrectly illustrated in the work cited, and new and better specimens having been collected since from equivalent strata in Ohio and Indiana, new figures and remarks are now offered so as to complete the publication of the species.

Fig. 15*a* represents a nearly perfect left valve from near the top of the Cincinnati Group, at Richmond, Ind. It shows the strongly elevated posterior border,* less prominent and more rounded anterior margin, and a nearly distinct prominence in front of the sulcus that may well be regarded as representing the median lobe of *Beyrichia*. Hence the change in nomenclature proposed above.

The original specimens were from rocks equivalent to the upper beds of the Cincinnati Group. Others were obtained from shale washings at Oxford, Ohio.

EURYCHILINA, Ulrich, 1889.

This genus, together with two species, *E. reticulata*, the type of the genus, from the Trenton shales of Minnesota, and *E. manitobensis*, from rocks supposed to be equivalent to the upper beds of the Cincinnati Group, is described in "Contributions to the Micro-Paleontology of the Cambro-Silurian Rocks of Canada," Part II, p. 52. The generic description given there is as follows:

"Valves semicircular, sub-oval, or nearly circular. Dorsal line straight. Generally with a well-defined sub-central sulcus and a

* In the original work on this species the term "anterior" was applied to what I now regard as the "posterior" extremity.

more or less prominent node behind it. A very broad convex border extends around the valves from the antero-dorsal to the postero-dorsal angle. This border is often striated in a radial manner, and in most cases terminated by a marginal 'frill,' or by a plain narrow border, usually directed slightly outward. The main body of the border, however, curves inward to near the plane of contact between the two valves, thus forming a deeply concave outer area. Hingement simple. Surface reticulate, granulose or smooth."

Type, M. RETICULATA, n. sp. Trenton shales, Minnesota.

"This genus is related to *Primitia*, Jones and Holl, and to *Primitiopsis*, Jones. The possession of an internal concave marginal area separates it from the first, while the greater extension of the hollow area distinguishes it from the second. In *Primitiopsis* the marginal hollow is developed only at the anterior end."

EURYCHILINA SUBRADIATA, n. sp.

Plate IX, Figs. 1a, b, c, and 2a, b, c.

Valves semicircular, or elongate sub-elliptical in outline. Dorsal margin straight, nearly as long as the valves, terminating abruptly at both ends. Upper two-thirds of anterior margin straight, forming nearly a right angle with the dorsal edge, then curving gently into the slightly convex ventral edge. Posterior end evenly rounded. Body of valves semicircular, moderately convex, the point of greatest convexity along an obtuse ridge-like prominence (most distinct in the anterior half), running lengthwise across the central portion of the valve and from the summit of which the surface descends with a gently concave slope to the dorsal edge on one side and the beginning of the broad ventral border on the other. Sulcus deep and wide, beginning a little within the dorsal margin and extending half way across the body, its lower and posterior margins thickened and sharply defined. Just back of the sulcus a large round tubercle. Surface smooth. Marginal area wide, its width nearly equal all around, the widest portion in the postero-ventral region. In the antero-dorsal region it becomes separated from the body of the valve by the intervention of a narrow triangular depressed space. Inner edge of area abruptly elevated above the

body of the valve, then convex and marked with rather obscure radial furrows; with or without a narrow, flattened, terminal border.

Dimensions of a large right valve: Entire length, 2.25 mm.; greatest height (posterior half), 1.25 mm.; length of body of valve, 1.5 mm.; height of same, 0.9 mm.; average width of marginal area, 0.35 mm.; greatest width of same, 0.45 mm.; greatest convexity of single valve, 0.25 mm.

The absence of surface reticulation, pinched appearance of the central portion of the valves, stronger tubercle, wider sulcus and more abruptly elevated marginal area, together with other differences will readily enough distinguish the species from *E. reticulata.* The Manitoba species is more uniformly convex and has a narrower marginal area without radial striæ or furrows. In other respects it is closely related.

Position and locality: This species has a wide geographical distribution, but apparently is not abundant anywhere. I have specimens from Lower Trenton or Birdseye limestone at Lebanon, Tenn., Dixon, Ill., and Minneapolis, Minn.

EURYCHILINA LONGULA, n. sp.

Plate IX, Figs. 3 *a, b, and* 4.

Valves elongate, sub-elliptical, dorsal and ventral margins subparallel. Dorsal margin long, straight, the points of junction with the equally rounded ends not forming angles though quickly turning into them. Ventral margin gently convex. Body of valve semicircular or elongate subelliptical, moderately and nearly uniformly convex, with point of greatest convexity just below the well-defined and rather broad, but not deeply impressed mesial sulcus. Just back of the sulcus a broad and not very prominent tubercle. Surface smooth. Marginal area double and widest at the anterior end; at the ventral side its width is equal to fully one-fourth of the height of the entire valve. The folding of the area is characteristic. Beginning at the margin of the body it rises rapidly into a narrowly convex rim, from which it slopes down again only to be brought up once more by the development of a delicate "frill." Surface of marginal area without ornamentation of any kind.

Dimensions of a perfect but small right valve: Entire length,

2.2 mm.; greatest height, 1.1 mm.; length of body of valve, 1.5 mm.; height of same, 0.8 mm.; convexity of same, 0.25 mm.; width of marginal area at anterior extremity, 0.4 mm.; width of same at ventral and postero-ventral margins, 0.3 mm.

This species is more elongate than any of the others. The ogee molding of the marginal area also serves to distinguish it.

Position and locality: Birdseye limestone, at High Bridge, Ky.; and "Glade limestone," of Central Tennessee.

EURYCHILINA GRANOSA, n. sp.

Plate IX, Figs. 9, 10, 11 *and* 12.

Valves elongate-subelliptical; about 1.7 mm. long by 1.15 mm. high. Dorsal margin straight, often appearing a little convex, forming nearly a right angle with the anterior margin. This curves neatly into the convex ventral edge, and from there up again into the more rounded posterior end; scarcely forming an angle where the latter joins the dorsal margin. Body of valve strongly convex, with a rather narrow and deeply impressed mesial sulcus, and just behind it a prominent round tubercle. Central portion of surface with small yet quite distinct granules. Marginal area separated from body of valve by a sharply impressed line, convex, strongly bent in, typically smooth, and terminated by a narrow flange which in young examples is represented by a closely arranged row of small spines. Width of area greatest along the ventral border, where it is about 0.3 mm., becoming gradually narrower toward the dorsal angles, where it is less than half that width.

A variety, represented by figure 11, differs in having a more elongate form, stronger tubercle, and the marginal area covered with fine, interrupted concentric striæ. The marginal flange is also absent. It is associated with the more typical examples.

The tubercle, granulose surface, and narrower marginal area distinguish this species from *E. æqualis*. It is shorter, the tubercle stronger, and the marginal area differently curved than in *E. longula*.

Position and locality: Chazy limestone, bottom of gorge of Kentucky River, at High Bridge, Ky.

EURYCHILINA ÆQUALIS, n. sp.

Plate IX, Figs. 5, 6, 7 *and* 8.

Valves subelliptical to subcircular, equilateral; an average specimen 1.54 mm. long, and 1.15 mm. high. Body of valve strongly and uniformly convex, sub-elliptical in outline, 1.18 mm. long, 0.82 mm. high, and 0.3 mm. thick (*i. e.*, one valve only). Sulcus central, narrow, not very deep, nor extending to the dorsal margin. Marginal area strongly convex, widest at the ventral side, where it averages about 0.3 mm., becoming narrower gradually as it passes around the ends to the extremities of the dorsal line. No flange or frill is developed to interrupt its uniform convexity. Entire surface smooth.

The width of the ventral portion of the marginal area varies considerably in different individuals of this species. The extremes in this respect so far noticed are represented by the figures.

Compared with other species *E. granosa* probably offers the greatest resemblance. The absence of granulations, also of a node, and the less marked mesial sulcus, and more nearly circular form of *E. æqualis*, serve amply in discriminating between the two species. *E. subæquata*, a new species from Minnesota, has a granulose surface, a flat marginal area, and is slightly more elongate.

Position and locality: Chazy and Birdseye limestone, at High Bridge, Ky. Also at Lebanon, Tenn., where it occurs in the "Glade" limestone.

EURYCHILINA OBESA, n. sp.

Plate IX, Fig. 13.

Valves subquadrate, equilateral, strongly convex, about 1.5 mm. long and 1.0 mm. high. Dorsal margin straight, nearly as long as the entire carapace. Upper halves of anterior and posterior margins nearly straight, the angle of junction with the dorsal edge about 100°; below curving uniformly into the more gently convex ventral edge. Body of valve tumid, the entire surface granulose, with only an obscure, broad depression to indicate the usual median sulcus. Marginal area of nearly equal width all around, rather narrow, being only about 0.15 mm. wide. It is covered with closely arranged radial rows of very minute granules.

E. subæquata is more elongate, has a well-defined mesial sulcus, and coarser surface granulations. *E. striatomarginata*, Miller sp., is not so tumid, has a mesial sulcus and no surface granulation.

Position and locality: Birdseye limestone, High Bridge, Ky.

EURYCHILINA STRIATOMARGINATA, S. A. Miller.

Plate IX, Fig. 14.

Beyrichia striatomarginata, S. A. Miller, Cin'ti Quart. Jour. Sci., Vol. I, p. 233, 1874.

Mr. Miller's figure of this species being unsatisfactory, another one is here offered. Mr. Miller states that he found his specimens "in the upper fifty feet of the Cincinnati Group, * * * about three miles south of Osgood, Ind." My specimens are associated with *Leperditia cæcigena*, S. A. Miller, at the same horizon, several miles north of Madison, Ind.

PRIMITIA CENTRALIS, n. sp.

Plate X, Figs. 1 *and* 2*a*, *b*, *c*.

Carapace sub-oblong, the dorsal edge straight, the ventral elliptically curved, the anterior end somewhat narrower and more sharply curved, both ends meeting the dorsal edge without forming distinct angles; free borders with a narrow flange, best developed along the posterior edge. Sulcus represented by a sub-central depression, not reaching the dorsal margin. Surface smooth.

Size:— { Length, 0.6 mm.; height, 0.35 mm.
" 0.75 " " 0.48 "

This form is perhaps to be regarded as a variety of *P. humilis*, Jones and Holl, described from the Wenlock of England, but the slightly different outline, less abrupt posterior slope, more central and less deeply impressed sulcus, and more defined flange in the Cincinnati form are distinctions deserving recognition. Fig. 1 represents a larger variety in which the posterior half is considerably the widest, and the sulcus is situated nearer the dorsal margin. It might be separated, but, as many intermediate phases occur, it has not been deemed advisable to do so.

Position and locality: Not uncommon in the Utica shales near

low water mark in the Ohio River, in the vicinity of Cincinnati, O. The larger form (fig. 1) appears to be restricted to this horizon, but specimens like fig. *2a* occur, rather rare, it is true, in the limestone three hundred feet higher.

PRIMITIA PERMINIMA, n. sp.

Plate VII, Fig. 7.

A minute, short or broad-ovate *Primitia*, having the dorsal edge straight; the anterior end more narrowly rounded than the posterior, the ventral edge rather strongly curved, and the sulcus represented by a well-marked sub-central impression.

Size: Length, 0 34 mm; height, 0.25 mm.

This species is in the main very much like the preceding, with which it is also associated, but being always much smaller and shorter, is readily distinguished. It should also be compared with *P. simplex*, Jones.

Position and locality: Occurs with *P. centralis* in the shales and shaly limestones of the Utica horizon at the mouth of the Licking River, Covington, Ky.

PRIMITIA IMPRESSA, n. sp.

Plate X, Fig. 3*a*, 3*b*, 3*c*, 4*a*, 4*b and* 4*c*.

A small, ovate species, rather tumid, with the dorsal and ventral margins nearly equally convex, and the ends equal, or the anterior slightly the widest. The free margins usually with an indistinct flange. Sulcus situated centrally, or a little in front of the middle, unusually deep, extending from the dorsal edge nearly half the distance across the valve, terminating abruptly. Just behind the sulcus a more or less faint swelling.

Size: Length, 0.6 mm.; height, 0.36 mm.

The valves of this species are more convex than those of *P. fabulina*, Jones and Holl, and *P. humilis*, Jones and Holl, to both of which it is closely related. Both of those species differ further in having the posterior end wider, and the point of greatest convexity further removed from the dorsal edge. There is no species known to me from American rocks resembling this sufficiently to make comparison necessary.

Position and locality: This species has till now been collected only at Savannah, Ill., in beds equivalent to the middle or upper portion of the Cincinnati Group. The specimens are associated with numerous minute bryozoa, of which *Trematopora (?) nitida*, Ulrich, and *Sceptropora facula*, Ulrich, are the most noteworthy.

PRIMITIA CINCINNATIENSIS, S. A. Miller.

Plate X, Figs. 5a, 5b, 6a, 6b and 6c.

Beyrichia cincinnatiensis, S. A. Miller, Cin. Quart. Jour. Sci., Vol. II, p. 350.

The original description and figure of this species are too indefinite for its identification, and, furthermore, since the species is interesting in this, that in some of its varieties a departure from *Primitia* toward *Klœdenia* and *Beyrichia* is indicated, it has appeared desirable to illustrate its peculiarities.

Fig. *6a* represents the right valve of an average example, in which the flange is pronounced, the ends sub-equal, the sulcus deep, and the tumid regions on each side of it almost equal.

A left valve of a larger example, fig. *5a*, shows some marked differences. The flange is narrow, and the tumid region in front of the strong sulcus has become separated to such an extent as to suggest the median tubercle of *Klœdenia* and *Beyrichia*. Of course, this departure from the typical form is very rare.

Size:—
Length, 0 6 mm.; height, 0.38 mm.
" 0.7 " " 0.44 "
" 0.82 " " 0.51 "

Position and locality: Upper half of the Cincinnati Group. Mr. Miller collected his specimens near Weisburg, nearly three hundred feet below the Upper Silurian, while mine were collected at Clarksville, Ohio, in shales at least one hundred feet higher.

PRIMITIA MEDIALIS, n. sp.

Plate X, Figs. 7a and 7b.

Carapace oblong, most convex in the ventral and posterior regions; dorsal margin straight, but not terminating sharply at the ends; ventral outline evenly convex, rounding gently into the ends, of which the posterior is the most blunt. Dorsal slope

slightly depressed. Sulcus central, including a thin, sharply-defined mesial ridge. Surface smooth.

Size : Length, 1.14 mm.; height, 0.58 mm.

The thin mesial ridge is a peculiar feature. In other respects the species might be compared with *P. humilis* and *paucipunctata*, J. and H.

Position and locality : Upper beds of the Cincinnati Group, Jefferson County, Ky. The specimen illustrated is the only one seen.

PRIMITIA MILLERI, n. sp.

Plate XII, Figs. 2a, 2b, 2c.

Valves broad-ovate, the length and height respectively as two is to three. Ends subequal, the anterior sometimes slightly the narrowest. Free edges with an unusually narrow rim. Dorsal margin straight but short. Sulcus narrow, well impressed, not extending much over one-fourth of the height of a valve from the dorsal margin; bending forward at its lower extremity. Surface rising higher and more abruptly on the posterior side of the sulcus than on the anterior. Point of greatest convexity very near the center of the posterior half.

Surface very finely reticulate, the meshes regular, mostly hexagonal, with a tendency to an arrangement in concentric lines observable.

Size : Length, 1.08 mm.; height, 0.76 mm.

Primitia bivertex, Ulrich, and its varieties, some of which resemble this species, have a more or less well-developed node on each side of the sulcus, and their shells are smooth. The valves of the new species, so long as they are in a good state of preservation, are not likely to be confounded with any other known to me.

The specific name is given for Mr. S. A. Miller, the author of the well-known work "North American Geology and Palæontology." He kindly loaned me the original examples of his *Primitia cincinnatiensis*, and in looking over the slabs for that form several valves of this species were also found. My own specimens are from Clarksville and Blanchester, O., from shales between two and three hundred feet below the top of the Cincinnati Group.

PRIMITIA GLABRA, n. sp.

Plate X, Figs. 9a, 9b and 9c.

Carapace comparatively large, moderately convex, the point of greatest convexity about the center of the posterior half. Hinge edge straight; anterior end semi-circular; posterior end somewhat oblique, very gently curved in the lower half, more abruptly in the upper; ventral edge gently convex; free margins with a moderate flange, widest at the ventral and posterior margins. Mesial sulcus represented by a broad, illy-defined and very shallow depression in the dorsal slope. Surface smooth.

Size: Length, 1.9 mm.; height, 1.17 mm.; greatest convexity of single valve, 0.45 mm.

This fine species belongs to a group of forms that approach *Isochilina*, the characteristic median sulcus of *Primitia* being almost obsolete. *P. valida*, J. and H., from the Wenlock of England, is another member of this group, and appears to be closely related to *P. glabra*, but differs in having a punctate shell, centrally restricted mesial depression, and the point of greatest convexity nearer the ventral edge. Of American species the Chazy group *P. logani*, Jones, may be compared. The dorsal notch in that species is, however, deeper, the shape of the carapace slightly different and the shell usually punctate. The outline of the anterior half in a ventral view, also shows the anterior slope to be more abrupt.

Position and locality: Upper beds of the Cincinnati Group, at Oxford and Blanchester, O. The species seems to be rare.

PRIMITIA NODOSA, n. sp.

Plate X, Figs. 11a, 11b, 12a and 12b.

This is a very neatly punctate species, having a straight dorsal margin, sub-equal ends, and nearly uniformly rounded ventral edge, with a distinct flange all around the free margins. There is no true sulcus; but the interval between two strong, rounded nodes situated one on each side of the center of the dorsal edge and projecting slightly beyond it, may represent the generic notch or sulcus. The anterior one of these knobs is the larger. A third node, smaller than either of those at the dorsal margin, occurs near the posterior edge, while a fourth rather inconspicuous eleva-

tion is found in the typical form of the species near the ventral border just beneath the postero-dorsal node.

In the slightly shorter variety, fig. 12*a*, the fourth elevation is missing, and the two dorsal knobs are less unequal in size.

Size— { Typical form: Length, 0.55 mm.; height, 0.34 mm.
{ The variety: " 0.48 " " 0.32 "

This species belongs to a group of species that ought perhaps to be distinguished generically from *Primitia*. All have two or more nodes, and are without a true sulcus. Of these species, *P. morgani*, Jones, is probably more closely related to *P. nodosa* than any of the others (*P. bicornis*, J., *P. æqualis*, *diversa*, *cornuta*, J. and H., etc.), but differs like the rest in wanting the third and fourth nodes, and also in being without a distinct flange.

Position and locality: The typical form occurs in the lower shales of the Cincinnati Group, in the vicinity of Cincinnati, O., from seventy-five to one hundred and fifty feet above low water mark in the Ohio River. The variety is rare, and was found only at one locality near the tops of the hills north of the city.

PRIMITIA NITIDA, n. sp.

Plate VIII, Fig. 7.

Carapace leperditoid in shape, the posterior half being much the widest and most prominent in the lower portion, the hinge line straight and terminating abruptly at each end, the ventral edge oblique and most curved in the posterior half. A well developed flange surrounds the free margins. Sulcus very shallow, situated on the dorsal slope, but not reaching the margin. A similar but even more faint impression beneath it. Surface finely pitted, most convex in the posterior half, slightly flattened centrally, and sloping gently toward the anterior end.

Size: Length, 1.05 mm.; height, 0.68 mm.

The pitted surface and narrower anterior end distinguishes this species from *P. centralis* of this paper. The English Wenlock species *P. valida*, J. and H., also has a pitted surface, but differs greatly in outline, the two extremities being almost equal.

Position and locality: The specimens are contained in a dark fragment of limestone which was used for ballast by the Kentucky Central Railroad. As near as I can learn, the material was derived from Upper Trenton strata near Paris, Ky.

PRIMITIA RUDIS, n. sp.

Plate X, Figs. 8a, 8b and 8c.

Carapace oblong, subelliptical, the two extremities nearly equal and most convex in the lower half; dorsal edge slightly convex; ventral margin gently rounded, almost straight in the middle third, with an indistinct flange. Sulcus rather wide, well impressed, but more sharply defined on the anterior side than on the posterior, extending from the dorsal border obliquely forward to the center of the valve. In front of the sulcus and between it and the dorsal margin, a faintly defined tubercle or lobe. Posterior half the most convex, the slope to the edge from point of greatest convexity, somewhat flattened. An undefined depression in the postero-cardinal region.

Size: Length, 1.0 mm.; height, 0.5 mm.

There is a rough and unshapely form and not a true species of *Primitia*. Its affinities seem to lie between *P. cincinnatiensis*, S. A. M., and *Beyrichia* (*? Primitia*) *parallela*, Ulr., in which case it would represent another link in the chain connecting *Primitia* and *Beyrichia*.

Position and locality: Rare at Covington, Ky., where it was collected from the shales of the lower one hundred feet of the Cincinnati Group.

PRIMITIA (?) SCULPTILIS, n. sp.

Plate VIII, Fig. 6.

Valves broad-oval or leperditoid in shape, the anterior end, though neatly rounded, much narrower than the posterior; in the latter half, from a point at about the center of the ventral edge to the subangular posterior extremity of the hinge line, the margin forms a semi-circular curve. In the anterior half the ventral border is less convex and slopes upward. Hinge line straight, the length equaling two-thirds the length of the valve, with the extremities obtusely angular. A depressed border, widest along the anterior and dorsal edges and very narrow at the ventral margin, encloses the elevated and coarsely pitted or sculptured main body of the valve. This is divided into two unequal lobes by a large sulcus, that is narrow and deepest above, but becomes shallow and much wider below the center.

Size: Length, 1.2 mm.; height, 0.84 mm.

Species of this and the *P. seminulum*, Jones, type, I can not regard as really belonging to *Primitia*, but I am not yet prepared to suggest a more fitting disposal of them.

Position and locality: Occurs in the dark Upper Trenton limestone at Perryville, Boyle County, Ky.

APARCHITES OBLONGUS, n. sp.

Plate X, Figs. 10*a*, *b*, *c*.

Carapace oblong, tumid, inequivalved, of irregular shape, widest posteriorly. Dorsal edge straight or faintly concave, rounding at the extremities. Anterior end semi-circular; the posterior most curved and prominent in the upper half, and much less curved and trending forward in the lower portion; ventral edge produced in the posterior half, straightened from there on anteriorly. Edges of valves irregularly thickened, apparently not overlapping. Surface smooth, glossy, most convex in the posterior half, the point of greatest convexity in the left valve being above the center, while in the right it is below it. The right valve is also much the most tumid in the ventral region.

Size: Length, 1.21 mm.; height, 0.8 mm.; greatest convexity, 0.78 mm.

The irregular, oblong shape of this species distinguishes it from all others known to belong to this genus. In *A. whiteavesi*, Jones, from the Lower Silurian of Manitoba, the edges are similarly thickened and fluted, but in other respects the two species are quite distinct, that one being almost sub-globular in shape.

Position and locality: Cincinnati Group, upper beds, at Middletown, Ohio. The species seems to be rare.

(*To be continued.*)

NEW AND LITTLE KNOWN AMERICAN PALEOZOIC OSTRACODA.

By E. O. Ulrich.

(Concluded from Page 137.)

LEPERDITIA FABULITES, Conrad.

Plate XI, Figs. 1 a—1 d, and 2.

Cytherina fabulites, Conrad, Proc. Acad. Nat. Sci. Phil., 1843, p. 332.

This much quoted and yet so illy known species, has been a source of much trouble to specialists in this class of fossils. My endeavors to collect a full series of specimens from localities in Wisconsin, Minnesota, Illinois, Kentucky and Tennessee, have been fairly successful, so that I am now able to point out and illustrate the really characteristic features of the species.

Plate XI, figs. 1*a*, *b*, *c* and *d*, represent four views (natural size) of a perfect example from near Beloit, Wis. The specimens from the northwestern localities are usually about one-third larger than those from Kentucky and Tennessee, but in all other respects they are practically identical. The shape, aside from peculiarities due to distortion, is very constant, the outer surface smooth or very faintly pitted under the glass. When in good condition, the outer surface exhibits not even a trace of the anterior tubercle and muscle spot which are such common features in this genus, but only a little weathering is required to disclose the suboval reticulated spot. The reticulation is in relief, from which it appears that the spaces enclosed by the meshes are composed of material giving way to the action of the weather with disproportionate rapidity. On the inner side, however, both the tubercle and muscle spot are clearly distinguishable, the former being represented here by a small but well-marked depression. (See fig. 2.) The muscle spot is surrounded by fine reticulating radial lines, short dorsally, longest postero-ventrally.

Perhaps the most characteristic feature of the species is found in the small papillæ which occur on the inner side of the ventral mar-

gin of the right valve, four in the posterior third, and three or four in the anterior third. On the outer side of the test these are generally represented by an equal number of small pits. The purpose of these two sets of papillæ seems to have been to prevent undue overlapping of the valves, by presenting an obstacle to the entering ventral edge of the left valve.

Such pits at the ventral edge of the right or overlapping valve, (and I think we may safely assume that they always represent internal papillæ,) are known to me in at least three other species, *L. linneyi* and *L. tumidula*, the two next described, and *L. bivia*, White.* In the first of these there are two in the anterior half and one or two in the posterior, but in the other two species only one occurs on each side.

It is possible that the Canadian species *L. josephana*, Jones, is the same as *L. fabulites*, but as that species often, if not always, exhibits an anterior tubercle on the *outer* side of the carapace, and since no pits nor papillæ have as yet been detected on the ventral margin, it is reasonable to suppose that Prof. Jones' species may prove distinct.

Position and locality: In Tennessee the species is very abundant in Safford's "Glade limestone" at Lebanon, Lavergne and other localities. This limestone I regard as equivalent to the Birdseye of New York. The species occurs also in the "Central limestone" near Murfreesboro. In Kentucky, silicified valves are sometimes very abundant near the top of the Birdseye at High Bridge. At Dixon, Ill., Beloit, Wis., Minneapolis, Minn., and other localities in the northwest, the species is a characteristic fossil of the lower portion of the series of limestones resting on the St. Peters sandstone. This horizon I regard as equivalent to the "Glade" of Tennessee, and the Birdseye of Kentucky and New York.

LEPERDITIA LINNEYI, n. sp.

Plate XI, Figs. 3 a—3e.

Size: { Right valve: Length, 10.45 mm.; height, 6.9 mm.; thickness, 2.25 mm.
Left " " 8.55 " " 5.7 " " 2.5 "
" " " 7.8 " " 4.95 " " 1.8 "

Carapace of medium size, oblique, produced and widest posteriorly; ventral edge rather strongly arched, rounding neatly into the anterior margin. Cardinal line straight, both the extremities

*The two supposed perforations at the ventral edge of the same valve of the Russian *L. grandis*, Schrenk, are doubtlessly of the same nature.

produced into sharp points. A small tubercle in the antero-dorsal region; between it and the center of each valve a large ovate spot is distinguishable in most specimens. The lower half of this spot marks the point of greatest convexity of each valve. The two ends with a well-defined flange. Right valve with the ventral edge thick and abruptly bent inward; two rather widely separated small pits situated close to the antero-ventral edge; one or two of these pits also behind the ventral overlap. Left valve more convex than the right, and less abruptly deflected at the ventral edge; a well-marked thickening along the posterior half of the dorsal margin. In both valves, but in the left especially, the slope from the point of greatest convexity toward the margins is somewhat flattened. Surface impunctate, polished; color dark brown.

The thickening along the posterior half of the dorsal edge of the left valve, allies this species to a group consisting of *L. gibbera*, and *scalaris*, Jones, *L. tyraica*, Schmidt, and one or two others. The *L. appressa* of this paper likewise belongs to this group, as may *L. tumidula* also. *L. linneyi* differs from the three first named in the outline, and in having the surface of the valves less uniformly convex.

Named for the late W. M. Linney, who was the first to bring the species to my notice.

Position and locality: Not uncommon in heavy bedded gray limestone belonging to the uppermost division of the Trenton limestone, near Harrodsburg, Perryville, Danville, Frankfort and other localities in central Kentucky. The horizon is above the *Brachiospongia* bed.

LEPERDITIA TUMIDULA, n. sp.

Plate XI, Figs. 4 *a, b, c.*

Size: { Length, 9.0 mm.; length of hinge line, 6.5 mm.; height, 6.0 mm.; thickness (a right valve), 2.3 mm.

Carapace of medium size, obliquely subovate, widest and moderately produced posteriorly; ventral curve strong, most pronounced in the posterior half; dorsal margin comparatively long, straight; the extremities simply angular, not produced beyond the curve of the ends. Ventral edge of right valve very thick, flattened, abruptly curved inward, the overlapping portion produced lip-like beyond the line of contact between the ends of the valves; one small pit on each side. Flange moderate. Valve tumid in the

ventral half, with point of greatest convexity very near the center; surface sloping rapidly from this point to the ends; cardinal slope flattened, triangular. Tubercle small, but distinct. Left valve represented by only one small individual. In this the surface is moderately convex and a little the most convex in the lower half. A faint swelling is noticeable along the posterior half of the dorsal edge. Surface smooth, apparently impunctate; specimens silicified.

This species differs from the preceding in a being a little less oblique, in having the ventral region of the right valve more tumid, the extremities of the hinge line simply angular instead of produced spine-like, and in having only one pit on each side of the ventral overlap. The triangular shape and flattened appearance of the cardinal slope is also diagnostic. *L. bivia*, White, is closely related, but differs in the outline.

Position and locality: Siliceous limestones occurring near the top of the Trenton, at Danville, Ky. The species is rather rare, only six examples having been found.

LEPERDITIA APPRESSA, n. sp.

Plate XI, Figs. 5 *a, b, c, d.*

This species is closely related to the two preceding, and as its characters are shown very well in the illustrations, a detailed description is scarcely necessary. It differs from both *L. linneyi* and *L. tumidula* in being considerably shorter, rounder, less oblique, and much less tumid. There is a well-defined swelling along the dorsal edge as in *L. linneyi.* The flange, though all the examples seen are larger, is narrower than in either of those species.

Size: { Left valve; length, 13.8 mm.; height, 9.8 mm.; thickness, 2.5 mm.
" " " 11.8 " " 7.8 " " 2.0 "

Position and locality: Near top of Trenton limestone, at Danville and Harrodsburg, Ky.

LEPERDITIA CÆCIGENA, S. A. Miller.

Plate XI, Figs. 6 *a, b, c, d.*

Leperditia cæcigena, S. A. Miller, Jour. Cin. Soc. Nat. Hist., Vol. IV, p. 262, pl. VI, figs. 5, 5*a*.

The original illustrations of this species being rather unsatisfactory, I take this opportunity to offer more reliable figures of two

examples having the typical shape. Figs. 6*b*, *c*, *d*, represent three views of a complete carapace of the average size. As usual this specimen shows not even a trace of either the eye tubercle or muscle spot. It shows clearly that the right valve overlaps the left all around the free margins, and that there is no flange at the margin of the left valve, and only a very inconspicuous one at the ends of the right. Fig. 6*a* is the largest right valve seen. In this a very faint tubercle may be noticed.

This species is restricted to the uppermost layers of the Cincinnati group, and is exceedingly abundant at several localities. The best specimens seen I collected in Indian Kentuck creek, seven miles above Madison, Ind.

Variety FRANKFORTENSIS, n. var.

Under this name I propose to distinguish a form that is abundant in the gastropoda bed at the top of the Trenton at Reservoir Hill, Frankfort, and other localities in central Kentucky. In size and general appearance the variety is identical with the typical Indiana examples of *L. cæcigena*, but slight differences in the shape and in other respects, but more especially the fact that the form will be found of use in identifying this important horizon, induce me to distinguish it as above. A careful comparison with the typical form of the species (see Pl. XI, figs. 6*a*–6*d*) shows that the variety has the dorsal angles sharper, an appreciably flattened border or flange at the ends of *both* valves, and the ventral edge a trifle more convex. The eye tubercle, and not infrequently the reticulated spot as well, is, though always very small, generally distinguishable. The outline is intermediate between figs. 5*a* and 6*a* of plate XI.

ISOCHILINA SUBNODOSA, n. sp.

Plate XI, Figs. 7 *a*, *b*, *c*.

Size: Length, 8.0 mm.; height, 4.7 mm; thickness (left valve only), 1.7 mm. A very large but imperfect right valve has a length of 13.5 mm.

Carapace oblong, subelliptical; ends subequal, rather narrowly rounded, most prominent about in the middle of the height. Dorsal margin straight, at least two-thirds as long as greatest length of valve; extremities sub-angular. Flattened border very wide but not sharply defined at the posterior end, about half as wide

and much better defined at the anterior end; very narrow at the ventral edge. Valves rather tumid at and below the center; anterior and ventral slopes abrupt, the posterior slope more gentle. Central portion of dorsal slope a little depressed, with a broad and low swelling on each side. The latter with a small tubercle near the center of the dorsal edge and a pair of similar ones situated near the antero-dorsal angle, have suggested the name *subnodosa*. Surface finely pitted.

This species is more elongate, has a wider, though illy defined, flattened posterior border, and more uneven surface than any other species of the genus known to me.

Position and locality: Upper Trenton limestone, associated with *Leperditia linneyi*, at Perryville, Ky.

ISOCHILINA SAFFORDI, n. sp.

Plate XI, Figs. 10 *a, b, c, d.*

Size: { Small right valve; length, 5.0 mm.; height, 3.2 mm.
{ Large left valve; " 16.2 " " 9.6 " thickness, 4.0 mm.

Carapace large, oblong, elliptical, with the ends subequal, semi-circular; dorsal margin straight or slightly convex, curving neatly into the posterior edge, but anteriorly terminating with a short spine-like prolongation. Flange sharply defined, wide at the ends (the most so at the posterior) and very narrow at the ventral side. Body of valve with point of greatest convexity in front of and somewhat beneath the center; from here the slope of the surface is flattened to the beginning of the flange where the descent is rather abrupt. Muscle spot distinguishable, situated just above the point of greatest convexity. Eye tubercle distinct. Surface with faint reticulating granulose lines.

This species is related more or less closely to a number of forms —chiefly European; but is distinguished by the peculiar surface ornamentation, the rounded character of the postero-dorsal edge, and other less obvious features.

The specific name is given as a small compliment to Prof. J. M. Safford, the State geologist of Tennessee, who, in his work on the geology of that State, did not overlook even this so generally neglected class of fossils.

Position and locality: Upper Trenton limestone, Nashville, Tenn. The specimens are a glossy black, and occur in a compact, dark gray limestone.

ISOCHILINA AMPLA, n. sp.

Plate XI, Figs. 8 *a, b, c, d.*

Size: { Length, 17.8 mm.; height, 13.0 mm.; thickness of one valve, 6.0 mm.
" 21.4 " " 17.0 "

Carapace large, oblique, widest posteriorly, unusually high, and strongly convex, with point of greatest convexity very near the center. Dorsal edge straight, long, obtusely angular behind, pointed in front. Flange distinct, narrow in front, wanting at the ventral edge, and of moderate width behind. Ventral region tumid, descending abruptly to the edge. Dorsal slope very abrupt. Eye tubercle distinct but rather small. Just behind it a slight depression, and beneath the latter the oval reticulated spot. (Not shown in fig. 8*a*.) Surface polished, apparently without punctæ or ornament of any kind. Internal characters as shown in fig. 8*d*.

This fine species is larger, higher and fuller than any other so far known from American rocks. *I. jonesi*, Wetherby, which is perhaps more nearly related than any of the others, differs principally in being less high, and in the outline of the ventral edge.

Position and locality: Upper beds of the Trenton limestone at Nashville, Tenn.

ISOCHILINA JONESI, Wetherby.

Plate XI, Figs. 9 *a, b, c.*

Isochilina jonesi, Wetherby, Jour. Cin. Soc. Nat. Hist., Vol. IV, p. 80, 1881.

This species, of which the above cited illustrations represent the largest example seen, is very abundant in the massive gray limestone forming the top of the Trenton near Harrodsburg, Ky. The same bed contains *Leperditia linneyi*, *L. appressa*, and other Ostracoda. The specimen figured is perhaps a very little higher than usual, but the difference is so small that we may with propriety regard it as a typical example of the species.

ISOCHILINA KENTUCKYENSIS, n. sp.

Plate XI, Figs. 11 *a, b, c, d.*

Compare *Leperditia* (*Isochilina*) *armata*, Walcott, 35th Rep. N. Y. St. Mus. Nat. Hist., p. 213, 1883.

Size of left valve: Length, 4.9 mm.; height, 2.66 mm.; thickness, 0.83 mm.

The outline of the specimens for which the above name is proposed agrees very nearly with that of *I. armata*, Walcott, the chief differences being that in that species *both* extremities of the long hinge-line are produced into short spines, while in this only the anterior end is prolonged; in Walcott's species the ventral margin is less convex and therefore more nearly parallel with the back, and the two ends more narrowly rounded in the lower half. The eye tubercle in *I. Kentuckyensis* is smaller and farther removed from the antero-dorsal angle, while the ventral tubercle or spine is much smaller, directed backward, and does not project beyond the ventral edge. The valves are also less and more evenly convex, there being no pronounced swelling above the spine. A row of minute pits along the ventral edge, and a narrow flange all around the free margins, two features not noticed in *I. armata*, aid in separating the species.

I. Kentuckyensis should be compared also with Kalmodin's *Leperditia tuberculata*, Œfvers, K. Vet.-Akad. Förh. (1879) 1880, which also has a sharp ventral spine.

Position and locality: In the Birdseye limestone, upper beds, at several localities in Mercer county, Ky., and at Frankfort, Ky.

ISOCHILINA AMIANA, n. sp.

Plate XI, Figs. 12 *a*, *b*, *c*.

Size of rather large right valve: Length, 5.1 mm.; height, 3.0 mm.; thickness, 1.13 mm.

Valves rather small, obliquely ovate, produced and widest posteriorly; ventral edge moderately convex, rounding neatly into the anterior margin; back straight, rather short, obtusely angular at the extremities. Posterior edge most curved in the lower half. Antero-dorsal region generally somewhat elevated, with a V-shaped or illy defined depression just behind the elevation. In a few specimens two faintly marked tubercles on each side of the depression add much to its definition. In others over half of the dorsal slope back of the anterior swelling may appear depressed. Central portion of valves strongly convex. Flange narrow, smooth, usually of nearly uniform width and extending all around the free margins; rarely obsolete at the anterior end. Surface impunctate, occasionally exhibiting a few obscure radiating lines over the central portion of the valves.

Variety INSIGNIS, n. var.

Plate XI, Fig. 13.

Associated with hundreds of the typical form of this species, as described above, I find two specimens differing from the usual forms in one respect only. Namely, in having a transverse ridge or crest-like elevation a little in front of the center of the valves. This feature causes the variety to resemble *I. cristata*, Whitfield sp., but the shape of the valves of that species is different, they being shorter with the posterior margin more oblique.

I. ottawa, Jones, has the ends more equal, the extremities of the hinge distinctly angular, and is without the depression in the dorsal slope. *I. gracilis*, Jones, likewise has the dorsal angles sharper, and the posterior end more truncate. Both of these species have a row of minute pits along the ventral edge, a feature not noticed in *I. amiana.**

Position and locality: This species is very abundant on the bed-planes of an erratic block of limestone, found by Mr. H. M. Ami, of the Geological survey of Canada, in Sussex street, Ottawa, and supposed to belong to an upper member of the Chazy group. Part of this block was kindly given to me by Mr. Ami.

PART II.

UPPER SILURIAN AND DEVONIAN SPECIES.

LEPERDITIA (?) SUBROTUNDA, n. sp.

Plate XVI, Figs. 1 *a, b, c.*

Size of left valve: Length, 0.85 mm.; height, 0.68 mm.; thickness, 0.21 mm.

Carapace small, short, rounded, uniformly convex, encircled, except at the strongly convex ventral edge, by a flattened border, widest in the postero-dorsal region. Dorsal edge scarcely straight,

* Since the above was written I have received from Prof. T. Rupert Jones proofs of two plates which have been prepared for the Geological Survey of Canada. On plate X I notice figs. 10*a* and 11*a* because I am satisfied that they have been drawn from specimens of *I. amiana*. These figures are marked "*I. ottawa*, variety," but, for the reasons stated above, I cannot accept this designation for my specimens.

gently curving into the ends. Ventral overlap distinct. Surface smooth and even, without eye tubercle or muscle spot.

The development of a flange at the dorsal border is a very unusual feature in this genus. *L. sinuata*, Hall, has nearly the same shape, but is without a flange, and, so far as known, its valves do not overlap at the ventral margin. I am inclined to believe that species of this character ought to be arranged with *Aparchites* rather than *Leperditia*.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio. Rare.

ISOCHILINA RECTANGULARIS, n. sp.

Plate XVI, Figs. 2 a, b, c.

Size of left valve: Length, 1.22 mm.; height, 0.81 mm.; thickness, 0.21 mm.

Carapace small, nearly symmetrical, with the straight hinge-line nearly as long as the valves, the upper fourth of the anterior edge a little oblique; below this the free margins to the posterior cardinal angle form a semi-circle. Upper half of posterior margin forming nearly a right angle with the hinge-line. This feature has suggested the name. A well-defined though rather narrow flange encircles the entire valve. Valves moderately convex, with point of greatest convexity in the posterior half. Eye tubercle not developed.

There are several species of *Leperditia* known that resemble this, but as ours is clearly an *Isochilina*, as that genus is now understood, there is little likelihood of confusion between them. I know of no Devonian species with which it could be confounded.

Position and locality: Same as the preceding.

APARCHITES INORNATUS, n. sp.

Plate XVI, Figs. 3 a, 3 b.

Size of left valve: Length, 0.8 mm.; height, 0.5 mm.; thickness, 0.2 mm.

This species is closely related to the Silurian *A. unicornis* (*Leperditia unicornis*, Ulrich). Prof. Jones places that species with *Primitia*, while to me *Aparchites* appears as the genus that should receive it and other forms of like character. In the present species

the valves are small, rather convex, irregular or subpentagonal in outline, with the ends subequal, narrowly rounded and most prominent in the lower half, the ventral edge straightened on each side of the protruding center, and the back straight, rather short, and without cardinal angles. An undefined and scarcely perceptible depression occasionally in the dorsal slope. Surface most elevated near the posterior margin, with the slope to this edge concave, the central portion of the valves depressed convex, and the slope to the anterior, dorsal, and ventral margins abrupt.

The posterior elevation I regard as representing the posterior spine of *A. unicornis.* This, together with the subpentagonal outline of the valves, will serve in distinguishing the species.

Position and locality: Same as the preceding.

ENTOMIS WALDRONENSIS, n. sp.

Plate XII, Figs. 3 *a*, 3 *b.*

Size of right valve: Length, 10.6 mm.; height, 6.7 mm.; thickness, 2.6 mm.

Valves oblong, subelliptical, moderately convex, back straight but short, ends subequal, the posterior strongly curved, the anterior subangular in the upper half; ventral edge moderately convex. Sulcus deep, subcentral, nearly vertical, extending from the dorsal margin more than two-thirds across the valve. A small tubercle to one side of the sulcus. No flattened border. Surface smooth.

This species is much larger than *E. madisonensis,* described in Part I of this paper. The sulcus is also less curved, and the two halves of the valves are not unequally convex as in that species.

Position and locality: Shales of the Niagara group, near Waldron, Ind.

ÆCHMINA ABNORMIS, n. sp.

Plate XII, Figs. 7 *a*, 7 *b.*

Size: Length, 1.53 mm.; height, 0.95 mm.

Valves ovate, with the anterior end a little narrower than the posterior, the dorsal edge straight and subangular at the extremities, the ventral margin rather strongly convex. A large lobe slightly overhangs the posterior margin; another is situated just within the anterior half of the ventral margin. Spine strong,

pointing mainly upwards and a little forward; it arises from the dorsal slope a little behind the center of the length of valve.

This species is associated with *Æ. spinosa*, Hall sp., but is generally larger, and less symmetrical, while the two marginal lobes impart an abnormal appearance to the valves that is quite foreign to that species.

Position and locality: Shales of the Niagara group, at Lockport, N. Y.

ÆCHMINA MARGINATA, n. sp.

Plate XVI, Fig. 5.

Size: Length, 0.6 mm.; height, 0.31 mm.; length of spine, 0.75 mm.

Valves small, elongate, narrowest anteriorly, with the dorsal edge straight and long, the angles obtuse, and the free margins forming nearly a semicircle. A slightly elevated marginal rim. Spine very long and slender. The marginal rim allies the species to *Æ. spinosa*, but the valves are more elongate and the spine much longer. In both of these features the species approaches the Wenlock *Æ. cuspidata*, Jones, but that form is without a marginal rim, and has the base of the spine stronger.

Formation and locality: Shales of the Hamilton group, 18-mile creek, N. Y.

HALLIELLA, n. gen.*

Valves similar to *Primitia*, but with a larger sulcus, narrow at the dorsal edge, and widening as it extends downward. Posterior lobe smaller than the anterior; the latter generally divided at or near the straight dorsal edge. Surface of lobes coarsely sculptured, or reticulate, perhaps also smooth, ventral edge thick, generally with a "frill" or a rim-like projection over the contact edges of the valves.

In the present state of our knowledge it is exceedingly difficult to draw up a satisfactory description of this genus. I am convinced, however, that the species for whose reception this new genus is proposed are not *Primitia* any more than are those for

*Named after Dr. James Hall, of Albany, N. Y. He requires no introduction.

which *Beyrichiella*, Jones and Kirkby, has been established, and I do not doubt that with more material and the new forms that are being continually brought to light, the present difficulty of picking out the really diagnostic characters will gradually be overcome.

Provisionally, I propose to place two species as *Halliella*, one described in Part I of this paper (p. 136, pl. VIII, fig. 6) as *Primitia* (?) *sculptilis*, the second the form next to be described. Of other species I would suggest that *Primitia seminulum*, Jones and Holl, may belong here. Perhaps also *Bollia* (?) *auricularis*, J., of which Prof. Jones writes in a letter to me, "it is not a good *Bollia*. Your *P. sculptiles* is nearer to it than any other known to me."

As to the relations of *Halliella*, I should say in the first place that they are with *Primitia* on the one hand and *Ctenobolbina* on the other, differing from the latter in this, that the posterior lobe is not bulbous.

HALLIELLA RETIFERA, n. sp.

Plate XV, Figs. 5 *a, b, c, d, e.*

Size: { Right valve; length, 1.38 mm.; height, 0.95 mm.; thickness, 0.5.
Left valve; " 1.42 " " 0.97 " " 0.52.

Valves slightly oblique, short, subovate, hinge-line straight, cardinal angles obtuse; ends slightly unequal, the anterior most prominent in the upper half, the posterior in the lower. A depressed, concave, smooth marginal rim, widest in the postero-dorsal region. Sulcus oblique, sharply impressed, situated behind the center, extending from the dorsal edge about one-third across the valve. Surface rising gradually in passing around the sulcus from the narrow upper portion of the posterior lobe to the point of greatest convexity in the anterior half of the valves. The broad dorsal end of the ventricose anterior lobe often divided by a faint mesial impression. Surface of lobes rather coarsely reticulated. Contact edges of valves bevelled; hinge thick, apparently with a small anterior tooth. (See fig. 5*e*.)

Several reticulated species are associated with this, but as they are all quite distinct in other respects, they are not likely to be confounded.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

CTENOBOLBINA PUNCTATA, n. sp.

Plate XII, Figs. 5 *a, b, c.*

Size of right valve: Length, 1.5 mm.; height, 1.0 mm.; thickness, 0.3 mm.

Carapace moderately convex, subovate, with the ends nearly equal, the anterior one very slightly the narrowest, the back straight, rather long, the dorsal angles about 110°; outline of ventral two-thirds semicircular. Flange or frill of moderate width, best developed at the ventral edge, becoming obsolete gradually before reaching the dorsal angles. Posterior sulcus deep, sharply defined, nearly vertical, slightly curved. Anterior sulcus wanting, but there is an oblique swelling, forming the most prominent portion of the valves, in the anterior half. Posterior lobe large, but of more ovate shape than in the typical Cincinnati species. Surface punctate.

This is an unquestionable *Ctenobolbina*, with relations to *C. ciliata* var. *emaciata*, (ante p. 109; p. 8 of reprint), but distinguished from that and all the other species known by its punctate surface. Comparison with the figures on plate VII, will reveal other differences.

Position and locality: Shales of the Niagara group, Lockport, N. Y.

CTENOBOLBINA PAPILLOSA, n. sp.

Plate XV, Figs. 8 *a, b, c.*

Size of left valve: Length with frill, 1.43 mm.; height with frill, 0.87 mm.; thickness, 0.4 mm.; length without frill, 1.32 mm.; height, 0.76 mm.

The valves of this species have the shape generally met with in *Ctenobolbina*. Lobation bijugate. The posterior sulcus, though well marked and deep, is comparatively short, causing the posterior lobe to be less distinct than usual. Central lobe large, prominent; anterior sulcus narrow but well-impressed, vertical, like the posterior sulcus extending but little more than half across the valve; anterior lobe small. Frill or flange well-developed. Surface strongly papillose, with the papillæ largest on the lobes.

This well-marked form is distinguished from the Silurian species

of the genus by the shorter and more erect character of the sulci, and more strongly papillose surface.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

CTENOBOLBINA INFORMIS, n. sp.

Plate XV, Figs. 6 a, b, c.

Size of right valve: With frill; length, 1.51 mm.; height, 0.92 mm.; thickness, 0.35 mm.; without frill, length, 1.4 mm.; height, 0.85 mm.

Valves subovate, back straight, ends strongly convex, the anterior the narrowest; ventral edge convex, rounding uniformly into the ends; dorsal angles obtuse. Sulcus deep and very wide, extending a little more than half across the valves. Posterior and median lobes united, U-shaped, thick at the bend, with three undefined swellings, one forming the major part of the posterior lobe, the second at the antero-ventral portion of the bend, while the third, comprising the upper half of the median lobe, projects slightly beyond the dorsal edge. Anterior lobe wanting, this portion of the valve being evenly convex. Frill bent inwards, scarcely distinguishable in a side view, concave on the inner side and forming a channel around the contact margin of the valve. Surface smooth.

This rudely marked species, though deviating in several important respects from the typical species of the genus, still retains, I believe, the more essential characters of *Ctenobolbina*. An approach toward *Bollia* is recognizable, particularly to such a form as *B.* (*?*) *auricularis*, Jones, but that species is not a good *Bollia*, and, as I view it, would be more fittingly disposed of under *Ctenobolbina*. I hesitate, however, to propose such an arrangement, because the relationship to my proposed genus *Halliella* is perhaps even more intimate.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

CTENOBOLBINA (? BOLLIA) ANTESPINOSA, n. sp.

Plate XV, Figs. 9 a, b, c.

Size of left valve: Length without frill, 1.9 mm.; height, 0.9 mm.; thickness, 0.4 mm.; height with frill, 1.0 mm.

Valves elongate-ovate, widest posteriorly, ends boldly curved,

ventral margin gently convex, most prominent in the posterior half. Marginal frill wide, but frail and easily broken away, geniculated in cross-section; within it a deep channel. Anterior lobe small, isolated, vertically elongate, papillose, situated near the anterior margin. The latter with a row of small spines. Mesial and posterior lobes connected, together forming a slightly oblique loop; the former terminating at the dorsal edge in a large, papillose, and greatly elevated knob; posterior lobe well-defined, consisting of three divisions, rising step-like over each other, the highest part, an upward extension of the ventral prolongation of the mesial lobe, forming the posterior border of the deep sulcus.

In some respects the departure from typical *Ctenobolbina*, mentioned under the preceding species, is even more apparent in this. Such species as *Bollia granifera* (see pl. XII, figs. 2 *a*) must be related rather closely, and it may have been better to refer this species to *Bollia* also.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

CTENOBOLBINA MINIMA, n. sp.

Plate XV, Fig. 7.

Size of right valve: Length, 0.4 mm.; height, 0.26 mm.

I propose the above name for a small Primitia-like species from the Hamilton shales, at 18 mile creek, near Buffalo, N. Y. I place it under this genus chiefly because of the strong, oblique sulcus, and the general resemblance which it presents to *C. bispinosa* (see pl. VII, fig. 6) which I am confident is congeneric with *C. alata* and *C. ciliata*. The Hamilton form has a narrow flange, and has the ventral spine situated far behind, while the dorsal spine is wanting, unless a minute tubercle on the posterior side of the sulcus represents it. Surface smooth, moderately convex.

BOLLIA UNGULA, Jones.

Plate XIV, Figs. 6 *a, b.*

Bollia ungula, Jones, (Claypole MS.) American Geologist, Dec. 1889, p. 338, figs. 10–13.

Size: Length, 1.2 mm.; height, 0.77 mm.

The specimens of this species from the Devonian Bryozoa bed at the Falls of the Ohio, agree very closely with Prof. Jones' figures,

especially fig. 10. The duplication of the marginal rim shown in his figs. 12 and 13 is not noticed in the Falls specimens, and the bent ridge is somewhat thicker in the latter. The last difference is explained by the fact that the Pennsylvania specimens occur as "casts in buff-colored, non-calcareous shales from the Marcellus limestone," while the Falls specimens are perfect valves.

BOLLIA OBESA, n. sp.

Plate XIV, Figs. 5 *a, b, c.*

Size of valve: Length, 1.52 mm.; height, 0.98 mm.; thickness, 0.5 mm.

Carapace sub-pentagonal, ends nearly equal, strongly curved, back straight, short, dorsal angles obtuse, ventral edge produced in the middle. Marginal portion of valves thick, causing them to appear unusually ventricose. Horse-shoe ridge unsymmetrical, with bulbous extremities, the anterior knob oval, and reaching the dorsal edge, the posterior one larger, more nearly round, and terminating a short distance within the dorsal margin.

This species is not likely to be mistaken for any other known to me. Though clearly a true *Bollia*, it is very different in its general appearance from the associated *B. ungula*, Jones.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BEYRICHIA TRICOLLINA, n. sp.

Plate XII, Fig. 6.

Size of left valve: Length, 1.85 mm.; height with frill, 1.25 mm.; height without frill, 1.0 mm.

Valves sub-oblong, semi-ovate, moderately convex, with a long straight hinge line, and a very wide marginal frill. Without the frill the shape of the valves might be called nearly semi-circular, were it not for a slight prominence in the postero-ventral portion of the curve. Surface exhibiting three rounded tubercles, one near the postero-cardinal angle, another, perhaps twice as large, near the center of the dorsal margin, the third, smaller than either, situated between and a little beneath them. Besides these two, slight swellings of the surface may be noticed in the postero-ven-

tral fourth of the valves. A moderate depression of the surface occurs between and extends some distance beneath the largest and smallest of the tubercles.

The wide frill and the arrangement of the three rounded tubercles sufficiently distinguish this fine species.

Position and locality: Shales of the Hamilton group, 18 mile creek, N. Y.

BEYRICHIA LYONI, n. sp.

Plate XIV, Figs. 2 a, b, c, and 3.

Size: { Right valve; length, 1.58 mm.; height, 1.1 mm.; thickness, 0.5 mm.
Left " " 1.77 " " 1.2 "

Valves subquadrate, hinge line straight, anterior cardinal angle about 90°, posterior angle 110°; posterior and ventral margins slightly convex. Frill of moderate width, extending around the free margins, frail and easily broken, the posterior portion sometimes with radial ribs. Surface coarsely reticulate, normally with three elevations; (1) a low marginal ridge running parallel with the ventral edge; (2) a large, prominent, vertical tubercle, extending from the ventral ridge to and often projecting beyond the dorsal edge; (3) a much smaller, circular tubercle. A well-marked sulcus-like depression between tubercles two and three is situated very near the center of the valves.

The specimen represented by fig. 3 (pl. XIV) has the ventral lobe hypertrophied—at any rate, I have so interpreted the pronounced oval swelling occurring at the ventral edge.

The species is named after Mr. Victor Lyon, of Jeffersonville, Ind., who has carried on extensive washings of the decomposed chert layers at the Falls of the Ohio. This and other species were found in a small parcel of the residue which he kindly gave me.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BEYRICHIA (? DEPRANELLA) KALMODINI, Jones.

Plate XIV, Figs. 1 a, b, c.

Beyrichia Kalmodini, Jones, Quart. Jour. Geol. Soc., Nov. 1890, p. 538, pl. xx, fig. 6.

Size: { Fig. 1*a*. With frill; length, 1.58 mm.; height, 1.02.
Fig. 1*c*. " " " 1.56 " " 1.01.
" " Without " " 1.50 " " 0.82.

I am satisfied that Prof. Jones' figure represents an imperfect example of the species here illustrated. As it is one of the commonest in the "Bryozoa bed" at the falls (the locality is in Clarke Co., Indiana) it might be expected to occur in the material sent to Prof. Jones from that locality. Comparing the figures it will be noticed that his specimen (a left valve) had a very narrow anterior end, with a slight concavity in the antero-ventral portion of the margin. The character of the marginal frill does not appear to have been recognized, though I have no doubt it is preserved in the posterior half of his specimen. As the frill bends inward at its edge, it might very easily be mistaken for the contact margin (*i. e.* in specimens attached to foreign bodies or to the matrix). My figures represent internal and external views of two average right valves of the species. In neither of these is the small central node connected with the curved marginal ridge by a "narrow neck." Indeed, that condition is rare, and was not observed by me till I had seen Prof. Jones' figure, when a re-examination revealed its presence in one out of every eight or ten specimens. The form of the long sub-marginal ridge suggests an alliance with the Lower Silurian species which I have called *Depranella.* (See plate 8.)

Position and locality: Devonian Bryozoa bed, (? Hamilton group,) Falls of the Ohio.

MOOREA BICORNUTA, n. sp.

Plate XVI, Figs. 4 *a, b, c.*

Size: Length, 1.02 mm.; height, 0.6 mm.; thickness (of one valve), 0.25 mm.

Valves suboblong, elliptical, rather strongly convex, with strongly rounded, nearly equal ends, the back straight in the middle two-fourths of the length; and the ventral edge gently convex. Near the anterior margin two conical prominences or blunt spines; at the opposite end of valve a prominent crescentic ridge curving parallel with the posterior margin. Margins of valves simple, without flattened borders.

Closely related to *M. kirkbyi*, lately described by Prof. Jones (Quart. Jour. Geol. Soc., Nov. 1890, p. 542) from the Corniferous chest of New York. That species has a longer and straighter

back, with submarginal ridges at both ends. In this species we have two blunt spines, instead of a ridge, at the anterior end.

Position and locality: Hamilton group, 18 mile creek, N. Y.

KIRKBYA SUBQUADRATA, n. sp.

Plate XV, Figs. 1 *a, b, c.*

Size: Length, 0.87 mm.; height, posterior, 0.62 mm., anterior, 0.57 mm.; thickness of one valve, 0.18 mm.

Valves compressed, subquadrate, ends subequal, the anterior the narrowest and most curved; back slightly concave, ventral edge straightened, dorsal angles blunt, antero-and postero-ventral regions abruptly curved. Free margins with a sharply elevated ridge, enclosing the reticulated body of the valve. A sharply defined, large umbilical pit just in front of the center of the reticulated area. Point of greatest convexity a little behind the pit.

This, like the next two species, is related to *K. permiana*, Jones, and *K. oblonga*, J. and K. The relationship, particularly in this instance, is not very close, the valves of *K. subquadrata* being much shorter and more nearly quadrate, with a more distinct umbilical pit, and higher marginal ridge.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

KIRKBYA PARALLELA, n. sp.

Plate XV, Figs. 2 *a, b.*

Size: Length, 0.79 mm.; height. 0.47 mm.

Valves suboblong, with subequal, rounded ends, straight back, and nearly straight ventral margin. Marginal ridge sharply elevated above the narrow, concave border, enclosing the delicately reticulated, and slightly convex body of the valve. Umbilical pit small, scarcely distinguishable.

This species is closely related to *K. oblonga*, Jones and Kirkby, described from the carboniferous limestones of England and Scotland, and recognized now, for the first time, in the Chester shales of Kentucky and Illinois. The latter is illustrated on plate 18 of this paper. Comparing fig. 4*a* of that plate with 2*a* of plate 15, it will be noticed that the outline is almost identical in the

two, but further examination will show that in the Devonian species the marginal ridge is much more elevated, and the reticulated area not nearly so convex.

Position and locality: Same as the preceding.

KIRKBYA SEMIMURALIS, n. sp.

Plate XV, Figs. 3 *a*, *b*, 4 *a*, *b*, *c*.

Size: { Fig. 3*a*; length, 0.7 mm.; height, 0.41.
Fig. 4*a*; " 0.76 " " 0.4.

This species varies somewhat, but may be described as suboblong, or elongate elliptical, with a straight back, obtuse cardinal angles, subequal rounded ends, and slightly convex ventral edge. Marginal ridge sharply elevated in the posterior region, but dying out before reaching the anterior end; margin outside of ridge a smooth, convex slope to edge of valve. Within the ridge the depressed-convex surface is delicately reticulated, with the meshes rather large, and extending to the anterior edge. Umbilical pit large but faintly impressed. Valves very thin and frail.

Position and locality: Same as the preceding.

OCTONARIA STIGMATA, n. sp.

Plate XVI, Figs. 8 *a*, *b*; *var. oblonga, figs.* 9 *a*, *b*, *c*; *var. loculosa, fig.* 10.

It is very difficult to distinguish the back from the ventral edge, and the anterior from the posterior end in species of this peculiar genus. If my arrangement of the figures of the three species and varieties on plate 16 is correct, then I have in each case illustrated a right valve. To save time and type we will assume that the parts have been correctly determined.

Species variable; valves with a raised and longitudinally ridged area occupying most of the surface. Ridges more or less irregularly thickened at intervals, or united by a greater or less number of cross-bars, producing a coarse network.

The typical form (figs. 8 *a*, 8 *b*) is ovoid or subrhomboidal in shape, with the anterior extremity the narrowest; posterior end strongly curved in the lower half, sloping forward in the upper

half; ventral edge gently convex, curving neatly up into the anterior curve which is the most prominent above the middle; back straight, without cardinal angles. Counting the marginal ridge of the elevated area, there are five longitudinal ridges in the anterior half. In the posterior half they become irregular.

Size: Length, 0.88 mm.; height, 0.53 mm.

Var. LOCULOSA, n. var., fig. 10.

In this variety the back is short, and both the ends most produced in the lower half. The elevated area is divided into numerous small compartments by cross-bars. Length, 0.85 mm.; height, 0.5 mm.

Var. OBLONGA, n. var., figs. 9a, b, c.

In this variety the ends are subequal, the dorsal and ventral edges parallel or nearly so, and the elevated area divided up in a very irregular manner. Length, 1.21 mm.; height, 0.7 mm.

Though these varieties appear very distinct, I am confident that with sufficient material a complete gradation from one to the other could be established. Very likely *O. linnarasoni*, Jones (Quart. Jour. Geol. Soc., Nov. 1890, p. 541, pl. XX, figs. 7 *a*, 7 *b*,) from the same horizon and locality, represents another form of the same species, with a shape near var. *loculosa*, and the elevated area consisting of a spirally wound ridge. *O. octoformis*, from the Wenlock of England, is another variable species, Prof. Jones having designated no less than seven distinguishable varieties.* Considerable variability may therefore be expected in species of this genus.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

OCTONARIA OVATA, n. sp.

Plate XVI, Figs. 6a, 6b.

Size: Length, 0.75 mm.; height, 0.48 mm.; thickness, 0.45 mm.

This is a true *Octonaria*, with shape and surface markings on the order of *O. octoformis*, Jones, but more nearly elliptical and symmetrical, and with the elevated area divided into more numerous pits. The right valve is somewhat smaller than the left, and straighter at the dorsal margin.

*Ann. and Mag. N. Hist., ser. 5, vol. XIX, 1 sp. 404-407, June, 1887.

The species is distinguished from *O. stigmata* and varieties by its more oval shape, and smaller and differently marked raised area.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

OCTONARIA CLAVIGERA, n. sp.

Plate XVI, Figs. 7 a, b, c.

Size: Length, 1.51 mm.; height, 0.77 mm.; thickness of one valve, 0.36 mm.

In this peculiar species the valves are suboblong, the back straight, rather long, and without angular extremities, the ends subequal and semicircular, and the ventral margin moderately convex, with the curve a little the strongest in the posterior half. Elevated area taking up nearly the entire surface, so that the edges of the valves appear to be very thick and concave. Center of area with a number of shallow pits surrounding a club-shaped longitudinal ridge.

Though deviating rather obviously from the ordinary types of *Octonaria*, the characters of this species, as far as determined, do not appear to differ in any really essential respect from those required by the genus.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

OCTONARIA CURTA, n. sp.

Plate XIII, Figs. 4a, 4b.

Size: Length, 0.78 mm.; height, 0.63 mm.; thickness of one valve, 0.25 mm.

Valves short, oval; elevated area with a simple oval depression, without ridges except an obscure elevation on one side; edges slightly thickened.

This species doubtlessly is related to *O. octoformis*, Jones, occurring in nearly equivalent strata in England, but its valves are shorter, the edges more abrupt, and the surface pattern more simple than in any of the known varieties of that species.

Position and locality: Shales of the Niagara group, Lockport, N. Y.

BYTHOCYPRIS DEVONICA, n. sp.

Plate XVII, Figs. 1 *a, b, c.*

Size: Length, 1.55 mm.; height, 1.01 mm.; thickness, 0.65 mm.

Carapace sub-triangular, ventral edge nearly straight, back strongly arched, ends subequal, the anterior slightly narrower than the posterior. Left valve larger than the right, overlapping it at all sides. Ventral and dorsal edges thick; sides of valves depressed-convex, with point of greatest convexity above the center in the large valve, and as much below it in the smaller.

This form, perhaps, ought to be placed as a variety of *B. phillipsiana*, Jones and Holl, originally described from the Wenlock, but later recognized by Jones and Kirkby in the Carboniferous deposits of England. The outline of the latter, which they distinguish as var. *carbonica*, is almost exactly like that of our Devonian variety, but in end and ventral views the latter is thicker above and below, while the central portion of the valves is less convex. In the Silurian type of the species the dorsal and ventral edges are even more acute in end views.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BYTHOCYPRIS PUNCTULATA, n. sp.

Plate XVII, Figs. 2 *a, b, c.*

Size: Length, 1.93 mm.; height, 1.15 mm.; thickness, 1.14 mm.

Carapace strongly convex, the height and thickness nearly equal; ventral edge straight, curving up at each end; back convex, the outline of the whole nearly semi-circular; greatest thickness of valves in the posterior half. Left valve much the largest, its edge overlapping that of the right valve. Entire surface neatly punctate; punctæ several times their diameter apart.

I have a right valve from the Niagara shales at Lockport, N. Y., that probably belongs to a variety of this species. Its surface is also punctate, but the punctæ are more closely arranged. The valve is also less convex, with the profile in a ventral view is somewhat flattened centrally. If it deserves a name it might be called var. *niagarenesis*.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BYTHOCYPRIS INDIANENSIS, n. sp.

Plate XVI, Figs. 11 *a, b, c.*

Size of left valve: Length, 1.13 mm.; height, 0.62 mm.; thickness, 0.33 mm.

This species, of which I have seen only the left valve illustrated, is closely related to *B. punctulata*, the chief differences being as follows: *B. indianensis* is comparatively a little longer, has the dorsal edge thicker, slightly grooved and incurved, and the test is not punctate. The species is also very much like *B. hollii*, Jones, from the Wenlock of England, but the profile in end and ventral views is different.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BAIRDIA LEGUMINOIDES, n. sp.

Plate XVII, Figs. 5 *a, b, c.*

Size: Length, 1.42 mm.; height, 0.75 mm.; thickness, 0.55 mm.

Carapace elongate, ends acuminate, subequal, the posterior a little more blunt than the anterior; dorsal edge arched in the middle, concave on each side to the extremities; ventral edge unusually convex, the curve almost uniform. Left valve much larger than the right, with a thick, overlapping edge all around. Right valve with a faintly marked central spot. Both valves more ventricose in the posterior two-thirds than usual in this genus.

The side view resembles that of *B. legumen*, Jones and Kirkby, but in other respects the two species are quite distinct. None of the species described by Reuss and Kirkby present any striking resemblances. *B. leguminoides* seems to differ from them all in having the posterior end blunter than the anterior.

Position and locality: Shales of the Hamilton group, 18 mile creek, N. Y.

PACHYDOMELLA, n. gen.

Carapace exceedingly ventricose; valves thick and strong, the left much the largest, its thick edges overlapping the right valve at all sides. Dorsal side strongly arched, ventral edge more nearly straight, ends subequal. A faintly impressed, subcentral umbilical pit.

The only known species resembles *Xestoleberis*, but the thick valves forbid placing it with that genus. *Bythocypris*, and other genera of that type, also have thin valves, and are never so ventricose. It might perhaps have gone with *Barychilina* were it not for the fact that it has the left valve the largest instead of the right.

PACHYDOMELLA TUMIDA, n. sp.

Plate XIII, Figs. 5 *a, b, c.*

Size: Length, 1.13 mm.; height, 0.75 mm.; thickness, 0.8 mm.; right valve of same: length, 1.05 mm., height, 0.62 mm.; thickness, 0.48 mm.

Carapace very thick, irregularly ovate, the ventral edge straightened, ends subequal, the anterior a little the narrowest. Right valve smaller than the left, most convex in the posterior half. Left valve overlapping the right, its edges thickened, especially at the dorsal side; point of greatest convexity very nearly central. Umbilical pit obscurely impressed, centrally situated. Surface irregularly wavy, sub-nodose.

The ventricose carapace, thick valves, and rough surface readily distinguish this species.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BARYCHILINA, n. gen.

Carapace small, subrhomboidal or ovate; valves thick, unequal, the right the largest, overlapping the left except in the posterior half of the more or less convex dorsal side; the edges of the valves in this portion of the back are smooth, and resemble a pair of thick lips; (see pl. 13, fig 1*d*) edges of both valves thick and smooth all around, that of the right valve much the heaviest. A sharply-defined narrow or rounded umbilical pit. Surface striate. Type, *Barychilina puncto-striata*, n. sp.

In this remarkable genus we have a superficial ornamentation strikingly similar to that of the Devonian species of *Entomis*, coupled with a restricted umbilical pit (instead of a long furrow) and a thickness of the valves, especially of their edges, that is quite foreign to that genus. The inequality of the valves also is unknown in *Entomis*. The two last characters bring the peculiar genus *Kyamodes*, Jones, to mind, but the lobation of the dorsal

region of the carapace in that genus finds no representation in *Barychilina*. A similar, but coarser longitudinal striation of the valves is found in certain subcarboniferous species that are referred, perhaps erroneously, to *Kirbya*. The *K. costata*, McCoy, illustrated on plate 18, figs. 2*a*, 2*b*, is one of these. It would pass very well as a *Barychilina* and, if it could be shown to have unequal valves, I would not hesitate to place it there.

Of other species that may belong to this genus I will mention *Entomis rhomboidea* and *Primitia* (?) *wolcotti*, both lately described by Prof. Jones from the Hamilton group of New York and Canada.

BARYCHILINA PUNCTO-STRIATA, n. sp.

Plate XIII, Figs. 1 *a, b, c, d, e,* 2 *a, b, c, and, var. curta,* 3 *a, b, c.*

Size: { Fig. 1, complete example, length, 1.85 mm.; height, 1.15 mm.; thickness, 0.94 mm.
" 2, left valve, " 1.55 " " 0.98 " " 0.37 "
" 3, right " " 1.47 " " 1.05 " " 0.35 "

Right valve, subrhomboidal, with the angles rounded off; outline produced in the postero-dorsal and antero-ventral regions; anterior portion of dorsal edge thickened and reflexed; the slit-like umbilical pit situated a short distance behind the center of the antero-dorsal fourth. Left valve more nearly oval, and narrower in front, with the edges, particularly the upper and lower, thickened and incurved to allow the overlap of the right valve. Edges of both valves smooth, the rest of the surface covered with distinct, flexuous longitudinal striæ; in each of the furrows between the striæ a row of small punctures.

Figs. 3 *a, b, c,* are outline representations of a right valve of

Var. CURTA, n. var.

This differs from the typical form in being shorter and not so thick.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

BARYCHILINA PULCHELLA, n. sp.

Plate XIII, Figs. 4 *a, b, c, d.*

Size: Length, 1.03 mm.; height, 0.68 mm.; thickness, 0.70 mm.

Carapace short, ventricose, and a little the highest in the posterior half. Right valve subrhomboidal, angles rounded, outline

produced in the antero-ventral and postero-dorsal regions; umbilical pit oval, sharply defined, situated a little in front of the center; margins smooth, thickened on the inner side where they overlap the edges of the smaller left valve except at the straightened dorsal side. Left valve nearly egg-shaped, narrowing anteriorly, with the umbilical pit situated higher than on the opposite valve. Surface of both valves with strong, more or less flexuous longitudinal striæ.

This species resembles *B. punctostriata* in many respects, but is distinguished by being shorter, smaller, and more convex, and in having slightly coarser striæ, no punctæ between them, and the umbilical pit more centrally situated, and of rounded form.

Position and locality: Devonian Bryozoa bed, Falls of the Ohio.

Part III.

CARBONIFEROUS SPECIES.

LEPERDITIA NICKLESI, n. sp.

Plate XVIII, Figs. 1 a, b, c, d, e.

Size: Length, 1.15 mm.; height, 0.77 mm.; thickness (of left valve), 0.25 mm.

Valves small, oval, widest posteriorly; hinge line short, straight; surface almost uniformly convex, often with obscure pimples especially in the posterior half. Eye tubercle represented by a spine-like prominence near the antero-dorsal angle.

The spine distinguishes this species from *L. carbonaria*, (Hall). In *L. armstrongiana*, Jones and Kirkby, the spine is larger and farther removed from the dorsal edge. The latter is longer, and the outline on the whole much less exactly egg-shaped.

Named for Prof. J. M. Nickles, of Sparta, Ill., who was my companion on the trip that resulted in the discovery of this and other interesting species.

Position and locality: Warsaw beds of the St. Louis group, Columbia, Monroe Co., Ill.

PRIMITIA GRANIMARGINATA, n. sp.

Plate XII, Figs. 8 a, b.

Size: Length, 0.51 mm.; height, 0.33 mm.

Valves moderately convex, egg-shaped, narrow in front, back straight, ends and ventral edge neatly curved, with a sharply defined flange. The border at each end with a row of small granules. Sulcus represented by a shallow pit just behind the center of valve; on each side of pit a faint impression.

A nearly related species occurs at Chester, Ill. It is a little larger and without granules on the flange.

Position and locality: Chester group shales, near Grayson Springs Station, Ky.

PRIMITIA SIMULANS, n. sp.

(*Not figured.*)

Size of left valve: Length, 0.78 mm.; height, 0.50 mm.; thickness, 0.18 mm.

This outline of the valves of this species is very nearly like plate 12, fig. 8*a*, the difference being that the hinge line is a little shorter, the posterior end very slightly wider and more produced in the lower half, and the ventral edge a trifle straighter. The flange is the same, except that the row of granules is wanting; but the umbilical pit is more central, larger and deeper, and extends as a shallow neck-shaped sulcus to the dorsal border.

Position and locality: Chester group shales, Chester, Ill.

PRIMITIA CESTRIENSIS, n. sp.

(*Typical form not figured; Plate XIV, Figs. 7 a, b, c, represents var. caldwellensis.*)

Size: Length, 0.84 mm.; height, 0.54 mm.; thickness, of one valve, 0.16 mm.

Valves moderately convex, in profile flattened centrally; shape very nearly like plate 14, fig. 7 *a*, with the ends a trifle narrower, and the central third of the ventral edge more convex. Flange distinct, wide at the ends, narrow at the ventral margin. Sulcus beginning with a well defined pit at the center of the valves, from which it extends, gradually widening and shallowing, to the dorsal edge.

This, the typical form of the species, has been seen as yet only in the Chester shales at Chester, Ill. What I shall provisionally call

var. CALDWELLENSIS, n. var.,

is represented by figures 7 *a*, *b*, *c*, on plate 14. It occurs at the top of the Chester group in Caldwell Co., Ky., and differs from the typical form in being a little shorter, in having the curve of its ends fuller, and only a centrally situated umbilical pit instead of a sulcus reaching the dorsal margin. The posterior half is also a little less tumid.

Size: Length, 0.79 mm.; height, 0.55 mm.; thickness, 0.15 mm.

PRIMITIA SUBÆQUATA, n. sp.

Plate XIV, Figs. 8 *a*, *b*, *c*.

Size: Length, 0.56 mm.; height, 0.34 mm.; thickness of one valve, 0.15 mm.

Valves suboblong, strongly convex, with straight back, rounded subequal ends, and uniformly curved ventral edge. Flange illy defined, recognizable at the ends only. Umbilical pit central, faintly impressed.

This and the two preceding species are related to the Silurian *P. humilis*, J. and H., but each is distinguished by its own peculiarities, so that, while I am willing to admit their probable descent from that early type, it has seemed desirable, and to the best interest of geology, to view them as specifically distinct. In any event, they are distinguishable, and therefore deserve recognition in our nomenclature.

Position and locality: Top of the Chester group, Claxton P. O., Caldwell Co., Ky.

ULRICHIA EMARGINATA, n. sp.*

Plate XII, Figs. 10 *a, b, c.*

Compare, *Beyrichia tuberculo-spinosa*, Jones and Kirkby, Ann. and Mag. Nat. Hist., Ser. 5, vol. 18, pl. 8, figs. 7 and 8.

Size: Length, 0.61 mm.; height, 0.38 mm.; thickness, 0.24 mm.

This species may not be distinct from the *Beyrichia tuberculo-spinosa*, J. and K., from the Carboniferous deposits of Great Britain, which, in a recent letter, Prof. Jones suggests should be removed to *Ulrichia*. Their species, as figured, differs from *U. emarginata* in being a little longer, in having the cardinal angles sharper, the ventral and posterior margins more convex, and in having no flattened border or flange. There is also a difference in the size and arrangement of the tubercles, but no great importance is to be attached to them since they are liable to vary in those respects.

The Lower Silurian *Primitia nodosa*, or *Ulrichia nodosa* as it should now be called, resembles *U. emarginata* sufficiently to render their generic identity reasonably obvious.

Position and locality: Chester group shales, near Grayson Springs, Ky.

ULRICHIA (?) CONFLUENS, n. sp.

Plate XII, Figs. 11 *a, b.*

Size: Length, 1.35 mm.; height, 0.78 mm.; thickness of left valve, 0.34 mm.

Valves suboblong, slightly oblique; dorsal edge straight, rather long, meeting the anterior curve without forming an angle; anterior end uniformly convex, ventral edge very gently curved, posterior margin obliquely truncate above, rounded and most prominent in the ventral half. Surface with a △-shaped depression just above the center; around it, and taking up nearly all of the remaining surface, a low rounded ridge, with a low swelling on it near the central of the ventral margin, a small tubercle at each of the antero-dorsal, antero-ventral, and postero-ventral angles, and two

*The genus *Ulrichia* has just been proposed by Prof. Jones (Quart. Jour. Geol. Soc. for November, 1890,) for the reception of *U. conradi*, Jones, and the group of species mentioned in the remarks on *Primitia nodosa* (*ante* p. 135.) It will be noticed that I there expressed myself as favoring a generic separation from *Primitia*, though totally unaware of the fact that Prof. Jones had arrived at the same conclusion.

low rounded prominences near the dorsal edge where the converging ends of the ridge fail to meet, leaving a sulcus between them.

As interpreted by me this species is near *U. tuberculo-spinosa*, J. and K., and *U. emarginata*, and distinguished from them by confluence of the bases of the tubercles which in those species are distinct. I am confident that the peculiarities of the species are to be accounted for in this manner, and that its affinities are with *Ulrichia* and not with *Primitia.*

Position and locality: Shales of the Chester group, near Grayson Springs, Ky.

BEYRICHIA RADIATA, Jones and Kirkby, var. CESTRIENSIS, n. var.
Plate XIV., Figs. 4 *a*, *b.*

Beyrichia radiata, Jones and Kirkby, Ann. Mag. Nat. Hist., ser. 5, vol. 18, pl. 8, figs. 1, 2 *a*, 2 *b.*

Size: Without frill; length, 0.85 mm.; height, 0.5 mm.; height with frill, 0.65 mm.

The Chester shales specimens which I propose to designate as above, are too much like the original figures of *B. radiata* to deserve separation of greater than varietal importance. They differ from the British examples in being a little higher, with the ends also more equal, the frill a little wider and extending more nearly on the same plane with the contact edges of the valves. The surface also is finely papillose all over, a feature that is not exhibited in Jones and Kirkby's figures. The large rounded lobes or tubercles also are of more ovate shape and less unequal in size. These differences may be of sufficient importance to establish the variety.*

Position and locality: Shales of the Chester group, near Grayson Springs, Ky.

*Since this was written I have looked over a small parcel of washings from shales at the extreme top of the chester in Caldwell County, Ky. Among others I detected three valves that seem to be *identical* with the British types of *B. radiata.* This discovery goes to show that the var. *cestriensis* is not a mere local modification of the species.

BEYRICHIA SIMULATRIX, n. sp.

Plate XVIII, Fig. 7 a, b.

Compare, *Beyrichia fœtoidea*, White and St. John, 1868, Trans. Chicago Acad. Sci., p. 126.

Size: Length, 0.73 mm.; height, 0.42 mm.

Valves obliquely subovate, widest posteriorly, back straight, ends and ventral edge neatly curved. A moderate but well defined flange around the free margins. A large ridge-shaped lobe begins near the center of the posterior margin and, running down to the ventral edge, turns and, at the same time gradually widening, proceeds parallel with the ventral margin nearly to the anterior end. This curved ridge occupies nearly half of the surface. Just above it a very narrow ridge, with a large and very prominent globular termination reaching the dorsal edge, and situated in front of the center. An equal distance behind the center, and not reaching the dorsal margin, a smaller prominence. Entire surface beautifully punctate or minutely recticulate.

The lobation of the valves is much as in *B. fœtoidea*, W. & St. J., described from the upper Coal Measures of Iowa, yet, providing that species is reliably illustrated, there are sufficient differences to count them as distinct. In the Iowa species the ventral lobe is thickest where in this species it is thinnest. Nor does White and St. John's figure show anything of the thin prolongation from the antero-dorsal prominence. The shape of the valves also seems to differ.

Position and locality: Shaly limestones of the Chester group, near Grayson Springs, Ky.

BOLLIA GRANIFERA, n. sp.

Plate XII, Figs. 12 a, b.

Size: Length, 2.1 mm.; height, 1.45 mm.; greatest thickness of right valve, 0.5 mm.

Valves comparatively large, oblique, back long, straight, with well-marked cardinal angles; anterior margin vertical above, then curving backward into the rather strongly convex ventral margin; posterior edge with a bold and nearly uniform curve. Free margins with a strong and wide, concave frill, overhanging and extend-

ing some distance beyond the contact edges. Peripheral portion of frill obscurely crenulated. The generic loop-ridge oblique, with bulbous extremities, the anterior bulb very large, sub-globular, reaching the dorsal edge; its surface is strongly papillose; the posterior bulb much smaller, situated a distance nearly equalling its diameter from the dorsal edge; curved connecting portion of loop ridge-like, rather thin. Surface of valves minutely granulose.

This is the latest known species having the character required by *Bollia*. It is possible that it is not a true descendant of the Silurian and Devonian species of the genus, but may represent a modification from such a *Beyrichia* as the Hamilton *B. tricollina*, illustrated on the same plate (Fig. 6). I know of no Carboniferous species with which it might be confounded, unless it be *Beyrichia radiata*.

Position and locality: Rare in the siliceous debris of the St. Louis limestone, at Elizabethtown, Ky.

MOOREA GRANOSA, n. sp.

Plate XII, Figs. 9 a, b.

Size: Length, 0.47 mm.; height, 0.24 mm.; thickness of right valve, 0.1 mm.

Valves oblong, moderately convex, slightly oblique, elongate-subelliptical in outline, with the back straightened, no cardinal angles, the ends rounded, the posterior the widest; ventral edge gently convex. Surface with a low granulose ridge, running parallel with the ends, and very close to the ventral edge. Near center of valve a subcircular, smooth space is encircled by a row of granules. A few granules are distributed also in the area between this space and the submarginal ridge.

Position and locality: Shaly limestones of the Chester group, near Grayson Springs, Ky.

KIRKBYA OBLONGA, Jones and Kirkby, var.

Plate XVIII, Figs. 4 a, b, 5 a, b.

Kirkbya oblonga, Jones and Kirkby, Ann. Mag. Nat. Hist., Ser. 5, Vol. XV, Plate VIII, Figs. 4–6.

Size: { Fig. 4 *a*; Length, 0.74 mm.; height, 0.43 mm.; thickness, 0.15 mm.
Fig. 5 *a*; " 0.72 " " 0.42 " " 0.18 "

The identity of these American specimens with the British Car-

boniferous *K. oblonga* may be considered as reasonably certain. Slight differences might be pointed out, but considering the variability of the species, it is highly improbable that they would prove constant.

Position and locality: Shaly limestones near the middle of the Chester group, at Chester, Ill., and near Grayson Springs, Ky.

KIRKBYA LINDAHLI, n. sp.

Plate XVIII, Figs. 6 a, b, c.

Size: Length, 2.3 mm.; height, 1.3 mm.; thickness of right valve, 0.65 mm.

Valves comparatively large, strongly convex, suboblong-ovate, slightly oblique, widest in the posterior half, with the ends equally curved, the back straightened, the cardinal angles obtuse, the ventral edge straight or very gently convex at the center and curving uniformly up at each end. Marginal ridge thin, nearly equally elevated all around the free margins. Body of valve strongly convex, with point of greatest convexity just behind the center, where a slight protuberance is noticeable. Just in front of this prominence a vertically elongate umbilical pit. Entire surface beautifully reticulate.

This fine species, which it gives me pleasure to name for my friend Dr. Josua Lindahl, State geologist of Illinois, is related to *K. oblonga*, J. & K., but is much larger, with coarser reticulation, and narrow instead of rounded umbilical pit. Other differences might be pointed out, but these will suffice.

Position and locality: Warsaw beds of the St. Louis group, at Columbia, Ill.

KIRKBYA TRICOLLINA, Jones and Kirkby.

Plate XVIII, Figs. 8 a, b.

Kirkbya tricollina, Jones and Kirkby, Ann. Mag. Nat. Hist., Ser. 5, Vol. XVIII, Plate VIII, Fig. 19.

Size: Length, 0.75 mm.; height, 0.43 mm.

The American specimens of this species differ in several unimportant respects from the British form as figured by the authors of the species. Chief among these is the greater prominence of the

central one of the three eminences that have suggested the specific name.

Position and locality: Shaly limestones of the Chester group, near Grayson Springs and Leitchfield, Ky.

KIRKBYA VENOSA, n. sp.

Plate XVIII, Figs. 3 a, b.

Size: Length, 0.75 mm.; height, 0.48 mm.; thickness of one valve, 0.15 mm.

Valves subelliptical, symmetrical, with the back straight, ventral edge nearly so, ends semicircular, equal; cardinal angles obtuse. A depressed and slightly concave marginal space, wide at the ends, narrow at the center of the ventral edge, encloses the elevated main body of the valve. This is traversed by flexuous, narrow, vein-like, longitudinal ridges. Spaces between ridges minutely reticulate. Umbilical pit round, situated above the center in a hollow between two of the ridges.

This species is near *K. plicata*, Jones and Kirkby, but in that species there is no depressed marginal area, and the longitudinal ridges or plications are fewer and much more simple.

Position and locality: Shaly limestones of the Chester group, near Grayson Springs, Ky.

KIRKBYA (? BARYCHILINA) COSTATA, (McCoy).

Plate XVIII, Figs. 2 a, b.

Kirkbya costata (McCoy), Jones and Kirkby, Ann. Mag. Nat. Hist., Ser. 5, Vol. XV, Plate VIII, Figs. 13 *a*, *b*.

Size: Length, 2.02 mm.; height, 1.06 mm.; thickness of one valve, 0.50 mm.

Of this species I have seen only a single valve. This does not agree exactly with the valve figured by Jones and Kirkby (it is longer), but the costate ornamentation is so nearly alike in the two that I feel reasonably certain of their identity. When it comes to the generic relations of the species I am much less confident. The general aspect of the valves strikes me as different from that of *Kirkbya*, and more like *Barychilina*. If the species really

belongs to the last genus, then I should regard my specimen as a left valve, and the straighter edge as the ventral.

Position and locality: In England, a Lower Carboniferous fossil; in America, in the Warsaw beds of the St. Louis group, at Columbia, Ill.

CYPRIDINA HERZERI, n. sp.

Plate XIV, Figs. 9 *a, b, c.*

Size: Length, 1.4 mm.; height, 0.7 mm.; thickness of left valve, 0.47 mm.

Valves strongly convex, suboblong, highest in front of the middle; dorsal side arched, nearly semi-circular, the antero-ventral extremity prolonged beak-like; ventral edge moderately convex except at the anterior end, where it forms the concave lower side of the beak-like prolongation; posterior end rather narrowly rounded. Surface smooth; dorsal and ventral edges of left valve bent inward as though they might have been overlapped by the right valve.

The genus *Cypridina*, Milne-Edwards, is represented by numerous living species in the Pacific and Indian Oceans, and in the fossil state chiefly in the Carboniferous deposits of Europe. The present species is, so far as I am aware, the first of the genus noticed in American rocks. I name it after Rev. H. Herzer, now of Berea, O., who was the first to awaken in me the latent love for nature that has since grown almost to a passion, and become an inexhaustible source of keenest enjoyment.

Position and locality: Near the top of the Waverly series (Keokuk horizon), at Richfield, O.

CYTHERELLA OVATIFORMIS, n. sp.

Plate XVII, Figs. 3, 4 *a, b, c.*

Size: { Fig. 3; Right valve: length, 0.67 mm.; height, 0.43 mm.
" 4*a*; " " " 0.7 " " 0.43 "
" 4*b*; Left " " 0.6 " " 0.33 "

Carapace slightly elongate, but almost regularly oval, compressed convex, with point of greatest thickness near the posterior end. A very faintly impressed or merely discolored central spot in each valve. Interior of the large (right) valve with a distinct

marginal furrow into which the edge of the smaller valve is inserted.

This species is shorter and thicker than the Warsaw *C. glandella*, Whitfield. In most respects it resembles the European Tertiary species *C. compressa* (Von Münster) Bosquet, very closely.

Position and locality: Shaly limestones at the top of the Chester group, Caldwell Co., Ky.

BAIRDIA CESTRIENSIS, n. sp.

Plate XVII, Figs. 6 *a*, *b*, *c*, 7 *a*, *b*.

Size: { Fig. 6; length, 1.05 mm.; height, 0.57 mm.; thickness, 0.45 mm.
{ " 7; " 0.85 " " 0.4 " " 0.32 "

Carapace strongly convex, drawn out and pointed posteriorly, narrowly rounded anteriorly, with the centro-dorsal margin arched, the antero-dorsal straight, the postero-dorsal gently concave; ventral edge nearly straight in the middle, strongly bent upward in front, and only a little behind.

Related to *B. ventricosa*, Kirkby, but is shorter, with the anterior end less acute, the postero-dorsal margin less concave, and the ventral on the whole more convex.

Position and locality: Shales of the Chester group, near Grayson Springs, Ky.

PONTOCYPRIS (?) ACUMINATA, n. sp.

Plate XVII, Figs. 8 *a*, *b*, *c*.

Size: Length, 2.37 mm.; height, 0.85 mm.; thickness of one valve, 0.46 mm.

Of this species I have seen only a single valve. The generic relations are therefore in doubt. If it is really a *Pontocypris* then it is a left valve and correctly figured. If, on the other hand, it should belong to a very elongate *Bairdia* (like *B. mucronata*, Reuss, or *B. sliquoides*, J. & K., but relatively longer), it would be a right valve and the most convex edge the ventral. Provisionally, or until a complete carapace is found, the species had best be arranged as above.

Left valve very elongate, acuminate behind, narrowly rounded in front, with the dorsal side curved uniformly, about equal to a one fourth segment of a circle; ventral side very gently convex except at the posterior extremity where it bends a little downward to form a more acute point. Surface smooth, strongly convex, with the thickest part very near the center. Ventral edge curving inward slightly, indicating that the opposite valve overlapped.

Position and locality: Lower Waverly, Moots' Run, near Granville, Ohio. The valve is attached to a fragment of a ferruginous nodule received from Mr. E. M. Cooper.

Plate VII.

Page.

Fig. 1. Ctenobolbina ciliata, (Emmons)..... 108

1*a*, left valve of average specimen, x 18 : 1*b*, interior of right valve, x 18.

Fig. 2. Ctenobolbina ciliata, var. curta, n. var..... 109

Left valve, x 18.

Fig. 3. Ctenobolbina ciliata, var. emaciata, n. var..... 109

3*a*, left valve, x 20 ; 3*b*, posterior view of same ; 3*c*, ventral view of same.

Fig. 4. Ctenobolbina alata, n. sp..... 110

4*a*, left side of small example, x 18 ; 4*b* and 4*c*, ventral and dorsal views of two larger specimens, x 25.

Fig. 5. Ctenobolbina tumida, n. sp..... 111

5*a*, left valve, x 18, with the anterior ridge less sharply elevated than usual ; 5*b*, dorsal view of same in outline.

Fig. 6. Ctenobolbina bispinosa, n. sp..... 110

Rather small, perfect right valve, x 18.

Fig. 7. Primitia perminima, n. sp..... 131

Right valve, x 18.

Fig. 8. Jonesella crepidiformis, Ulrich..... 122

8*a*, right side of an average example of this species, x 18 ; 8*b* and 8*c*, ventral and posterior views of same.

Fig. 9. Jonesella pedigera, n. sp..... 122

9*a*, left valve, x 18 ; 9*a*, posterior view of same.

Fig. 10. Jonesella digitata, n. sp..... 122

10*a*, right valve, x 20 ; 10*b* and 10*c*, dorsal and posterior views of same.

Fig. 11. Jonesella crassa, n. sp..... 123

11*a* left valve, x 20 ; 11*b*, dorsal view of same.

Fig. 12. Entomis madisonensis, n. sp..... 107

12*a*, left valve, x 18 ; 12*b*, ventral view of same.

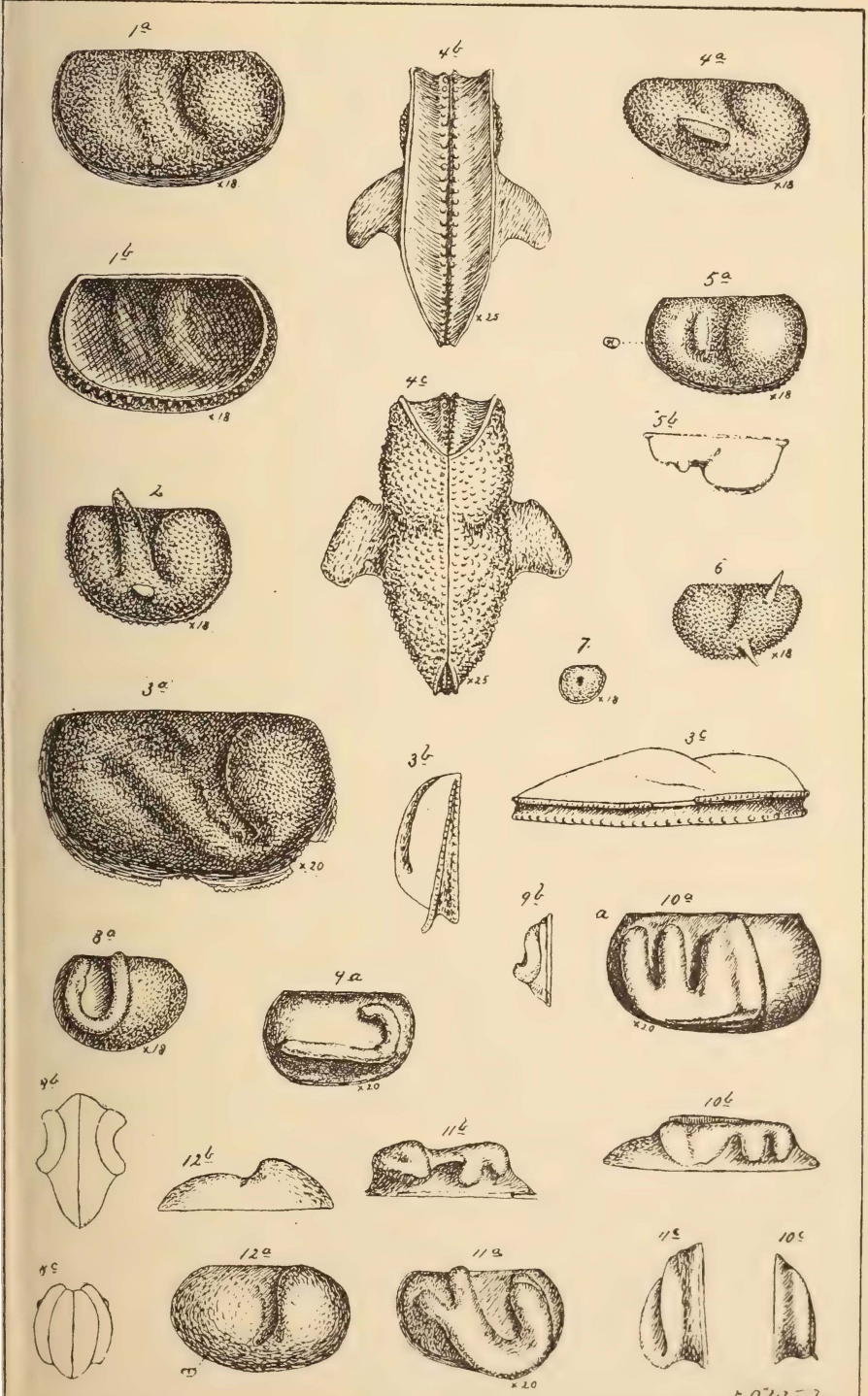
1a
x18
4b
x25
4a
x18
1b
x18
5a
x18
4c
x25
5b
2
x18
6
x18
7
x18
3a
x20
3b
3c
9b
10a
a
x20
8a
x18
4a
x20
9c
12b
11b
10b
12a
11a
x20
11c
10c
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Plate VIII.

Page.

Fig. 1. Depranella crassinoda, n. sp. 118

1*a*, right valve, x 20; 1*b*, dorsal view of same; 1*c*, posterior end of complete carapace.

Fig. 2. Depranella ampla, n. sp. 120

Right valve, x 20.

Fig. 3. Depranella crassinoda, var. nitida, n. var. 119

3*a* and 3*b*, left and ventral views of an average example of this variety, x 20.

Fig. 4. Depranella macer, n. sp. or var. 119

4*a*, left valve, x 20; 4*b* and 4*c*, sectional views of same between points marked *b* and *c* on fig. 4*a*.

Fig. 5. Depranella ampla, var. elongata, n. var. 121

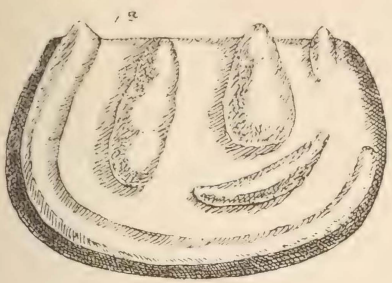
5*a*, left valve, x 20; 5*b*, sectional view of same between points marked *b* on fig. 5*a*.

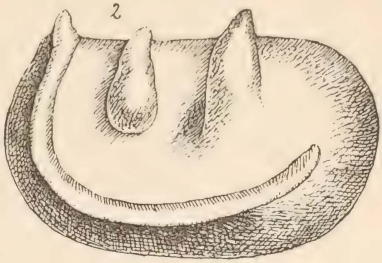
Fig. 6. Primitia (?) sculptilis, n. sp. 136

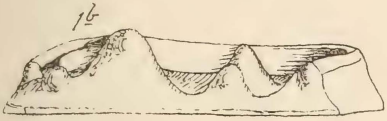
Right valve, x 18.

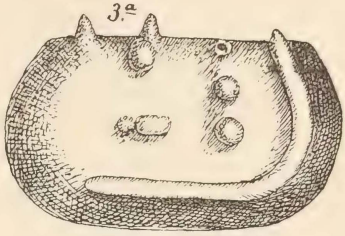
Fig. 7. Primitia nitida, n. sp. 135

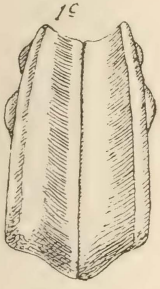
Left valve, x 18.

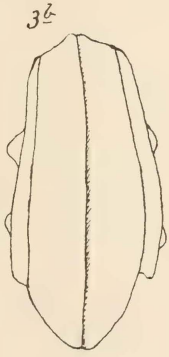


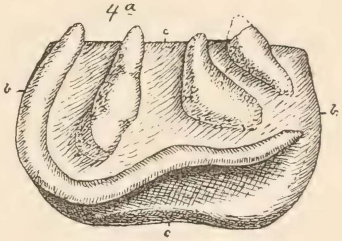


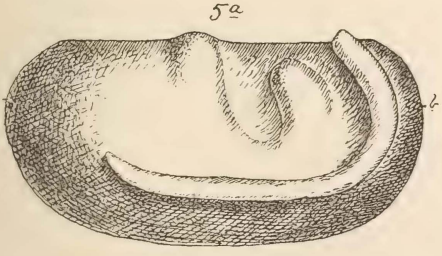


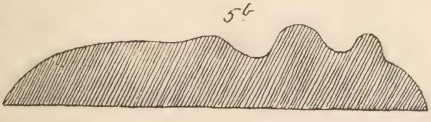


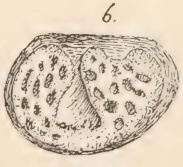


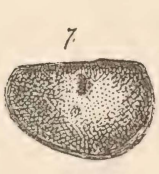












E. O. Ulrich

Plate IX.

All the figures on this plate are magnified eighteen diameters.

Page.

Figs. 1 and 2. Eurychilina subradiata, n. sp. 126

1*a*, 1*b* and 1*c*, left valve, from Lebanon, Tenn., with profiles between points marked on margin of fig. 1*a*; 2*a*, 2*b* and 2*c*, right valve, from Dixon, Ill., with similar profiles.

Figs. 3 and 4. Eurychilina longula, n. sp. 127

3*a*, large left valve, showing the interior, with the concave marginal area and "frill"; 3*b*, vertical profile of same; 4, right valve, showing the external features of the species. Both specimens are from the Birdseye limestone, at High Bridge, Ky.

Figs. 5, 6, 7 and 8. Eurychilina æqualis, n. sp. 129

5, an example from Lebanon, Tenn., on which the marginal area is exceedingly wide; 6*a*, 6*b* and 6*c*, left valve of the usual type, from High Bridge, Ky, with vertical and longitudinal profiles; 7, very young example, from same locality; 8, an unusually elongate right valve, from the same locality as 6 and 7.

Figs. 9, 10, 11 and 12. Eurychilina granosa, n. sp. 128

9*a*, 9*b* and 9*c*, average left valve, with vertical and longitudinal profiles; 10, young left valve, with a spinous fringe; 11, elongate variety, right valve, having larger tubercle, and the marginal area covered with interrupted concentric striæ; 12, interior of a left valve.

Fig. 13. Eurychilina obesa, n. sp. 129

Left valve, showing the faint sulcus, granulose surface, and grano-radiate margin. Birdseye limestone, High Bridge, Ky.

Fig. 14. Eurychilina striatomarginata, (S. A. Miller) 130

Left valve, from Southern Indiana, with the sulcus not reaching the dorsal edge. In some examples it seems to do so.

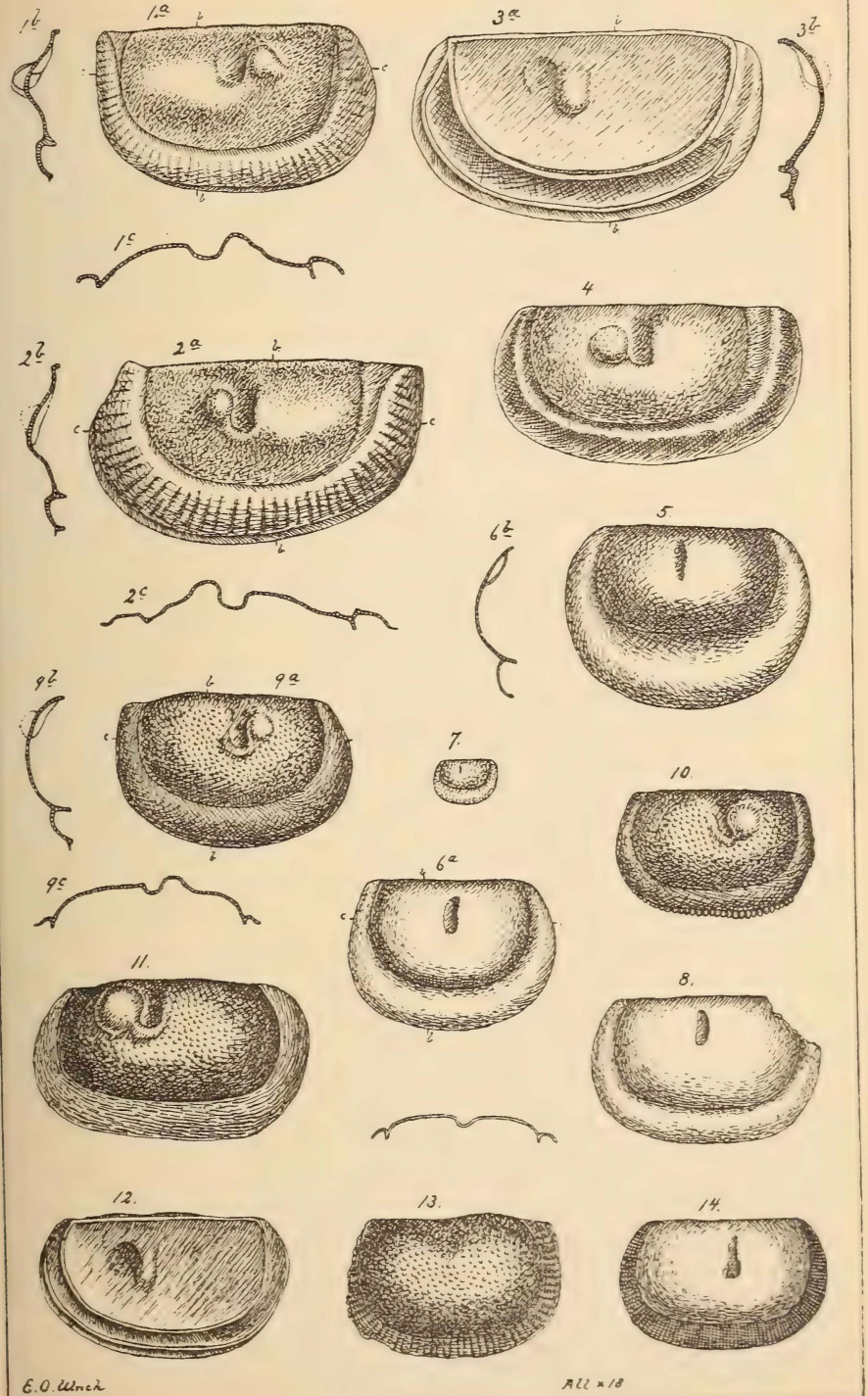

1b
1a
3a
3b
1c
4
2b
2a
2c
5
6b
9b
9a
7.
10.
9c
6a
11.
8.
12.
13.
14.
E.O. Wrich
All ×18

Plate X.

All species illustrated on this plate are from the Cincinnati Group, and all the figures, unless otherwise marked, are magnified twenty diameters.

Page.

Figs. 1 and 2. Primitia centralis, n. sp. 130

1, a left valve of the wider form from the Utica shales horizon; 2*a*, 2*b* and 2*c*, side, anterior and dorsal views of a left valve of the narrow variety that occurs near the top of the hills at Covington, Ky.

Figs. 3 and 4. Primitia impressa, n. sp. 131

Two right valves, illustrating slight differences, with anterior and dorsal views of each. Savannah, Ill.

Figs. 5 and 6. Primitia cincinnatiensis, (S. A. Miller). 132

5*a* and 5*b*, left side and dorsal views of a complete carapace, differing in several points from the typical form of the species; 6*a* and 6*b*, right side and anterior views of an average example; 6*c*, interior of a right valve.

Fig. 7. Primitia medialis, n. sp. 132

7*a*, left valve, showing the narrow ridge in the sulcus; 7*b*, end view of same.

Fig. 8. Primitia rudis, n. sp. 136

8*a*, right valve; 8*b* and 8*c*, posterior and ventral views of same.

Fig 9. Primitia glabra, n. sp. 134

9*a*, left valve; 9*b* and 9*c*, posterior and dorsal views of same.

Fig. 10. Aparchites oblongatus, n. sp. 137

10*a*, 10*b* and 10*c*, right side, ventral and posterior views of a complete carapace of this species.

Figs. 11 and 12. Primitia nodosa, n. sp. 134

21*a*, right valve of the typical form, x 20; 11*b*, dorsal outline view of same, x 35; lower beds at Cincinnati, Ohio; 12*a*, right valve of the short variety (in which the ventral node is not developed), that is so far known only from strata exposed near the tops of the hills at Cincinnati; 12*b*, posterior end of same.

Fig. 13. Placentula marginata, n. sp. 124

13*a*, 13*b* and 13*c*, lateral, dorsal and anterior views of a right valve of this species.

Fig. 14. Placentula inornata, n. sp. 124

14*a*, 14*b*, lateral and anterior views of a right valve, x 18.

Fig. 15. Beyrichia (? Primitia) parallela, Ulrich. 125

15*a*, left valve; 15*b*, dorsal, 15*c*, anterior, and 15*d*, posterior views of same. Richmond, Ind.

Fig. 16. Pontocypris (?) illinoisensis, n. sp. 107

16*a*, 16*b* and 16*c*, three views of a valve of this species, from Savannah, Ill.

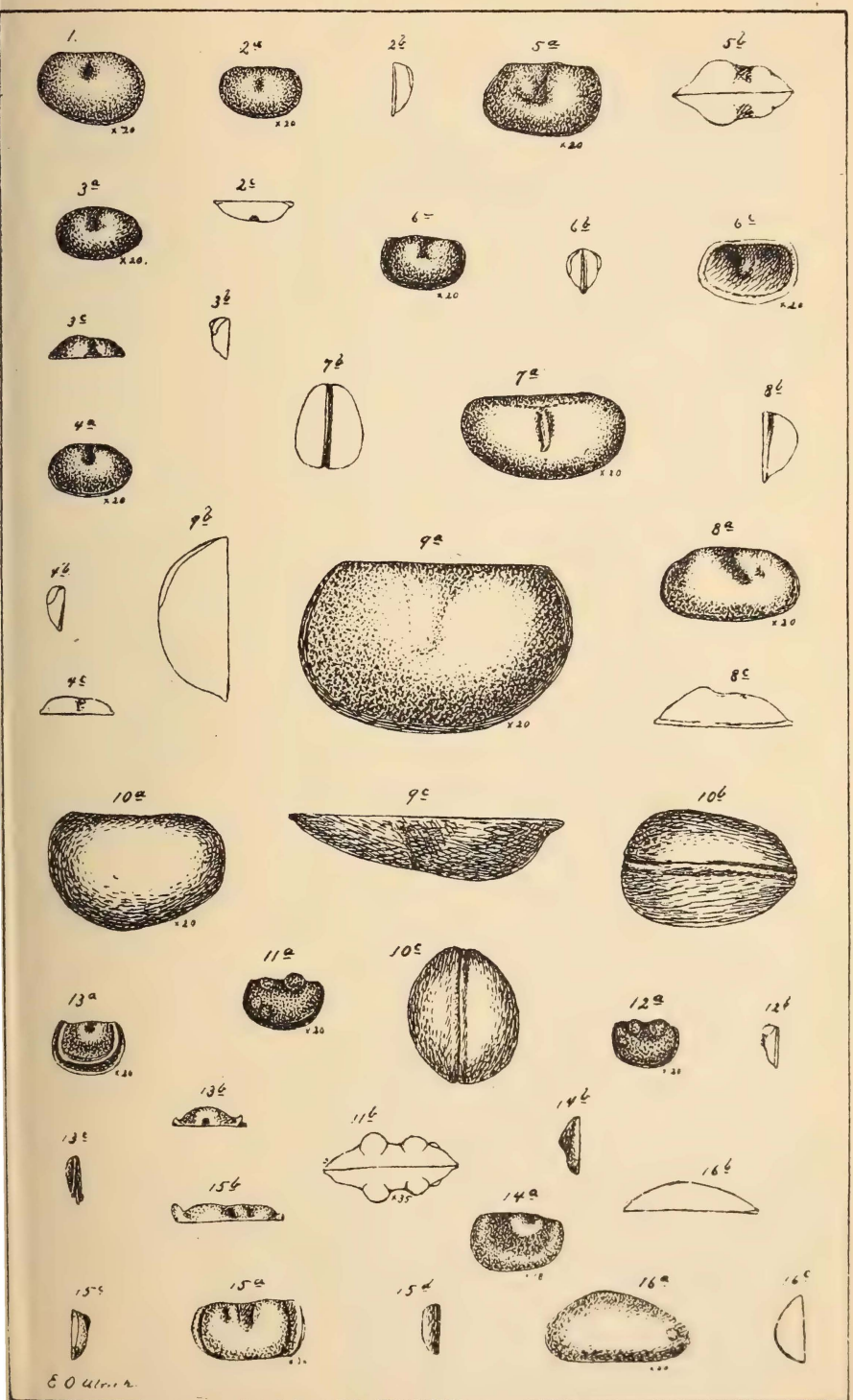

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Plate XI.

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Figs. 1 and 2. Leperditia fabulites, Conrad 173

1*a*, 1*b*, 1*c* and 1*d*, left, end, right, and ventral views of a complete example of this species, natural size, from Beloit, Wis.

2. Interior of right valve, from Lebanon, Tenn., x 2, showing the two rows of papillæ within the ventral edge, the radiately marked muscle spot, and the eye spot.

Fig. 3. Leperditia linneyi, n. sp 174

3*a*, left valve, x 2, from near Harrodsburg, Ky.

3*b* and 3*c*, posterior and ventral views of same, x 2.

3*d*, right valve, x 2; 3*e*, anterior view of same, x 2.

Fig. 4. Leperditia tumidula, n. sp 175

4*a*, 4*b* and 4*c*, side, posterior, and ventral views of a right valve, x 2, from Danville, Ky.

Fig. 5. Leperditia appressa, n. sp 176

5*a*, 5*b* and 5*c*, side, anterior, and ventral views of a left valve, x 2, from Harrodsburg, Ky.

5*d*, outline view, natural size, of a large left valve, from Danville, Ky.

Fig. 6. Leperditia cæcigena, S. A. Miller 176

6*a*, a large right valve, x 3, showing a small eye spot.

6*b*, 6*c* and 6*d*, left side, posterior, and ventral views, x 3, of a complete example, of medium size. Both of these specimens are from near Madison, Ind.

Fig. 7. Isochilina subnodosa, n. sp 177

7*a*, 7*b* and 7*c*, side, anterior, and ventral views of rather small left valve, x 2, from Perryville, Ky.

Fig. 8. Isochilina ampla, n. sp 179

8*a*, 8*b*, 8*c*, side, anterior, and ventral views of a right valve, natural size. Nashville, Tenn.

8*d*, interior of another right valve, natural size, showing eye, and reticulated muscle spot; Nashville, Tenn.

Fig. 9. Ishochilina jonesi, Wetherby 179

9*a*, 9*b* and 9*c*, three views of a large left valve, natural size, from near Harrodsburg, Ky.

Fig. 10. Isochilina saffordi, n. sp 178

10*a*, 10*b* and 10*c*, three views of a large left valve, natural size, from Nashville, Tenn.

10*d*, small portion of surface, x 3, showing the grano-reticulate surface ornamentation.

Fig. 11. Isochilina Kentuckyensis, n. sp 179

11*a*, 11*b* and 11*c*, side, anterior, and ventral views, x 2, of a left valve, from Mercer Co., Ky.

11*d*, ventral spine and small portion of margin, x 4, to show the row of small pits.

Fig. 12. Isochilina amiana, n. sp 180

12*a*, 12*b* and 12*c*, side, end, and ventral views, x 2, of an average right valve, from Ottawa, Can.

Fig. 13. Isochilina amiana, var. insignis, n. var 181

A right valve, x 2, occurring with the typical form of the species.

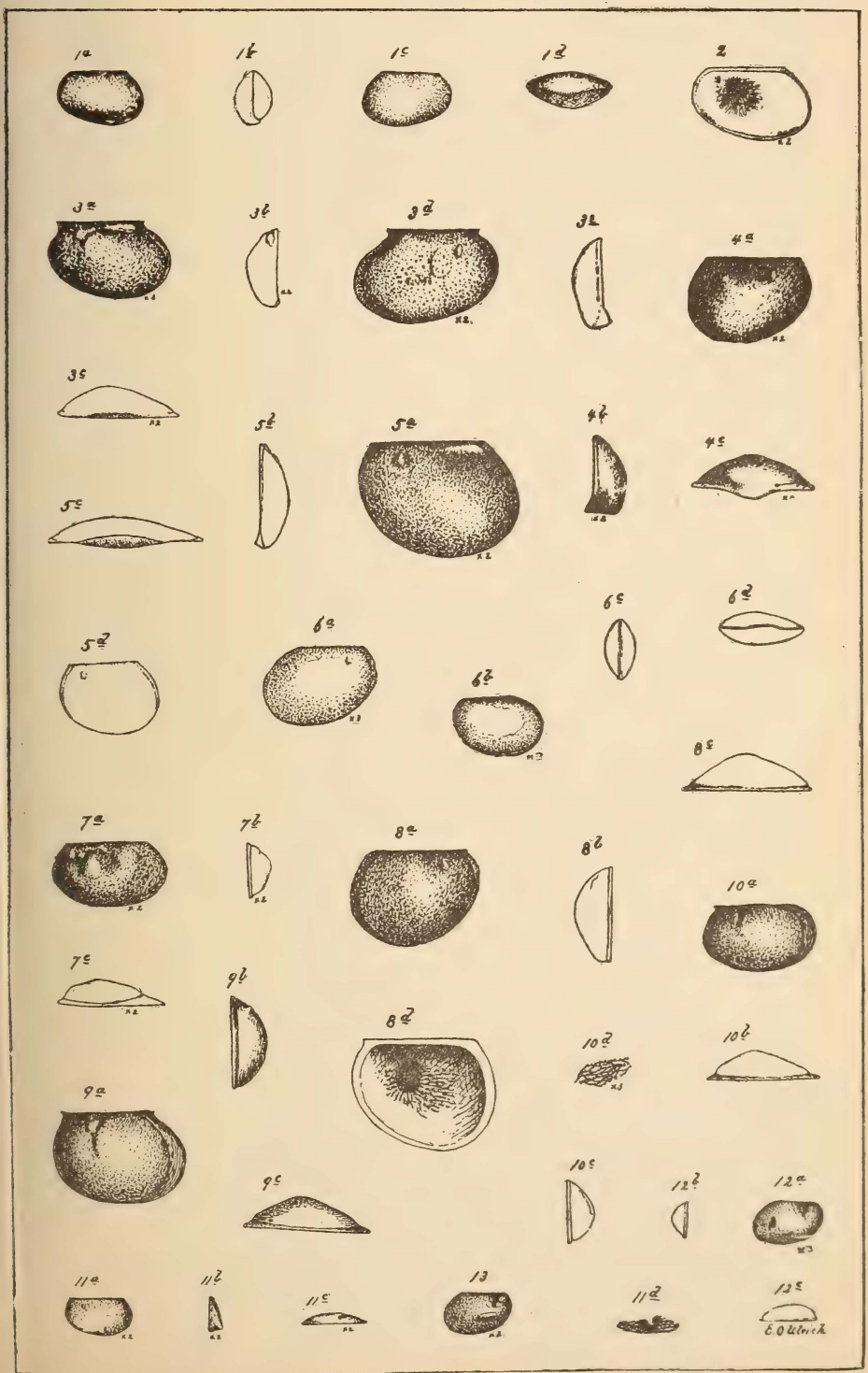
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Plate XII.

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Fig. 1. Bollia pumila, n. sp. 117
1*a* and 1*b*, side and end views of a valve of this species, x 20; from near Weisburg, Ind.

Fig. 2. Primitia milleri, n. sp. 133
2*a*, left valve, x 20, from near Weisburg, Ind. The entire surface is beautifully punctate as shown at a small spot.
2*b* and 2*c*, ventral and anterior views of same.

Fig. 3. Entomis waldronensis, n. sp. 183
3*a* and 3*b*, side and dorsal views of a right valve, natural size.

Fig. 4. Octonaria curta, n. sp. 195
4*a* and 4*b*, side and ventral views of a valve of this species, x 20, from Lockport, N. Y.

Fig. 5. Ctenobolbina punctata, n. sp. 186
5*a*, 5*b* and 5*c*, three views of a right valve, x 20, from Lockport, N. Y.

Fig. 6. Beyrichia tricollina, n. sp. 189
A right valve, x 20, with the frill broken away at the anterior end; from 18 mile creek, N. Y.

Fig. 7. Æchmina abnormis, n. sp. 183
7*a* and 7*b*, side and anterior views of a right valve, x 20, from Lockport, N. Y.

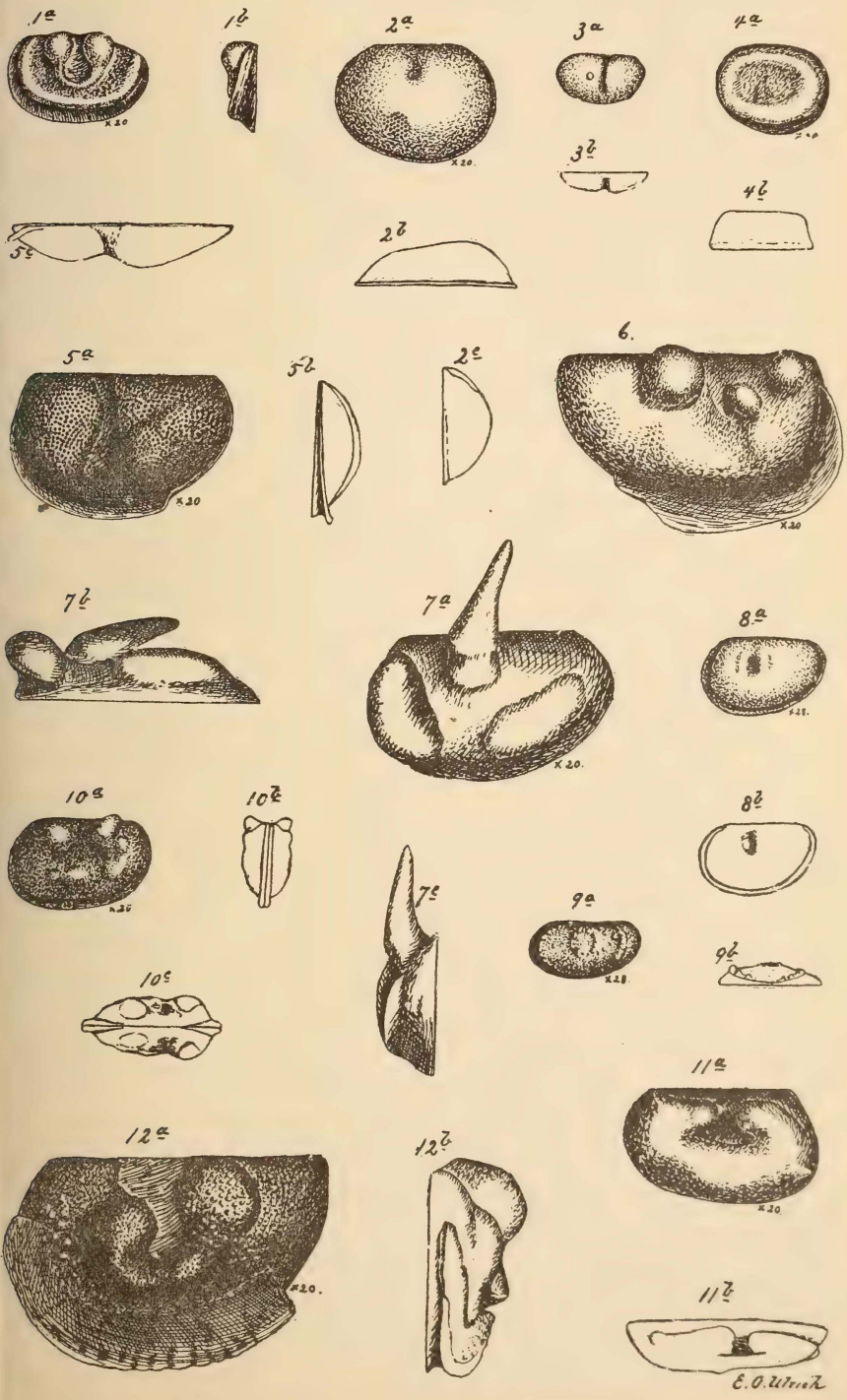
Fig. 8. Primitia granimarginata, n. sp. 201
8*a*, left valve, x 28, from near Grayson Springs, Ky. The small granules at the margin are not well shown in the figure.
8*b*, another valve, in outline, x 28, differing slightly in shape.

Fig. 9. Moorea granosa, n. sp. 206
9*a* and 9*b*, side and ventral views, x 28, of a right valve.

Fig. 10. Ulrichia emarginata, n. sp. 203
10*a*, 10*b* and 10*c*, three views of an entire carapace, x 28.

Fig. 11. Ulrichia confluens, n. sp. 203
11*a* and 11*b*, side and dorsal views of a left valve, x 20.

Fig. 12. Bollia granifera, n. sp. 205
12*a* and 12*b*, side and posterior views of a right valve, x 20.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11a
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11b
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Plate XIII.

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Figs. 1 and 2. Barychilina punctostriata, n. gen. et sp. 199

1*a*, right side, 1*b*, left side, 1*c*, posterior end, and 1*d*, dorsal view of a perfect carapace, x 20. Falls of the Ohio.

1*e*, small portion of surface, x 75, showing rows of punctures between the striæ.

2*a*, 2*b* and 2*c*, three views, x 20, of a worn left valve.

Fig. 3. Barychilina punctostriata, var. curta, n. sp. 199

3*a*, 3*b* and 3*c*, outline views of a right valve, x 20.

Fig. 4. Barychilina pulchella, n. sp. 199

4*a*, 4*b*, 4*c* and 4*d*, right side, left side, dorsal, and posterior views of an entire carapace, x 28 (4*d*, x 20.) Falls of the Ohio.

Fig. 5. Pachydomella tumida, n. gen. et sp. 198

5*a*, right side, 5*b*, anterior end, 5*c*, dorsal view of a complete example, x 28. Falls of the Ohio.

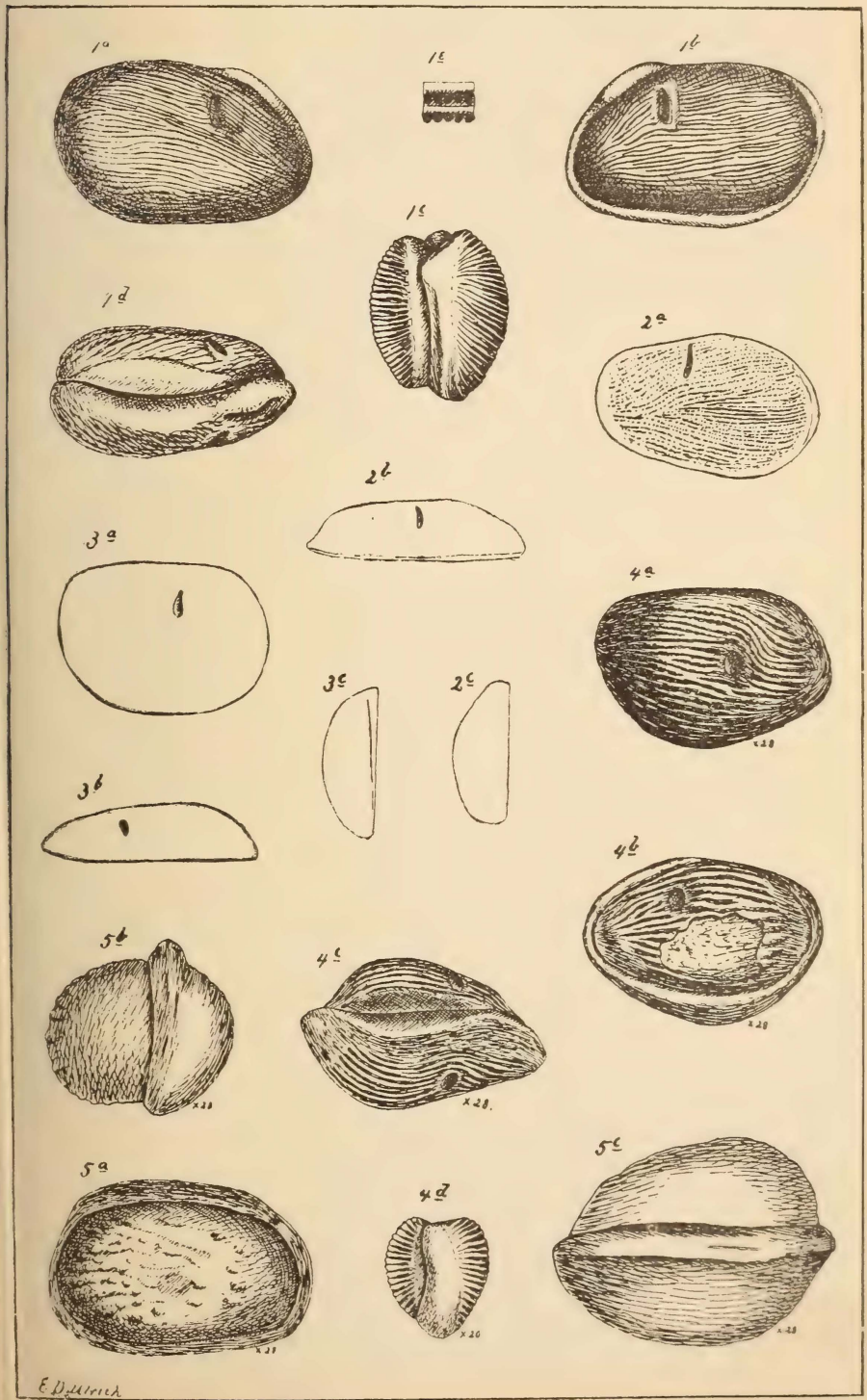
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Plate XIV.

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Fig. 1. Beyrichia (? Depranella) kalmodini, Jones 190

1*a* and 1*b*, side and dorsal views of a left valve, x 20.

1*c*, interior of another perfect left valve, x 20, showing the wide concave frill, and other features of the species. Falls of the Ohio.

Figs. 2 and 3. Beyrichia lyoni, n. sp 190

2*a*, 2*b* and 2*c*, side, dorsal, and posterior views of a right valve, x 20. Falls of the Ohio.

3, a left valve, with hypertrophied ventral lobe, x 20.

Fig. 4 Beyrichia radiata, var. cestriensis, n. var 204

4*a* and 4*b*, side and posterior views of a left valve, x 28.

Fig. 5. Bollia obesa, n. sp 189

5*a* and 5*b*, side and front views of a left valve, x 20.

5*c*, longitudinal section through center of valve. Falls of the Ohio.

Fig. 6. Bollia ungula, Jones 188

6*a* and 6*b*, side and posterior views of a perfect left valve, x 20. Falls of the Ohio.

Fig. 7. Primitia cestriensis, var. caldwellensis, n. var 202

7*a*, 7*b* and 7*c*, side, posterior, and ventral views of a right valve, x 28. Caldwell Co., Ky.

Fig. 8. Primitia subæquata, n. sp 202

8*a*, 8*b* and 8*c*, side, front, and ventral views of a valve of this species, x 28. Caldwell Co., Ky.

Fig. 9. Cypridina herzeri, n. sp 209

9*a*, 9*b* and 9*c*, three views of a left valve, x 20. Richfield, Ohio.

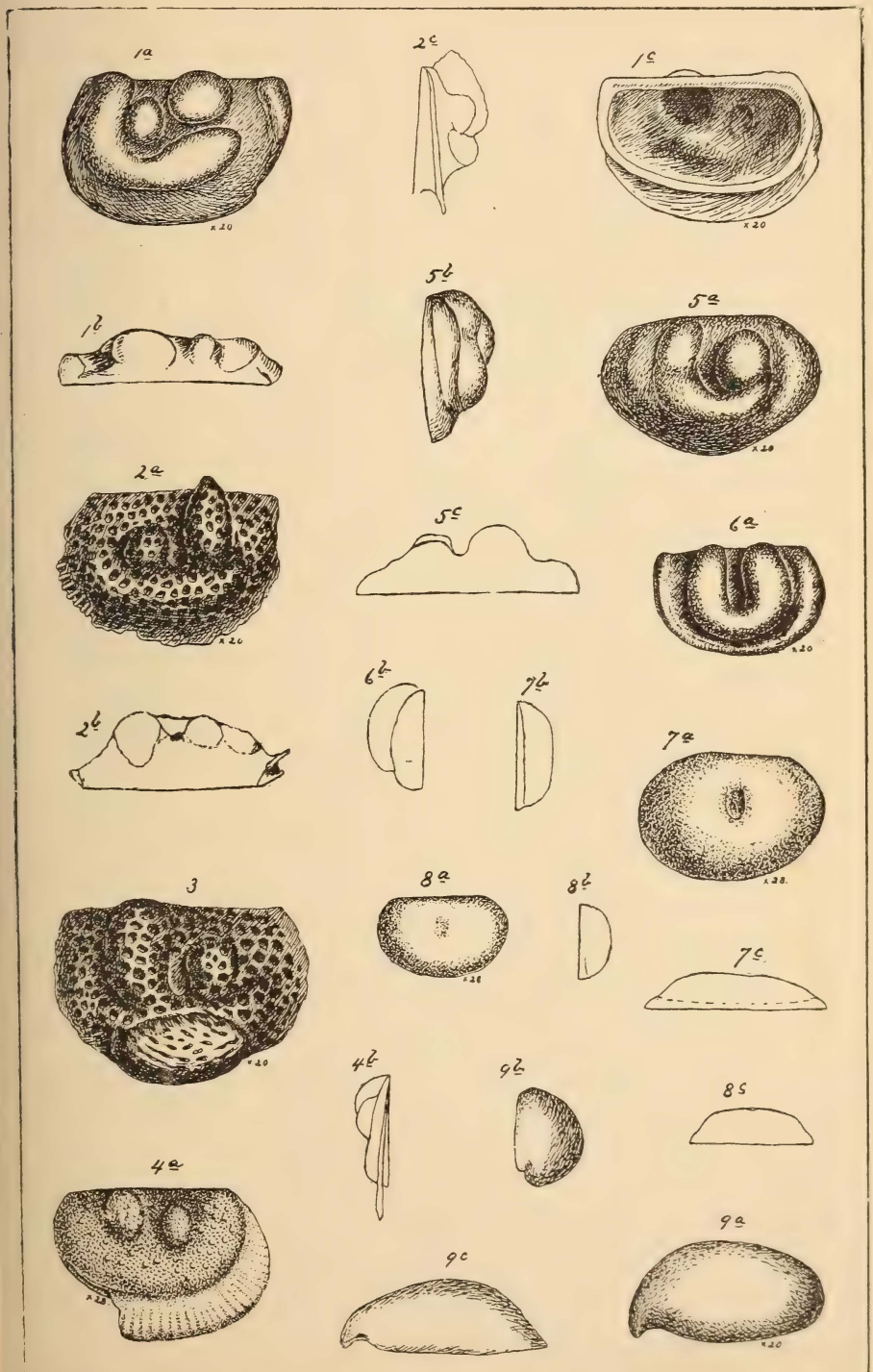

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Plate XV.

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Fig. 1. Kirkbya subquadrata, n. sp. 192

1*a*, 1*b* and 1*c*, side, posterior, and dorsal views of a right valve, x 28. Falls of the Ohio.

Fig. 2. Kirkbya parallela, n. sp. 192

2*a* and 2*b*, side and posterior views of a right valve, x 28. Falls of the Ohio.

Figs. 3 and 4. Kirkbya semimuralis, n. sp. 193

3*a* and 3*b*, side and ventral views, x 28, of a rather short right valve.

4*a*, 4*b* and 4*c*, side, ventral, and posterior views, x 28, of a longer and otherwise different right valve. Falls of the Ohio.

Fig. 5. Halliella retifera, n. gen. et sp. 185

5*a* and 5*b*, side and posterior views of a right valve, x 20.

5*b* and 5*d*, ventral and side views of a left valve, x 20.

5*e*, interior of another left valve, x 20. Falls of the Ohio.

Fig. 6. Ctenobolbina informis, n. sp. 187

6*a*, 6*b* and 6*c*, side, posterior, and ventral views of a right valve, x 20. Falls of the Ohio.

Fig. 7. Ctenobolbina minima, n. sp. 188

A right valve x 20. 18 mile creek, N. Y.

Fig. 8. Ctenobolbina papillosa, n. sp. 186

8*a*, 8*b* and 8*c*, side, posterior, and ventral views of a left valve, x 20. Falls of the Ohio.

Fig. 9. Ctenobolbina antespinosa, n. sp. 187

9*a*, 9*b* and 9*c*, side, dorsal, and posterior views of a left valve, x 20. The frill is broken away at the ends. Falls of the Ohio.

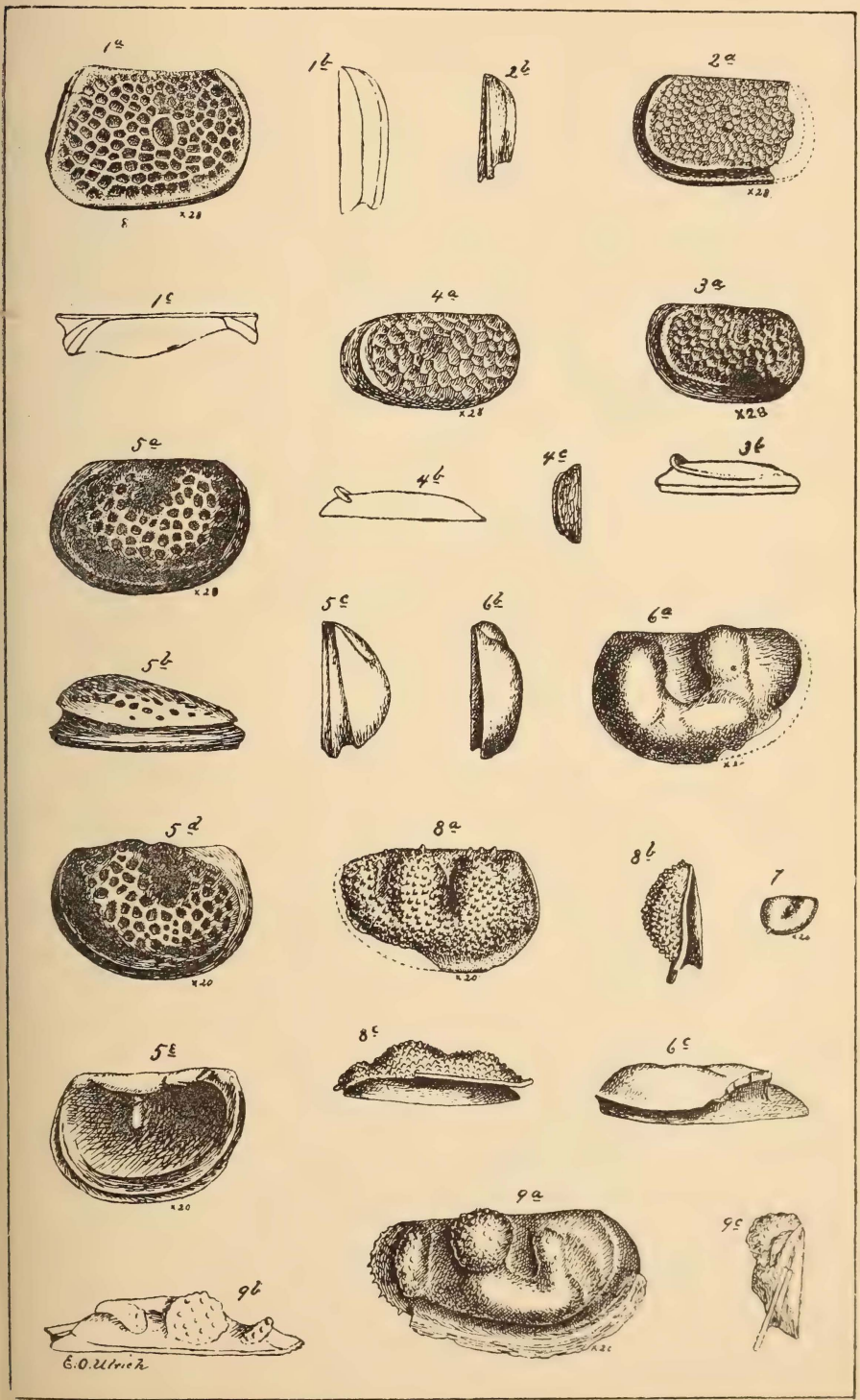
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Plate XVI.

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Fig. 1. Leperditia (?) subrotunda, n. sp. 181
1*a*, 1*b* and 1*c*, side, front, and ventral views of a left valve, x 20. Falls of the Ohio.

Fig. 2. Isochilina rectangularis, n. sp. 182
2*a*, 2*b* and 2*c*, three views of a left valve, x 28. Falls of the Ohio.

Fig. 3 Aparchites inornatus, n. sp. 182
3*a*, 3*b*, side and ventral views of a left valve, x 20. Falls of the Ohio.

Fig. 4. Moorea bicornuta, n. sp. 191
4*a*, 4*b* and 4*c*, side, front, and ventral views of a right valve, x 20; 18 mile creek, N. Y.

Fig. 5. Æchmina marginata, n. sp. 184
Left valve, x 20. Hamilton group, 18 mile creek, N. Y.

Fig. 6. Octonaria ovata, n. sp. 194
6*a* and 6*b*, right side, and ventral views of an entire carapace, x 28. Falls of the Ohio.

Fig. 7. Octonaria clavigera, n. sp. 195
7*a*, 7*b* and 7*c*, side, anterior, and ventral views, x 20, of a right valve. Falls of the Ohio.

Fig. 8. Octonaria stigmata, n. sp. 193
8*a* and 8*b*, side and front views of a right valve, x 28.

Fig. 9. Octonaria stigmata, var. oblonga, n. var. 194
9*a*, 9*b* and 9*c*, three views of a valve (? right) of this variety, x 20.

Fig. 10. Octonaria stigmata, var. loculosa, n. var. 194
A right valve, x 28. Species and varieties from Falls of the Ohio.

Fig. 11. Bythocypris indianensis, n. sp. 197
11*a*, 11*b* and 11*c*, side, front, and dorsal views of a left valve, x 28. Falls of the Ohio.

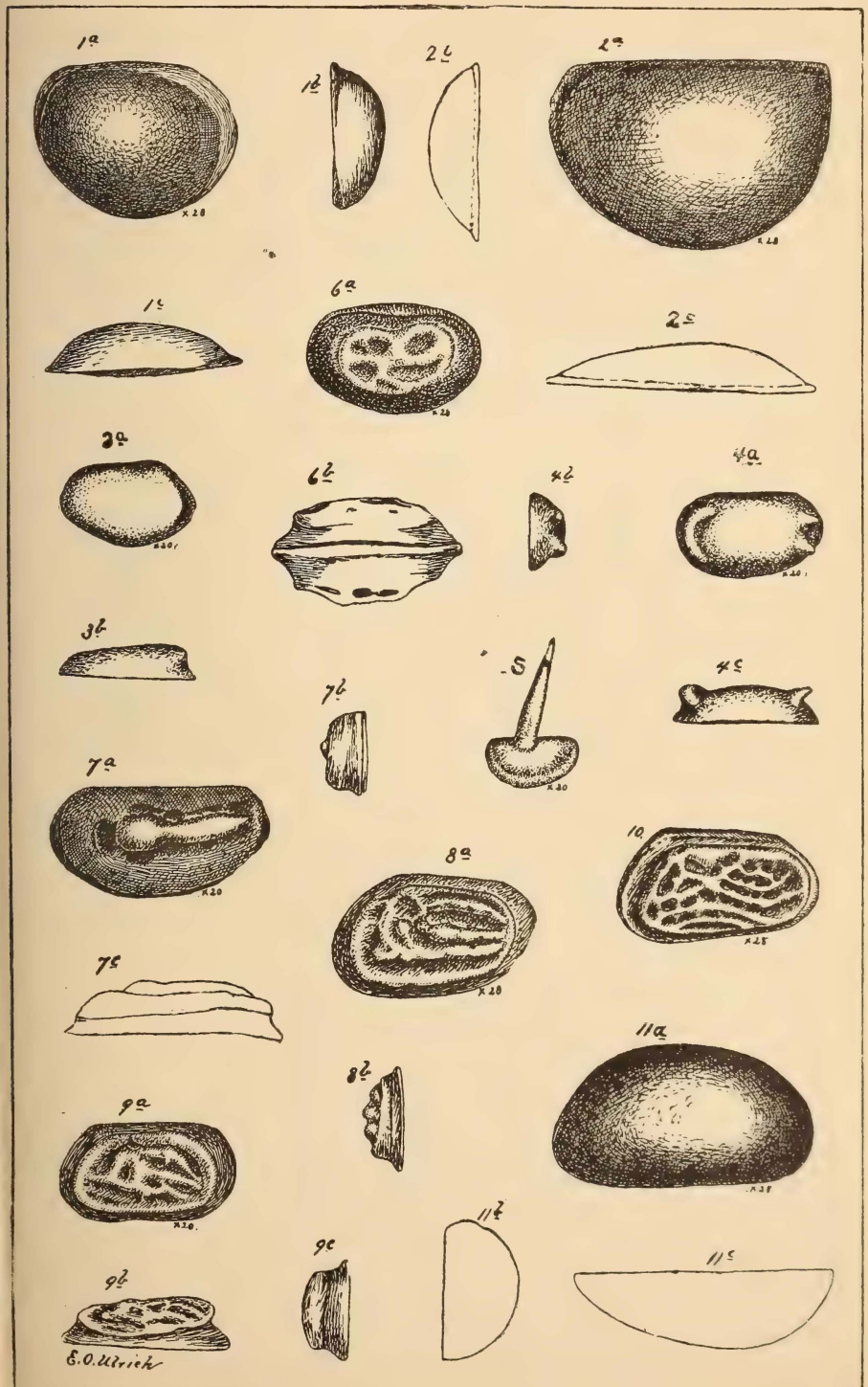
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Plate XVII.

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Fig. 1. Bythocypris devonica, n. sp. 196

1*a*, 1*b* and 1*c*, right side, posterior, and ventral views of a perfect carapace, x 20. Falls of the Ohio.

Fig. 2. Bythocypris punctulata, n. sp. 196

2*a*, 2*b* and 2*c*, right side, anterior, and ventral views of a complete carapace, x 20. Falls of the Ohio.

Figs. 3 and 4. Cytherella ovatiformis, n. sp*. 209

*Figs. 3, 4*a*, *b* and *c*, are reversed on the plate.

3, interior of a right valve, x 28.

4*a*, 4*b* and 4*c*, three views of a complete carapace, x 28. Caldwell Co., Ky.

Fig. 5. Bairdia leguminoides, n. sp. 197

5*a*, 5*b* and 5*c*, right side, ventral, and anterior views of a perfect carapace, x 20. 18 mile creek, N. Y.

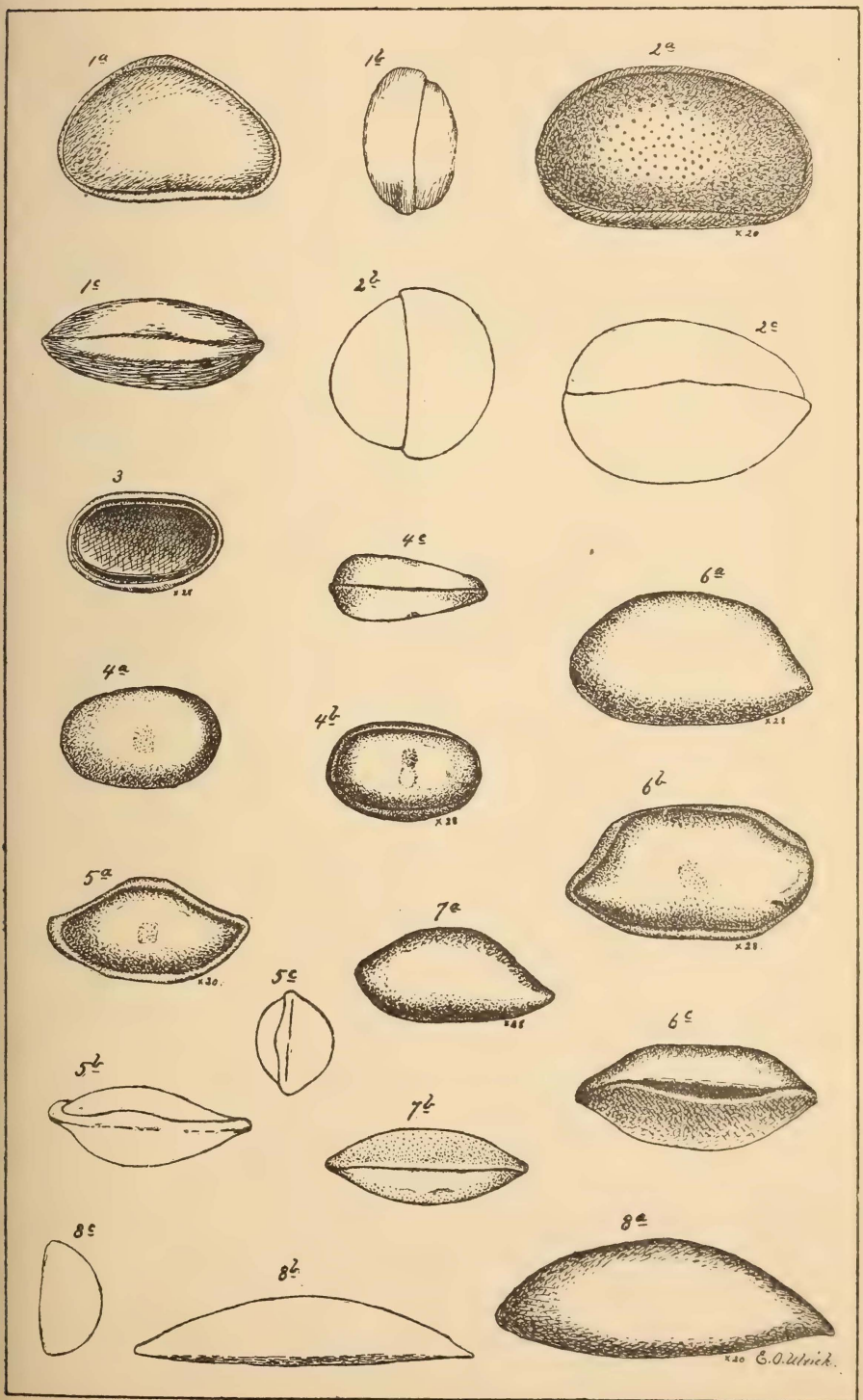
Figs. 6 and 7. Bairdia cestriensis, n. sp. 210

6*a*, 6*b* and 6*c*, left side, right side, and dorsal views, x 28, of an old example

7*a* and 7*b*, left side and ventral views of a small specimen, x 28. Both from Caldwell Co., Ky.

Fig. 8. Pontocypris (?) acuminata, n. sp. 210

8*a*, 8*b* and 8*c*, side, ventral, and posterior views of a left valve, x 20.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x 20
1c
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x 11
4c
6a
x 21
4a
4b
x 28
6b
x 21
5a
x 30.
7a
x 41
5c
6c
5b
7b
8c
8b
8a
x 20
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Plate XVIII.

Page.

Fig. 1. Leperditia nicklesi, n. sp 200

1*a*, 1*b* and 1*c*, side, anterior, and ventral views, x 28, of a left valve. Columbia, Ill.

1*d*, interior of another left valve; narrower in front; x 28.

1*e*, sectional view of ventral portion of carapace, showing method of overlap.

Fig. 2. Kirkbya (? Barychilina) costata (McCoy) 208

2*a* and 2*b*, side and edge views of a valve of this species, x 20. Columbia, Ill.

Fig. 3. Kirkbya venosa, n. sp 208

3*a*, side and posterior views of a right valve, x 28; from Chester group, near Grayson Springs, Ky.

Figs. 4 and 5. Kirkbya oblonga, Jones and Kirkby 206

4*a* and 4*b*, side and end views of a symmetrical valve of this species, x 28. Chester, Ill.

5*a* and 5*b*, side and end views of an unsymmetrical right valve, x 28. Near Grayson Springs, Ky.

Fig. 6. Kirkbya lindahli, n. sp 207

6*a*, 6*b* and 6*c*, side, ventral, and posterior views, x 20, of a medium sized right valve. Columbia, Ill.

Fig. 7. Beyrichia simulatrix, n. sp 205

7*a* and 7*b*, side and posterior views of a left valve, x 28. Near Grayson Springs, Ky.

Fig. 8. Kirkbya tricollina, Jones and Kirkby 207

8*a* and 8*b*, side and end views, x 28, of a (? right) valve of this species. Near Grayson Springs, Ky.

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