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COMMON OSTRACODA OF THE TRAVERSE GROUP

BY
ALFRED S. WARTHIN, JR.

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(Continuation of Contributions from the Museum of Geology)

UNIVERSITY OF MICHIGAN

Editor: EUGENE S. MCCARTNEY

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(Continued on inside of back cover)

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INTRODUCTION

THE middle Devonian limestones and shales of the Traverse group in Michigan have furnished paleontologists with a diverse series of large fossils, but comparatively little is known of the abundant and well-preserved microscopic forms. Because of their use in identifying strata encountered in drilling wells for oil these small fossils are of particular importance at the present time. Among the microscopic species those of the Ostracoda are well adapted for this work because of their relatively short time ranges. Some of the more abundant and conspicuous Ostracoda found in these beds are now described as a preliminary step toward the wider knowledge of these minute forms in the Traverse group. The twenty-one species and varieties discussed here represent about one fifth of the Traverse ostracod fauna.

The author is indebted to Professor G. M. Ehlers of the University of Michigan and R. B. Newcombe of the Michigan Geological Survey Division for aid in the study of these fossils.

The holotypes of the new species are deposited in the Museum of Paleontology of the University of Michigan. Other type material is in the collections at the American Museum of Natural History in New York City, and at the U. S. National Museum in Washington. The illustrations are the work of L. K. Barkman.

STRATIGRAPHY

The Traverse beds underlie the larger part of the Lower Peninsula of Michigan, but are well exposed only at the northern

end. The best outcrops lie in a semicircular belt stretching from Charlevoix on the Lake Michigan shore to Alpena on the Lake Huron side of the peninsula. The succession of rocks in this belt has been studied by numerous geologists, sometimes with diverse results because of the large amount of glacial cover present. The stratigraphy of the series on the west and east sides of the state has been most recently published by Pohl[1] and Ver Wiebe,[2] who have subdivided the Traverse group as follows:

WESTERN (Pohl)		EASTERN (Ver Wiebe)	
Petoskey limestone	85′	Thunder Bay limestones and shales	130′
Charlevoix stage	31′	Alpena limestone	126′
Gravel Point stage	112′	Long Lake limestones and shales	196′
Limestones and shales (covered)	354′	Bell shale	80′
Bell shale (covered)	70′		

Because of lateral variation in lithology (with consequent variation in the faunal facies) it is not possible at present to correlate across the state any but the lowest of these members.

Collections for this study were made chiefly from the upper and lowermost members of the group, in order to determine the vertical ranges of the ostracod species. The clay shales furnished the best specimens because of their easy disintegration on boiling in a strong solution of baking soda. The more important localities from which collections were made are listed in detail after the descriptions of species.

Ostracod Index Species

Upper Traverse

Welleria aftonensis, sp. nov., was found only in the beds at the quarry at Afton, Cheboygan County, at a horizon a few feet below the overlying Antrim black shale. This genus occurs elsewhere characteristically in limestones deposited in retreating seas. It is possible that the limestones at Afton represent the deposits of such a sea, and are perhaps younger than the top beds of the

[1] Pohl, E. R., *Proc. U. S. Nat. Mus.*, Vol. 76, Art. 14, 1930.

[2] Ver Wiebe, W. A., *Pap. Mich. Acad. Sci., Arts and Letters*, Vol. 7 (1926), pp. 181–190, 1927.

Traverse in either the Charlevoix or Alpena regions, which are nearer the edge of the Michigan basin.

Other species which are apparently restricted to the upper third of the Traverse beds are *Monoceratina casei*, sp. nov., *Halliella bellipuncta*, Van Pelt, and *Amphissites tenuis*, sp. nov.

Species which range throughout the entire Traverse group, but which are rare in the lower third and common in the upper part, include *Tetradella cicatricosa*, sp. nov., and *Ulrichia fragilis*, sp. nov.

Lower Traverse

Poloniella cingulata and *Octonaria nucleolata*, spp. nov., were not found above the lowest third of the group. Species abundant in the lower and rare or absent in the upper Traverse include *Thlipsurella swartzi*, sp. nov., *Octonaria crescentiformis* Van Pelt, and *Euglyphella sigmoidalis primitiva*, sp. nov.

SYSTEMATIC DESCRIPTIONS

Family PRIMITIIDAE Ulrich and Bassler

Genus MONOCERATINA Roth

Roth, Journ. Pal., Vol. 2, p. 16, 1928.

Monoceratina casei, sp. nov.

(Plate I, Fig. 1)

Carapace small, with pronounced backward swing; greatest height and thickness central; anterior end high and sharp; posterior end blunt, below the median line of the shell; hinge line straight, nearly equal to the total length; margins simple; each valve ornamented with a single heavy spine arising near the ventral border just anterior to the center, and directed outward and downward from the carapace; surface, including the spines, very finely reticulated. Length, 0.62 mm.; height, 0.34 mm.; thickness (spines excluded), 0.3 mm.

Holotype No. 14531 U.M.

Horizon and locality. — Thunder Bay series, locality 5 (see p. 224).

This small but conspicuous species is common only in the Thunder Bay series. It is distinguished from *M. ventrale* Roth, the genotype, by having a much sharper and longer spine.

Genus HALLIELLA Ulrich

Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. 13, p. 184, 1891.

Halliella bellipuncta Van Pelt

(Plate I, Fig. 2)

Amphissites bellipunctus Van Pelt, Journ. Pal., Vol. 7, p. 332, pl. 39, figs. 37–40, 1933 (Middle Devonian, Michigan).

Carapace semioval in outline, with very little backward swing; greatest height just posterior to center; greatest thickness in center of anterior half; ends smoothly rounded on the ventral side, meeting the dorsal margin with distinct obtuse angles; a heavy smooth border surrounds all margins; sulcus sharply defined, subtriangular, slightly posterior to the center; a strong smooth ridge, parallel to the dorsal margin, crosses each valve from the posterior border nearly to the anterior end, where it ends in a knob or anteriorly directed blunt spine; remaining surface finely pitted, the pits being roughly grouped in pairs. Length, 0.71 mm.; height, 0.36 mm.

Plesiotype No. 14532 U.M.

Horizon and locality. — Lower Thunder Bay series, locality 4.

This little species has a long time range, but seems to be more abundant in the upper part of its extent. The pairing of the surface pits is only apparent in clean specimens.

Family ZYGOBOLBIDAE Ulrich and Bassler

Genus WELLERIA Ulrich and Bassler

Ulrich and Bassler, Maryland Geol. Surv., Silurian, p. 307, 1923.

Welleria aftonensis, sp. nov.

(Plate I, Fig. 3)

Carapace large, subovate in lateral view; greatest height just posterior to the center; greatest thickness central; hinge line

straight, three fourths of the total length; anterior end nearly straight, forming a slightly obtuse angle with the hinge line; posterior end evenly rounded, meeting the hinge at an angle of about 135 degrees; surface of valves formed chiefly by three nodes, which are confluent ventrally; anterior node the largest, covering almost half the valve; median node semicircular above, not approaching the hinge as closely as the anterior; posterior node low, poorly defined; surface otherwise smooth. Length, 1.53 mm.; height, 1.11 mm.

Holotype No. 14533 U.M.

Horizon and locality. — Upper Traverse, locality 8.

This species occurs in tremendous numbers in some of the limestone beds at the Afton quarry, but was not found in calcareous shales elsewhere. It is best distinguished from *W. obliqua* Ulrich and Bassler by the semicircular outline of the dorsal end of the middle lobe.

Family BEYRICHIIDAE Jones

Genus TETRADELLA Ulrich

Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. 13, p. 112, 1891.

Tetradella cicatricosa, sp. nov.

(Plate I, Figs. 4–6)

Carapace semiovate in lateral view, with pronounced backward swing; greatest height one third of length from posterior end; both ends make distinct, slightly obtuse angles with the hinge line; hinge line straight (convex in adult females), nearly the greatest length of the shell; well-preserved adults show about seventy fine denticulations on the hinge and rarely some on the free margins; free margins surrounded by a narrow false border; in females the false border is swollen from the anterior node to the post-cardinal angle, incorporating the lower ends of the three posterior nodes, and containing six brood pits; each valve is crossed transversely by four ridgelike nodes; the anterior node is low and subelliptical; the other nodes are narrow and higher, the one next to the anterior being the strongest; in males the

lower ends of the two inner nodes project below the ventral margin; the outer surface of the nodes (except the posterior node in females) is pustulose, the pustulose areas being surrounded by a distinct border; a short fimbriate keel borders the anterior end of the right valve; right valve grooved on free margins to receive the edge of the left valve. Length, 1.04 mm.; height, 0.59 mm.; thickness, 0.61 mm.

Holotype No. 14534 U.M.; Paratype No. 14535 U.M.

Horizon and locality. — Thunder Bay series, locality 5.

The juvenile stages of this beautiful species are not like those of *Tetradella*, and this form perhaps belongs in some other genus. Young carapaces about 0.3 mm. in length are spinose rather than ridged, and resemble *Kiesowia* Ulrich and Bassler in general appearance.

This species occurs throughout the Traverse group, but is more abundant in the upper beds. It does not range much above the top of the Traverse as exposed in Alpena County.

Family KLOEDENELLIDAE Ulrich and Bassler

Genus DIZYGOPLEURA Ulrich and Bassler

Ulrich and Bassler, Maryland Geol. Surv., Silurian, p. 313, 1923.

Dizygopleura euglyphea, sp. nov.

(Plate I, Fig. 7)

Carapace subovate; greatest height near center of posterior half; greatest thickness in center of anterior half; anterior end subacute, just below the dorsal margin; posterior end blunt, evenly rounded, on the median line of the shell; dorsal margin gently convex, with a faint upturn at the antero-cardinal angle and a distinct prominence at the posterior end of the hinge line, caused by the interlocking tooth; anterior and posterior sulci straight and of equal length; median sulcus curved posteriorly, twice as wide as the other sulci at its upper end, and dying out just below the median line of the shell; slope from the posterior node to the margin broad and even; anterior node sharply delimited, with a rather broad slope between it and the end; surface

otherwise smooth; right valve overlaps the smaller left valve on all margins. Length, 1.22 mm.; height, 0.69 mm.

Holotype No. 14536 U.M.

Horizon and locality. — Lower Gravel Point stage, locality 2.

This species is distinguished from the many Silurian forms of its genus by the straightness and uniform width of the anterior and posterior sulci. It is close to *D. clarkei* and *D. halli* (Jones), but it has a sharper anterior end in lateral view than those species.

Well-preserved specimens show that the edges of the nodes and sulci which face forward are distinctly sharper than those facing backward.

Dizygopleura oblonga, sp. nov.

(Plate I, Fig. 8)

Carapace suboblong in lateral view; greatest height in center of posterior half; anterior end almost as evenly rounded as the symmetrical posterior end; dorsal margin convex in posterior half, concave in the anterior part; ventral margins slightly concave in front of center; posterior sulcus curved forward in its lower part, nearly reaching the mid line of the shell; median sulcus broad, slightly comma-shaped, dying out about the center of the valve; anterior sulcus arises farther below the dorsal margin than the others, and curves posteriorly in its lower part, nearly meeting the end of the posterior sulcus; no distinct post-dorsal tooth on the hinge line. Length (right valve), 0.82 mm.; height, 0.50 mm.

Holotype No. 14537 U.M.

Horizon and locality. — Lower Long Lake series, locality 3.

This form is somewhat like *D. clarkei* (Jones), but is distinctly longer, its length-height ratio being 1.7 as compared with 1.5 in Jones' form from the upper Silurian. The added length is found chiefly on the ends of the valves, beyond the nodes.

Genus POLONIELLA Gürich

Gürich, Verhandl. Russ.-kaiserliche min. Ges. St. Petersburg, Ser. 2, Vol. 32, p. 388, 1896.

This genus includes degenerate descendants of *Dizygopleura*, the nodes and sulci having been much distorted. The anterior and posterior sulci meet ventrally.

Poloniella cingulata, sp. nov.

(Plate I, Fig. 9)

Carapace suboblong in lateral view; greatest height in center of posterior half; greatest thickness just post-ventral to the center of the anterior half; anterior end higher and sharper than the broadly rounded posterior end; dorsal margin straight in the central third, concave anteriorly and broken posteriorly by the large hinge tooth; ventral margin straight, rising anteriorly; posterior sulcus arises at the hinge tooth and runs in a straight line two thirds of the distance down the valve, then narrows and turns forward to join the base of the anterior sulcus; median sulcus triangular, ending just below the mid line in a sharp point close to the posterior sulcus; anterior sulcus strongest ventrally, dying out about the mid line, leaving the anterior node almost undivided. Length, 1.06 mm.; height, 0.77 mm.

Holotype No. 14538 U.M.

Horizon and locality. — Upper Gravel Point stage, locality 1.

This species is distinguished from young specimens of *P. devonica* Gürich, the genotype, by the straight posterior sulcus. It was not found in the higher beds of the Traverse.

Family KIRKBYIDAE Ulrich and Bassler

Genus ULRICHIA Jones

Jones, Quart. Journ. Geol. Soc. London, Vol. 46, p. 543, 1890.

Ulrichia conradi Jones

(Plate I, Fig. 10)

Jones, Quart. Journ. Geol. Soc. London, Vol. 46, p. 544, text fig. 2, 1890 (Hamilton group, Thedford, Ontario).

Carapace semiovate; greatest height central; anterior end slightly higher and sharper than the posterior; hinge line straight, nearly equal to the total length; free margins surrounded by a heavy false border; posterior tubercle blunter than the anterior; anterior tubercle inclined slightly forward, extending well above the hinge line; kirkbyan pit shallow, round, on the antero-ventral corner of the posterior tubercle; surface, except for border and tubercles, coarsely reticulated. Length, 0.69 mm.; height, 0.42 mm.

The kirkbyan pit is usually not conspicuous, but its presence indicates the affiliation of this genus with the Kirkbyidae rather than the Primitiidae.

Plesiotype No. 14539 U.M.

Horizon and locality. — Thunder Bay series, locality 5.

Ulrichia fragilis, sp. nov.

(Plate I, Fig. 11)

Carapace semiovate in lateral view, with pronounced backward swing; greatest height just posterior to the center; anterior end much sharper and higher than the posterior; hinge line straight, four fifths of the total length; false border around the free margins delimited by a thin carina which is strongest ventrally; the carina describes a nearly perfect semicircle, cutting across the anterior portion about one sixth of the length from the end; tubercles blunt, short, converging toward the dorsal margin, where they barely project above the hinge line; kirkbyan pit twice the size of the reticulation pits, located on the antero-ventral slope of the posterior tubercle; surface of the valves within the false border finely reticulated. Length, 0.53 mm., height, 0.33 mm.

Holotype No. 14540 U.M.

Horizon and locality. — Hamilton group, Widder beds, twelve and one-half feet above "encrinal" limestone, Arkona, Ontario.

The shell of this little species is extremely delicate, and undistorted specimens are rare. The holotype was taken from a Canadian locality where perfect individuals are common.

This form is quickly recognized by the broad smooth area on the anterior end between the carina and the margin.

Genus AMPHISSITES Girty

Girty, Ann. N. Y. Acad. Sci., Vol. 20, p. 235, 1910.

Amphissites subquadratus (Ulrich)

(Plate I, Fig. 12)

Kirkbya subquadrata Ulrich, Journ. Cincinnati Soc. Nat. Hist., Vol. 13, p. 192, pl. 15, fig. 1, 1891 (Devonian Bryozoa bed, Falls of the Ohio).

Carapace subquadrate in lateral view; greatest height one fourth of the length from the posterior end; greatest thickness in center of posterior half; cardinal angles subequal; dorsal margin smooth and straight, the articulation between the valves being strongest at the cardinal angles, where a tooth on the left valve fits into a depression on the right; free margins smooth or striated parallel to the free edge; a heavy carina runs around each valve between the cardinal angles, nearly paralleling the ventral border, but cutting sharply across both ends, producing the subquadrate appearance of the species; a variable inner keel arises about three reticulations post-ventrally of the kirkbyan pit and runs forward until it meets the main keel, curving slightly upward as it does so; kirkbyan pit slightly anterior to the center of the valve, oval in shape, about the size of three reticulations; an indistinct node lies just anterior and another just posterior to the kirkbyan pit, the posterior node being the larger; surface coarsely reticulated; valves essentially equal. Length, 1.00 mm.; height, 0.68 mm.

The appearance of this species varies with the age of the individual carapace, and the foregoing description fits best the average adult about one millimeter in length. In smaller indi-

viduals the inner keel is faint or absent, and the main keel is extremely conspicuous. Larger specimens, which run up to 1.3 mm. in length, show their old age in the character of their reticulation. The lines between the pits tend to strengthen in certain directions only, so that a striated rather than reticulated appearance is seen in specimens partly covered with matrix. This change in the surface usually appears first in the region antero-dorsal to the kirkbyan pit, and a small carina is sometimes produced in that region.

Plesiotype No. 14541 U.M.

Horizon and locality. — Thunder Bay series, locality 5.

Amphissites tenuis, sp. nov.

(Plate I, Fig. 13)

Carapace thin, suboblong in lateral view, with very little backward swing in undistorted specimens; height slightly greater in the posterior half; thickness slightly greater in anterior portion, usually much greater because of distortion; ends subequal, smoothly rounded; hinge line straight, inconspicuous, three fourths of the total length; free margins paralleled by a delicate carina; other carinae and nodes absent; kirkbyan pit central, round, not much larger than a reticulation; entire surface except cardinal and free margins finely reticulated, the pits usually showing a tendency toward concentric arrangement around the kirkbyan pit; valves essentially equal. Length, 0.53 mm.; height, 0.34 mm.

Cotype No. 14542 U.M.

Horizon and locality. — Upper Gravel Point stage, locality 1.

This species represents a primitive type of *Amphissites* with the kirkbyan pit and the cardinal teeth poorly developed. Together with *A. retiferus* Roth and *A. concentricus* (Ulrich & Bassler) it probably represents an intermediate stage between *Laccoprimitia* or *Euprimitia* and some of the less ornamented *Amphissites* of the upper Paleozoic. The genus *Amphissites*, as the name is used at present, is polyphyletic, containing species descended from three or more different sources.

The thin carapace of this species is usually somewhat crushed,

the flattened specimens having a more rhomboidal outline than in life. The strongest part of the valve is the antero-dorsal portion, which often resists distortion and stands out as an apparent node.

FAMILY THLIPSURIDAE JONES

Genus THLIPSURELLA Swartz

F. M. Swartz, Journ. Pal., Vol. 6, p. 43, 1932.

Thlipsurella ehlersi, sp. nov.

(Plate I, Fig. 14)

Carapace reniform; greatest height just posterior to center; ends evenly rounded, nearly symmetrical; dorsal margin convex; ventral margin nearly straight; anterior third of left valve ornamented with three longitudinal grooves, the two lower ones being well defined and equal in size, whereas the dorsal groove is merely a branch from the middle one; surface otherwise smooth; right valve overlaps the left on all margins. Length, 0.76 mm.; height, 0.49 mm.

Holotype No. 14543 U.M.

Horizon and locality. — Upper Gravel Point stage, locality 1.

This species is distinguished by the grooving, which occurs only on the left valve. The orientation of the valves is in some doubt.

Thlipsurella swartzi, sp. nov.

(Plate I, Fig. 15)

Carapace subovate in lateral view; greatest height central; greatest thickness just posterior to the center; posterior end higher and sharper than the symmetrical anterior end; dorsal margin nearly straight; ventral margin convex, the convexity being slightest in the central portion; surface of each valve ornamented with a deeply impressed pit located slightly above and in front of the center; a shallow groove starts from the dorsal margin just above the pit and curves forward and downward around it until it dies out about half way to the ventral margin; the right valve overlaps the left on all margins. Length, 0.70 mm.; height, 0.38 mm.

Holotype No. 14544 U.M.

Horizon and locality. — Lower Long Lake series, locality 3.

This species is closely related to *T. curtinensis* Swartz, but the anterior groove does not persist to the ventral margin as in that form. The name is given in appreciation of Mr. Swartz's work on Helderbergian Thlipsuridae.

Genus OCTONARIA Jones

Jones, Ann. Mag. Nat. Hist., Ser. 5, Vol. 19, p. 404, 1887.

Because of its marked ornamentation this genus is easily detected in samples, and its species are readily recognized. Orientation in the following specific descriptions is somewhat in doubt, since most of the usual criteria are lacking.

Octonaria quadricostata Van Pelt

(Plate I, Figs. 16–17)

Van Pelt, Journ. Pal., Vol. 7, p. 336, pl. 39, fig. 45, 1933 (Middle Devonian, Michigan).

Carapace reniform, stout; greatest height just posterior to center; greatest thickness in center of anterior half; ends smoothly rounded, the anterior being the sharper; dorsal border convex, ventral border straight or with a slight median concavity; hinge line straight, one third of the total length, sloping anteriorly; valves thick, the right grooved to receive the margins of the left; each valve ornamented with a low boss just posterior to the center, and a series of deep pits; on the left valve the pits anterior to the boss lie in two parallel longitudinal rows, usually of three pits each, but occasionally with small accessory pits in each row; pits posterior to the boss three in number, arranged in a curve across the valve, the uppermost nearly touching the dorsal margin; right valve has three parallel rows of pits running forward from the boss and terminating in a sharp transverse ridge; a less distinct fourth row of pits may dot the dorsal margin; three large pits define the posterior side of the boss; surface also ornamented with fine longitudinal striations on the margins of the valves. Length, 0.92 mm.; height, 0.58 mm.; thickness, 0.46 mm.

Plesiotypes Nos. 14545–6, U.M.

Horizon and locality. — Gravel Point stage, locality 2.

This conspicuously marked species is best identified by the straight parallel rows of pits anterior to the boss.

Octonaria crescentiformis Van Pelt

(Plate I, Fig. 18)

Van Pelt, Journ. Pal., Vol. 7, p. 334, pl. 39, fig. 58, 1933 (Middle Devonian, Michigan).

Carapace reniform; greatest height just posterior to center; greatest thickness in center of anterior half; ends smoothly rounded, the posterior being slightly below the median line of the shell; dorsal border convex; ventral border straight; right valve grooved to receive the edge of the left, overlapping it slightly in the middle of the ventral margin; left valve strongly convex, bearing three longitudinal grooves formed by the coalescence of deep pits; dorsal groove the longest, convex upward, formed by about ten pits, most deeply impressed at the ends; middle groove also convex upward, lying closely against the dorsal groove, and broken by a prominent cross ridge one third of the way from its posterior end; ventral groove short, straight, lying across the anterior ends of the first two; surface of right valve grooved in similar fashion, but the grooved area is smaller, occupying only the central half of the valve; surface otherwise smooth. Length, 0.89 mm.; height, 0.53 mm.; thickness, 0.40 mm.

Plesiotype No. 14547 U.M.

Horizon and locality. — Gravel Point stage, locality 2.

The most conspicuous feature of this species is the convex dorsal groove, for which the specific name is given. This species shows a marked change in general proportions through the Traverse group, the earliest forms seen (Bell shale) here being considered a distinct species. *O. crescentiformis* may represent an intermediate stage between *O. ovata* Ulrich and *O. quadricostata* Van Pelt.

Octonaria nucleolata, sp. nov.

(Plate I, Fig. 19)

Carapace like the preceding, but smaller and proportionately much shorter. The pits on the surface have not coalesced as thoroughly into grooves in this primitive form. Length, 0.55 mm.; height, 0.44 mm.; thickness, 0.36 mm.

Holotype No. 14548 U.M.

Horizon and locality. — Bell shale, locality 7.

Genus HYPHASMAPHORA Van Pelt

Van Pelt, Journ. Pal., Vol. 7, p. 339, 1933.

Hyphasmaphora textiligera Van Pelt

(Plate I, Fig. 20)

Van Pelt, Journ. Pal., Vol. 7, p. 340, pl. 39, figs. 3–7, 1933 (Middle Devonian, Michigan).

Carapace subovate; greatest height in center of posterior half; hinge line straight, sloping downward anteriorly, one half of the total length; ends smoothly rounded, the posterior being the lower and blunter; margins of each valve nearly paralleled by a finely striated, inward-facing carina, weakest dorsally and strongest at the ends; area within the carina covered with coarse irregular reticulations, the center being always occupied by one conspicuously large round pit; four weak carinae extend out from the central pit, one going to the bordering carina at each end and margin; weak reticulation may be found in well-preserved material between the outer carina and the margins; right valve grooved slightly to receive the margins of the left, also overlapping the left along the center of the ventral side. Length, 0.68 mm.; height, 0.44 mm.

Plesiotype No. 14549 U.M.

Horizon and locality. — Gravel Point stage, locality 2.

The oval carina and central pit of this form give it a superficial appearance suggestive of *Strepula.* The central pit, however, is not a typical kirkbyan pit, and the characters of hingement and overlap are typical of the Thlipsuridae.

Genus **EUGLYPHELLA,** gen. nov.

Carapace subtriangular in lateral view; greatest height in posterior half; anterior end much sharper and higher than the broadly rounded posterior end; hinge line straight, inconspicuous; each valve ornamented with a high sharp carina, the basic plan of which is a hollow letter C open toward the anterior end; anterior ends of both valves bluntly spinose.

Type *Euglyphella sigmoidalis* (Jones) = *Strepula sigmoidalis* Jones. Range, Helderbergian to Hamilton.

The genotype of this group lacks the long hinge line, concentric carination, and reticulation of *Strepula* and is here removed from that genus. It also differs from *Octonaria* in the narrow anterior end, the anterior spines, and the emphasis on carination rather than pitting. The primitive variety described below seems to indicate a descent from the *Octonaria* group. In addition to the species listed here, several undescribed forms occurring in the Devonian of New York state fall in this genus.

Euglyphella sigmoidalis (Jones)

(Plate I, Fig. 21)

Strepula sigmoidalis Jones, Quart. Journ. Geol. Soc. London, Vol. 46, p. 11, pl. 2, fig. 4, 1890 (Hamilton group, Eighteen Mile Creek, New York).

Strepula plantaris Jones, Quart. Journ. Geol. Soc. London, Vol. 46, p. 540, pl. 20, fig. 8, 1890 (Hamilton group, Eighteen Mile Creek, New York).

Octonaria percarinata Van Pelt, Journ. Pal., Vol. 7, p. 335, pl. 39, figs. 52–54, 1933 (Middle Devonian, Michigan).

Carapace subtriangular; greatest height in center of posterior half; anterior end much sharper and higher than the broadly rounded posterior end; hinge line straight, two thirds of the total length; right valve grooved on all margins to receive the edge of the smaller left valve; each valve ornamented with a sharp carina, which forms a flattened hollow C pointing toward the anterior end; the upper limb of the C is rounded and has a weak branch carina forking from its center forward to the dorsal margin; the lower limb of the C is pointed at its anterior end, and shows

a weak cross bar just back of the center; anterior ends of both valves spinose. Length, 0.77 mm.; height, 0.44 mm.

Plesiotype No. 14550 U.M.

The type specimen of *Strepula sigmoidalis* has been cleaned and studied by the writer, and proves to be identical with *S. plantaris*, later described from the same beds by Jones.

Horizon and locality. — Lower Gravel Point stage, locality 2.

Euglyphella sigmoidalis (Jones) var. **primitiva,** var. nov.
(Plate I, Fig. 22)

Carapace like the preceding except in details of ornamentation; the hollow C formed by the carina is not closed anteriorly in the upper limb, and the grooves between the limbs of the carina are distinctly and deeply pitted; carinae less acute than in the preceding form. Length, 0.88 mm.; height, 0.52 mm.

Holotype No. 14551 U.M.

Horizon and locality. — Bell shale, locality 7.

The pitting between the carinations weakens the C effect of the carinae, but shows a close relationship to typical forms of *Octonaria.*

Family BAIRDIIDAE Norman

Genus BYTHOCYPRIS G. S. Brady

G. S. Brady, Rep. Voy. Challenger, Zool., Vol. 1, p. 45, 1880.

Bythocypris devonica Ulrich var. **borealis,** var. nov.
(Plate I, Fig. 23)

Carapace subovate; greatest height and thickness just posterior to the center; anterior end below the mid line of the carapace; posterior end broader and symmetrically placed; dorsal and ventral borders of the left valve convex, the greatest convexity of the ventral border being central, and that of the dorsal border just posterior to the center; overlap of left valve least at anterior end, greatest on the post-dorsal slope and the middle of the ventral margin; surface smooth. Length, 1.06 mm.; height, 0.70 mm.; thickness, 0.45 mm.

Holotype No. 14552 U.M.

Horizon and locality. — Thunder Bay series, locality 5.

This variety differs from *B. devonica* Ulrich in the greater convexity of the ventral border of both valves.

Family CYTHERELLIDAE G. O. Sars

Genus CYTHERELLINA Jones and Holl

Jones and Holl, Ann. Mag. Nat. Hist., Ser. 4, Vol. 3, p. 215, 1869.

Cytherellina punctulifera (Hall)

(Plate I, Figs. 24–25)

Leperditia punctulifera Hall, N. Y. State Cabinet, 13th Ann. Rept., p. 92, 1860 (Hamilton group, New York).

Primitiopsis punctulifera Jones, Quart. Journ. Geol. Soc. London, Vol. 46, p. 9, pl. 2, figs. 7, 12, 13 (Hamilton group, New York).

Cytherella ? bispinulatus Stewart, Geol. Surv. Ohio, 4th Ser., Bull. 32, p. 60, pl. 5, figs. 18–19 (Silica shale, Silica, Ohio).

Primitiopsis unicornis Van Pelt, Journ. Pal., Vol. 7, p. 326, pl. 39, figs. 23–28, 1933 (Middle Devonian, Michigan).

Carapace large, reniform; greatest height central; greatest thickness in the center of the posterior half; dorsal border more convex than the ventral; right valve grooved on all margins to receive the edge of the smaller left valve; left valve overlapped by the right on the central third of the ventral margin; right valve ornamented with one or two short spines on the posterior end and a ridge, strongest dorsally, at the anterior end; left valve with one or two short spines on the posterior end and rarely a weak ridge on the anterior end; surface covered with funnel-shaped pits, weakest at the ends and absent along the dorsal and ventral margins; muscle spots smooth, flush with the surface, at or just in front of the center of each valve. Length, 1.54 mm.; height, 0.93 mm.; thickness, 0.81 mm.

This conspicuous species occurs in almost every middle Devonian sample. It is subject to much variation in the spines and ridges which ornament its carapace, these variations having considerable stratigraphic significance. Specimens from the Bell

shale at the bottom of the Traverse group show but one spine and no ridge on the right valve, whereas those from the Thunder Bay series have two spines and a ridge on the same valve. In the stratigraphically youngest specimens studied (from the top of the Wanakah shale of New York) the anterior ridge on the right valve is extremely strong, and curls up into a blunt spine at the dorsal end.

The depth of the surface pits varies with the perfection of the specimen, worn individuals showing only small, well-separated pits which disappear at each end of the carapace.

The generic affinities of this form are in some doubt, but it clearly does not belong in *Primitiopsis*, where it was placed by Jones, since the pitted surface is the only character which it has in common with the genotype. The general shape, overlap, thickness of shell, and internal sculpture are all so characteristic of *Cytherellina* that it is here referred to that genus, despite some dissimilarity in the surface ornamentation.

Because of its abundance and wide geographic range this form deserves wider recognition as a middle Devonian index fossil. Its occurrence where megafossils may be absent (as in the Arkansas novaculite of Oklahoma) makes it particularly valuable for such a purpose

Plesiotypes Nos. 14553, 15109 U.M.

Horizon and locality. — See page 226.

DESCRIPTION OF LOCALITIES

1. Blue calcareous shale from pit in bottom of unused quarry of Charlevoix Rock Products Co., Sec. 33, Charlevoix Township, Charlevoix County. Upper Gravel Point stage, zone 6, bed 3 of Pohl.

2. Blue-gray, highly calcareous shale with abundant *Atrypa* and *Stropheodonta*, floor of unused quarry at south side of mill, Petoskey Portland Cement Co., Sec. 2, T. 34 N., R. 6 W., Emmet County. Lower Gravel Point stage, zone 2 of Pohl.

3. Blue and yellow clay weathered from limestone at top of abandoned quarry on shore of Black Lake, one-half mile west of Onaway State Park, Cheboygan County. Long Lake series, lower member.

4. Blue shale (upper eight feet a pteropod ooze without megafossils, lower foot highly calcareous with megafossils) on south side of Thunder Bay River, at base of Seven-Mile Dam, Sec. 12, T. 31 N., R. 7 E., Alpena County. Thunder Bay series, basal part.

5. Blue clay shale with megafossils from bank on south side of Thunder Bay River, one mile below Three- (Four-)Mile Dam, Sec. 20, T. 31 N., R. 8 E., Alpena County. Thunder Bay series, basal part, bed 28 of Ver Wiebe.

6. Calcareous gray shale with abundant Bryozoa, bank on Lake Huron shore, tip of Partridge Point, Alpena County. Top of Traverse group in Alpena County, bed 2 of Ver Wiebe.

7. Blue shale with abundant megafossils from drainage ditch in bottom of the quarry of the Great Lakes Stone and Lime Co., Rockport, Alpena County, Michigan. Bell shale, top two feet.

8. Crystalline petroliferous limestone from beds about twenty feet below the top of the quarry face in the quarry of the Afton Stone Co., Afton, Cheboygan County. Probably fifty feet below the top of the Traverse in this area.

EXPLANATION OF PLATE I

All specimens are magnified 30 diameters unless otherwise indicated

All specimens are magnified 30 diameters unless otherwise indicated

All specimens are magnified 30 diameters unless otherwise indicated

PAGE

FIG. 16. *Octonaria quadricostata* Van Pelt 217
Left valve
Plesiotype No. 14545 U.M.
Locality 2

FIG. 17. *Octonaria quadricostata* Van Pelt 217
Right valve
Plesiotype No. 14546 U.M.
Locality 2

FIG. 18. *Octonaria crescentiformis* Van Pelt 218
Right valve
Plesiotype No. 14547 U.M.
Locality 2

FIG. 19. *Octonaria nucleolata*, sp. nov..... 219
Left valve
Holotype No. 14548 U.M.
Locality 7

FIG. 20. *Hyphasmaphora textiligera* Van Pelt 219
Right valve
Plesiotype No. 14549 U.M.
Locality 2

FIG. 21. *Euglyphella sigmoidalis* (Jones)..... 220
Right valve of a typical upper Traverse specimen, more heavily carinated than the New York Hamilton individuals
Plesiotype No. 14550 U.M.
Locality 2

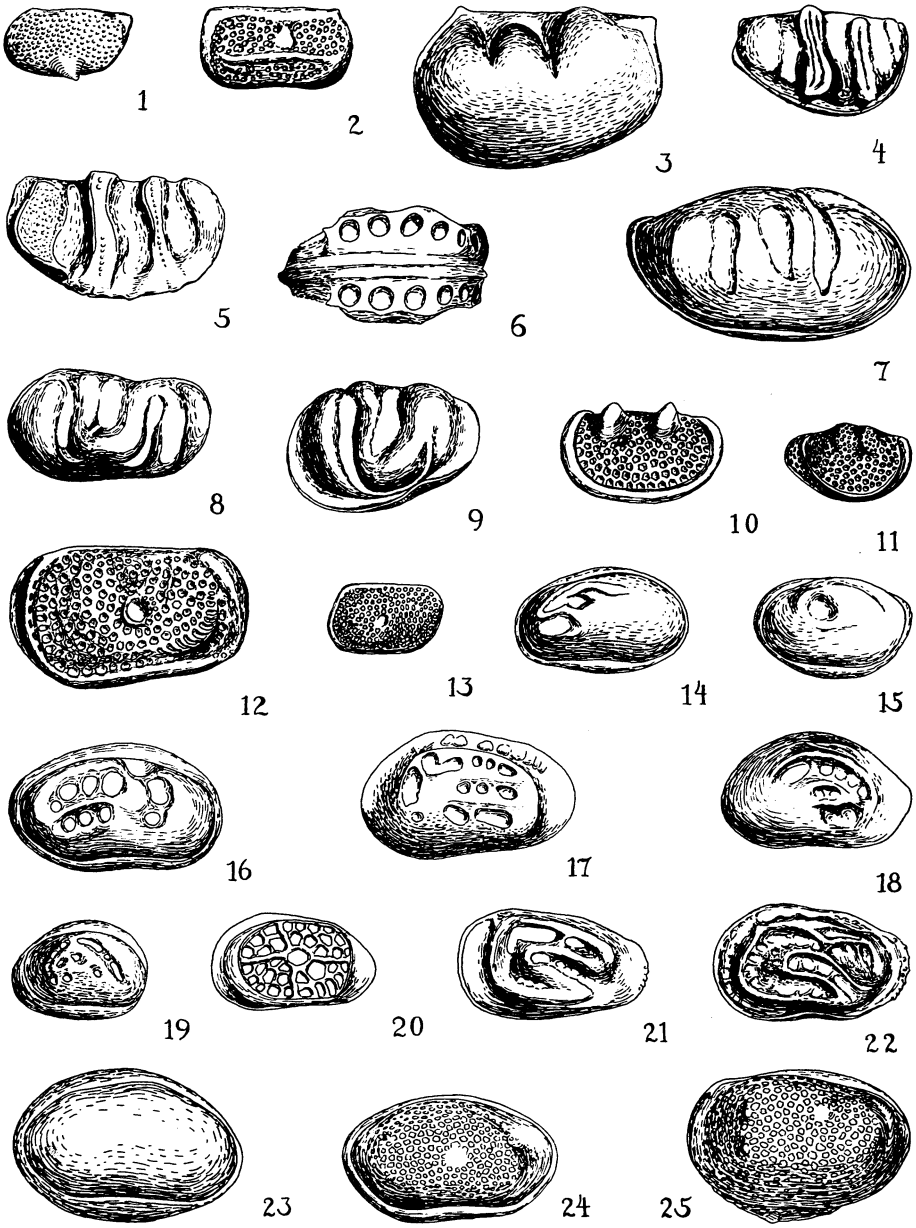
FIG. 22. *Euglyphella sigmoidalis* (Jones) var. *primitiva*, var. nov..... 221
Right valve
Holotype No. 14551 U.M.
Locality 7

FIG. 23. *Bythocypris devonica* Ulrich var. *borealis*, var. nov..... 221
Right valve
Holotype No. 14552 U.M.
Locality 5, sample B

FIG. 24. *Cytherellina punctulifera* (Hall) ($\times$ 20)..... 222
Left valve of typical Traverse form
Plesiotype No. 14553 U.M.
Locality 5, sample B

FIG. 25. *Cytherellina punctulifera* (Hall) ($\times$ 20)..... 222
Left valve of higher Hamilton form
Plesiotype No. 15109 U.M.
Upper Wanakah shale, Eighteen Mile Creek, New York

PLATE I



(*Continued from inside of front cover*)

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