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MIDDLE ORDOVICIAN BLACK RIVER OSTRACODS FROM MICHIGAN, INTRODUCTION AND PART I THE NATURE OF *MACRONOTELLA*

BY

ROBERT V. KESLING, FREDERICK S. CRAFTS, DAVID G. DARBY, KENNETH E. SHUBAK, and RAYMOND N. SMITH

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INTRODUCTION

A REMARKABLE ostracod fauna has been discovered in limestone strata exposed at Bony falls on the Escanaba River, Delta County, Michigan. Preservation is good, specimens are numerous, and many genera are represented. Because the fauna is large and unusual, I plan to describe it in several parts, the first of which is included in this paper.

Although exceptionally fine details of ornamentation are present on the ostracods, preparation of specimens is time-consuming. The ostracods are embedded in limestone, and none are completely exposed when the rock is split. Each requires careful work with Vibrotool, needles, and small chisels to remove obscuring matrix. After much experimentation I found that the most effective means of cleaning the specimens required four steps: (1) fracturing, shattering, and loosening the rock by applying the Vibrotool with a rather blunt point at a distance of about 3 mm from the specimen, (2) quarrying out the loose and broken matrix by the Vibrotool with a sharp point, not touching the specimen at the distal limit of the vibration, (3) removal of matrix around the periphery with small chisels, and (4) cleaning to the surface of the specimen with sharp needles. All work must

be done under a binocular microscope at magnifications of 24× to 45×. Although the procedure has led to some unexpectedly good results, it has its limits. Many of the species are frilled. In them, only one side of the frill can be exposed. A more serious hindrance to study is the concealment of marginal structures by overlying velate structures. The only practical solution is to look for some specimens with the inner face of the valve exposed. After each specimen had been cleaned, a small block of limestone containing it was removed from the rest of the layer by cutting with a diamond saw.

Specimens are numerous, so that many species are well represented. A few, however, are rare. The search for near-perfect examples of certain species could continue for years.

The fauna is remarkable because it contains a mixture of genera and species known in Black River strata from other North American exposures and several genera known best, or exclusively, from northern Europe. For example, preliminary taxonomic work discloses such previously recorded Black River ostracods as *Eoleperditia fabulites* (Conrad), *Eurychilina reticulata* Ulrich, *E. subradiata* Ulrich, and *Macronotella scofieldi* Ulrich. Side by side with them in the strata are species of such typically Scandinavian and Estonian genera as *Platybolbina* Henningsmoen, *Oepikella* Thorslund, *Laccochilina* Hessland, and *Levisulculus* Jaanusson.

The first part of this study concerns the type species of *Macronotella*. Discovery of the female dimorph of the type species, *M. scofieldi* Ulrich, drastically alters the concept and taxonomic position of the genus. Because of the importance of this new information, it was selected as the first subject in this series. Other investigations have been started, and will appear soon.

Previous work.—The only ostracod previously listed from the strata at Bony Falls is *Eoleperditia fabulites* (Conrad), which was reported in the fauna by Hussey (1950, p. 3; 1952, p. 20).

Other North American ostracods of Black River age have been studied by T. Rupert Jones (1858*a*, 1858*b*) at Pauquettes Rapids on the Ottawa River, Canada; Ulrich (1890, 1892, 1894) in Minnesota, Wisconsin, Illinois, Kentucky, Tennessee, and Pennsylvania; and Bassler (1919) in Maryland. Certain of the Bony Falls ostracods appear to be conspecific with species described by Ruedemann (1901) from the Rysedorph conglomerate in Rensselaer County, New York.

Related European faunas have been described by Bonnema (1909) in Estonia, Öpik (1937) in Estonia, Thorslund (1940) in Sweden, Jaanusson (1957) in Sweden, and Sarv (1959) in Estonia. Other Scandinavian works are surveyed by Jaanusson (1957, pp. 177–78).

Locality and stratigraphy.—The specimens used in this series are all from the following locality:

Strata exposed on the east bank of the Escanaba River just below Bony Falls, NE ¼ sec. 2, T. 41 N., R. 24 W., Delta County, Michigan. County Road 532 gives access to the left bank of the river at the dam at Bony Falls. Strata are accessible on the east bank by crossing the dam at times when the level of the Bony Falls Basin has been lowered and the outlets of the dam shut off. Middle Ordovician Black River group, Bony Falls limestone. Material collected by G. M. Ehlers and R. V. Kesling in 1954.

Hussey (1950, p. 2) described the exposure at Bony Falls as: "A hydro-electric plant is located here and the construction of a dam has diverted the water of the river from a part of its original channel and exposed a rock section about 40 feet thick along the east bank of the stream. There are exposures below the dam but the wooded nature of the country makes it impossible to trace the rocks for more than a few feet back from the edge of the river."

The strata exposed at Bony Falls are the oldest found along the Escanaba River. They dip very gently southeastward.

Hussey (1936, pp. 236–38; 1952, pp. 17–20) gave a measured section and associated fauna, heading the discussion "Black River, Bony Falls Member." His section and descriptions are combined in the following:

Unit		*Feet*
10	Argillaceous limestone, hard, buff, not very fossiliferous	2
9	Limestone, relatively pure, fine grained, some laminated limestone layers separated by sandy partings. One colony of the coral *Foerstephyllum halli* (Nicholson) five feet in largest diameter found at the top of unit. *Hesperorthis tricenaria* (Conrad)	4
8	Fine grained limestone, very fossiliferous. Beds weather with very rough upper surfaces. Occasional specimens of *Eoleperditia fabulites* (Conrad) with fragments of large crinoid stems, fucoids, *Ctenodonta nasuta* (Hall), *Strophomena incurvata* (Shephard), *Orthis* sp., *Pterygometopus* sp., and broken parts of *Illaenus* sp.	2
7	Limestone, similar to unit 8, crinoid stems very abundant. *Pianodema subaequata perveta* (Conrad), *Rhynchotrema minnesotense* Sardeson, *Hesperorthis tricenaria* (Conrad), and *Lambeophyllum* sp.	3
6	Gray limestone, characterized by abundant fucoids. *Strophomena filitexta* (Hall) and *Stromatocerium rugosum* Hall fairly common. A pygidium of *Bathyurus (Raymondites)* also found	2
	Disconformity	
5	Limestone, irregularly bedded, upper surface pitted and bored by some organism. Borings on upper surface planed off by erosion. Two-inch layer of clay at the top of zone may be bentonite or metabentonite. *Maclurites bigsbyi* Hall. A large incomplete specimen of the cephalopod *Endoceras,* three feet long and eight inches in diameter, observed in place. Discon-	

formity at top may represent a time break of considerable duration. May be top of Black River 5
4 Argillaceous limestone, layers 2 to 8 inches thick. Intraformational conglomerate. Ripple marks on some layers 8
3 Argillaceous limestone, fine grained, gray, irregular bedding 6
2 Finely crystalline dolomitic limestone. Lower part mottled green and pink. Some beds beveled by erosion 7
1 Bluish-gray limestone below level of the river. Some rocks of this unit blasted from bed of stream and built into a wall along the west bank below the dam.

In this section, the unit yielding the most and best-preserved ostracods is unit 4. Within the unit, certain layers are more productive than others.

Although Hussey referred to the beds as the "Bony Falls Member," they should be regarded as a formation, and are here called the Bony Falls limestone. The upper limit is questionable, and additional paleontologic work is needed to determine if all the rocks exposed at Bony Falls are Black River in age or if part of the section is lower Trenton. Hussey (1952, p. 19) stated: "Ulrich identified *Lambeophyllum profundum* from the upper beds at Bony Falls. This is a Black River coral. However, the form from Bony Falls is apparently a new species." If Hussey (1950, p. 2; 1952, p. 18) correctly identified the ostracods in unit 8 as *Eoleperditia fabulites*, and if they prove to show no signs of having been reworked from older deposits, then all of the Bony Falls exposure is most likely Black River in age.

I plan to collect from the section, unit by unit, to determine the upper limits of ostracods known to occur in other North American outcrops of Black River strata.

PART I. THE NATURE OF *MACRONOTELLA*

Study of newly discovered specimens of *Macronotella scofieldi* Ulrich, the type species of the genus, reveals that *Macronotella* is dimorphic and closely allied to *Oepikella* Thorslund. Inasmuch as its cotypes are not considered to be conspecific, we have designated one as the lectotype for *M. scofieldi*. Because certain Devonian ostracods previously assigned to *Macronotella* are nondimorphic, they do not belong in that genus nor even in the same family with it. For their reception we propose a new genus.

One of the serious problems of micropaleontology is the continued reliance upon original descriptions and illustrations, particularly those written and prepared several decades ago. Authors have extended the boundaries of genera by adding new species, accepting the statements and interpretations of the original author and subsequent revisers. Obviously, the nature of a genus must be based on the characteristics of its type species. It is difficult to explain, therefore, why concepts of genera are perpetuated

decade after decade without study and re-evaluation of the type species.

This is true for *Macronotella*. The range of the genus has been extended to include nondimorphic Middle Devonian species. Different kinds of subovate, straight-hinged ostracods have come to be classified as *Macronotella* because their lateral surfaces are ornamented with pits except for a bare central spot. They have little else in common, and *Macronotella* is a confused taxon.

Our investigation of *Macronotella scofieldi* has uncovered some deficiencies in the generic description. We found a female valve, proving that the species is dimorphic. In addition, the dorsal border is straight, not humped, and the cardinal angles are much more obtuse than those shown in the rather fanciful original figures.

For some reason, Ulrich selected cotypes from widely separated localities. One came from near Cannon Falls, Minnesota, and the other from High Bridge, Kentucky (Ulrich, 1894, p. 684). For convenience, we refer to them as the Minnesota and Kentucky specimens. Although neither the original publication nor the labels with the cotypes definitely states which catalogue number should be associated with which specimen, we assume that the Minnesota specimen should be USNM 41848 and the Kentucky specimen USNM 41849. Our opinion is based on the sequence in which the specimens were first mentioned.

The Minnesota specimen (Pl. I, Fig. 3; Pl. II, Fig. 1; Pl. III, Fig. 4) still has its anterior corner covered by matrix. Apparently, Ulrich assumed that the valve was completely exposed and that the dorsal border consisted of the rear part of the actual border and the boundary between the matrix and the anterodorsal part of the valve. At least his figure (1894, Pl. 43, Fig. 30) strongly suggests this interpretation. Furthermore, the specimen bears a deep curved scratch parallel to the position of the anterior part of the dorsal border inferred by Ulrich, probably inflicted during cleaning operations, which adds to the illusion of a curved dorsal border. In this specimen, the pits are coarse in the central part of the valve and decrease in size distally (Pl. I, Fig. 3); the margins of the valve are smooth, without pits or punctae of any kind.

The Kentucky specimen (Pl. I, Fig. 4) is larger than the Minnesota specimen. It also seems not to have been faithfully portrayed by the original illustrator. Although poorly preserved, it obviously does not have the dorsal hump, nearly 90° cardinal angles, nor the pattern of pits shown in Ulrich's figure (1894, Pl. 43, Fig. 33). The pits are about equal in diameter and extend to the edges of the lateral surface.

Whereas both cotypes appear to be male dimorphs of *Macronotella,* we do not believe they are conspecific. We designate the Minnesota specimen

as lectotype, not only because it is better preserved, but because its original figure has been copied in several subsequent publications (Ulrich and Bassler, 1923, Fig. 22, No. 7; Bassler and Kellett, 1934, Fig. 13, No. 4; Pokorný, 1954, Fig. 468, and 1958, Fig. 698). Undoubtedly, the current concepts of *Macronotella* are founded on published figures of this specimen. Furthermore, it was the first of the cotypes mentioned and illustrated. Lastly, it is the male of the species for which we found the female, so that the dimorphism can be firmly established.

For the present, we refer to the Kentucky specimen as *?Macronotella* sp. A. Better-preserved specimens from the High Bridge locality should be found to determine if this species is dimorphic and, therefore, correctly assigned to *Macronotella*. Then, this ostracod should be compared with known species to determine if it belongs to a new or to a previously described species.

In addition to *M. scofieldi,* there is another species in the Black River strata at Bony Falls which we assign to *?Macronotella* sp. B, represented only by a right valve (Pl. III, Fig. 5). We think this specimen is the male dimorph of an undescribed species of *Macronotella,* but until its dimorphism can be determined we do not wish to describe any new species of *Macronotella.*

We are grateful to Dr. G. Arthur Cooper and Dr. Remington Kellogg, who arranged the loan of the cotypes of *Macronotella scofieldi* Ulrich from the National Museum. Dr. George M. Ehlers and Dr. C. A. Arnold kindly reviewed the manuscript.

Specimens from the collection of the United States National Museum are identified by "USNM" before the catalogue number. Those from the University of Michigan Museum of Paleontology are identified by "UMMP"; the specimens of *Macronotella* are from the Middle Ordovician Black River group, Bony Falls limestone, at Bony Falls, Delta County, Michigan, and those of *Ehlersia,* gen. nov., are from the Middle Devonian Traverse group, Genshaw formation, Presque Isle County, Michigan.

HISTORY OF THE GENUS

At the time he described *Macronotella,* Ulrich assigned it to the family Beyrichiidae, which then included all paleocopan ostracods except the Leperditiacea. As shown in Table I, the genus was subsequently shifted about among the families Leperditellidae, Kirkbyidae, Primitiidae, and Aparchitidae. As presently understood, ostracods like *Macronotella,* but nondimorphic, could not be assigned to the Kirkbyidae or Primitiidae. As to whether such ostracods should be placed in Leperditellidae or Aparchiti-

TABLE I

SOME FAMILIAL ASSIGNMENTS OF *Macronotella*

Year	Author	Page	Family
1894...	Ulrich	683	Beyrichiidae
1906...	Ulrich and Bassler	155	Kirkbyidae
1923...	Ulrich and Bassler	316	Kirkbyidae
1934...	Bassler and Kellett	32	Kirkbyidae
1937...	Öpik	23	Primitiidae
1937...	Warthin	Index	Kirkbyidae
1940...	Kay	244	Aparchitidae
1941...	Schmidt	18	Aparchitidae
1949...	Hessland	148	Aparchitidae
1950...	Přibyl	106,147	Aparchitidae
1952...	Kesling and Kilgore	2	Leperditellidae
1953...	Henningsmoen	268	?Aparchitidae
1953...	Kummerow	48	Kirkbyidae
1954...	Pokorný	377	Aparchitidae
1955...	Přibyl	166,216,262	?Aparchitidae
1956...	Jones	161	Kirkbyiidae [*sic*]
1956...	Matthes	120	Aparchitidae
1958...	Mertens	Table 7	Aparchitidae
1958...	Neckaja	243	Aparchitidae
1958...	Pokorný	149	Aparchitidae
1959...	Sarv	162	Aparchitidae

dae depends upon the equality of the valves and the degree of overlap. With the discovery of dimorphism, these characteristics are of minor concern. With the similar (particularly in regard to the nature of its dimorphism) genus *Oepikella, Macronotella* can be assigned to the subfamily Oepikellinae of the Eurychilinidae.

REVISED ASSIGNMENT AND DESCRIPTION

Family Eurychilinidae Ulrich and Bassler, 1923

In determining the content of paleocopan families and the proper placement of their genera, dimorphism is a prime consideration. Males that are strikingly similar belong to different families, as pointed out in Table II. For these ostracods, the correct genus can be found only through the characteristics of the female.

As diagnosed by Jaanusson (1957, pp. 229–30), the Eurychilinidae includes dimorphic ostracods with a more or less convex frill in the female and a frill, velate ridge, or no velate structure in the male. Whether any males lack velate structure completely is a matter of interpretation. In *Oepikella,* cited by Jaanusson (1957, p. 232) as a genus in which the males have "no velar frill at all," we believe the velate structure to be the bend

TABLE II

MALES OF SIMILAR FORM IN DIFFERENT FAMILIES OF PALEOCOPA

Genus	Family
Aparchites Jones, 1889, p. 384	Aparchitidae
Phlyctiscapha Kesling, 1953*a*, p. 222	Beyrichiidae
Oepikella Thorslund, 1940, p. 181	Eurychilinidae
Arcyzona Kesling, 1952, pp. 30–31	Arcyzonidae
Hibbardia Kesling, 1953*b*, pp. 19–20	Beyrichiidae
Ceratopsis Ulrich, 1894, p. 675	Quadrijugatoridae
Sigmoopsis Henningsmoen, 1953, p. 204	Sigmoopsidae
Quadrijugator Kesling and Hussey, 1953, pp. 82–83	Quadrijugatoridae
Ogmoopsis Hessland, 1949, p. 324	Sigmoopsidae
Euprimitia Ulrich and Bassler, 1923, p. 299	Piretellidae
Primitiopsis Jones, 1887, p. 5	Primitiopsidae
Bollia Jones and Holl, 1886, p. 360	Drepanellidae
Zygobolbina Ulrich and Bassler, 1923, p. 305	Zygobolbidae
Chilobolbina Ulrich and Bassler, 1923, p. 304	Eurychilinidae
Bolbineossia Kesling, Heany, Kauffman, and Oden, 1958, p. 149	Beyrichiidae
Winchellatia Kay, 1940, pp. 253–54	Sigmoopsidae
Flaccivelum Kesling and Peterson, 1958, p. 139	Hollinidae
Macronotella Ulrich, 1894, p. 683	Eurychilinidae
Ehlersia, gen. nov.	?Aparchitidae

(*Umbiegungskante*) at the edge of the lateral surface, which can be seen only in ventral and end views. Jaanusson correctly and aptly points out (pp. 229–30) that the female frill is "partitioned internally by septa of shell substance into numerous, radially arranged tubules which were apparently originally hollow."

The family Eurychilinidae is divided by Jaanusson (1957, pp. 230–33) into three subfamilies: Eurychilininae, male with frill, female with dimorphism exhibited in only the proximal part of the frill; Chilobolbininae, male with frill, female with dimorphism in the entire width of the frill; and Oepikellinae, male with narrow velate ridge or bend, female with restricted frill. These divisions are workable and reasonable, and seem to place the eurychilinid genera in natural groups.

Although there is little room for doubt that *Macronotella* is correctly assigned to the Oepikellinae, it shows certain resemblances to the Chilobolbininae which tend to substantiate the close relationship of the two subfamilies. In fact, a remarkable sequence of female dimorphs exists from

Platybolbina to *Macronotella* to *Oepikella,* as shown in Table III. Henningsmoen (1953, p. 228) noted the resemblances between *Platybolbina*

TABLE III

SEQUENCE OF FEMALE DIMORPHS OF *Platybolbina, Macronotella,* AND *Oepikella*

Species	Ornamentation, Except for Bare Central Spot	Frill	Illustration
Platybolbina kapteyni (Bonnema)	Reticulation of small shallow punctae	Entire, but posterior part narrow	Jaanusson, 1957, Pl. 4, Fig. 1
P. temperata Sarv	Reticulation of medium punctae	Entire, but posterior part narrow	Sarv, 1959, Pl. 2, Fig. 3
P. maslovi Sarv	Reticulation of very large punctae	Restricted, none posterior	Sarv, 1959, Pl. 2, Figs. 4, 6–7
Macronotella scofieldi Ulrich	Coarse pits decreasing in size distally	Restricted, none posterior or anterodorsal	Our Pl. I, Fig. 2
Macronotella bonnemai Öpik* ..	Reticulation of numerous small shallow punctae	Unknown	Jaanusson, 1957, Pl. 4, Figs. 7–8
O. tvaerensis (Thorslund)	Smooth except for few small shallow punctae around central spot	Restricted to ventral and anteroventral border	Jaanusson, 1957, Pl. 4, Fig. 9

* Based on male; female dimorph unknown.

and *Oepikella.* Jaanusson (1957, p. 262) astutely drew attention to the variation in the velate structure of males in *Platybolbina:* wide in *P. ampla* Jaanusson, moderately wide in *P. kapteyni* (Bonnema), and narrow and ridgelike in *P. temperata* Sarv. He also pointed out (p. 270) that this sequence leads morphologically to the Oepikellinae by further reduction of the velate structure. *Macronotella scofieldi* is closer to *Platybolbina* in ornamentation, intermediate between *Platybolbina* and *Oepikella* in the restriction of the frill, and definitely affiliated with *Oepikella* by the velate structure of the male.

Subfamily Oepikellinae Jaanusson, 1957

Revised diagnosis.—Convex, non-sulcate, dimorphic. Males with velate structure developed only as a narrow ridge or bend at the lateral surface

in each valve; females with a well-defined frill restricted to ventral and anteroventral border.

Remarks.—The frill of the female in *Macronotella scofieldi* is slightly undulating, but is not incurved in what Jaanusson (1957, p. 269) terms for the Oepikellinae a "velar dolon." The diagnosis has been revised, therefore, to eliminate reference to the degree of curvature in the female frill.

Only the type genus was previously assigned to the subfamily. Jaanusson expressed the opinion (1957, p. 270) that *Macronotella kuckersiana* Bonnema, *Isochilina frequens* Steusloff, and *Primitiella umbilicata* Kummerow, which had been previously assigned to *Oepikella,* did not belong in that genus and "for their reception probably one or more new genera should be erected." The number and nature of the genera in the subfamily can only be decided after both dimorphs of each included species have been studied.

Genus *Macronotella* Ulrich, 1894

Macronotella Ulrich, 1894, p. 683.
?*Punctaparchites* Kay, 1934, p. 331.
?*Baltonotella* Sarv, 1959, pp. 161–62.

Type species.—By original designation, *M. scofieldi* Ulrich (1894, p. 683).

Generic diagnosis.—Oepikellin ostracods without furrows delimiting the corner areas. Male with velate structure developed only as a bend at the edge of the lateral surface; female with a well-defined frill, not convex or incurved, restricted to ventral and anteroventral border.

Remarks.—Macronotella, as exemplified by the type species, differs from *Oepikella* in three ways. In both dimorphs the lateral surface is pitted or punctate, except for a central bare spot (thought to mark the external position of the internal adductor muscle scars). In both dimorphs, also, the corner areas are confluent with the rest of the lateral surface, not delimited by furrows as in *Oepikella.* In the female the frill, although developed to about the same extent as in *Oepikella,* is not convex and incurved, and it bears distinct radial grooves.

It is not possible at this time to determine the number of species in *Macronotella.* Certainly, no additional species should be named until their dimorphism is clearly established. Possibly, as other species of oepikellin ostracods become known, the boundary between *Macronotella* and *Oepikella* can be established with greater accuracy.

Of immediate interest is the taxonomic position of the ostracod described by Öpik (1937, p. 87, Pl. 1, Figs. 7–8) as *Macronotella bonnemai.* Later, Öpik (1940, p 65) considered that *Macronotella tenuis* Teichert,

1937, might be conspecific with *M bonnemai* Öpik, 1937, and constitute a species of *Oepikella* Thorslund, 1940. Jaanusson (1957, p. 270) assigned *Macronotella bonnemai* to *Oepikella,* but denied that *M. tenuis* was the same species. He stated (1957, p. 271), "*M. tenuis* may belong to *Oepikella* or to some other oepikelline genus, but this cannot be proved without an examination of the type material. It is however, certainly not conspecific with *O. bonnemai.* . . ." At present, the female dimorph of *Macronotella bonnemai* is unknown, but its surface ornamentation leads us to believe that the original author (Öpik, 1937) correctly placed it in *Macronotella.*

Although Kay (1940, p. 244) placed his previously erected genus *Punctaparchites* definitely in synonymy with *Macronotella,* we are not as certain that it should be so assigned. Kay (1934, p. 331) based *Punctaparchites* on *Cytheropsis rugosus* Jones (1858*b*, p. 249, Pl. 10, Fig. 5). He redescribed the type species (1934, pp. 331–32), but made no mention of a central bare spot. Later (1940, p. 244), he stated that it resembled *Macronotella* in "bearing a subcircular muscle spot." As illustrated by Kay (1934, Pl. 44, Figs. 1–4) each valve of *Punctaparchies rugosus* (Jones) is strongly plenate at one end, so that it has a distinct swing; its shape is very different from the nearly symmetrical *Macronotella scofieldi.* Until additional specimens are studied, we are inclined to believe that *Punctaparchites* should be retained as a valid genus.

Sarv (1959, pp. 161–62) described a new genus, *Baltonotella,* based on *Macronotella kuckersiana* Bonnema (1909, p. 55, Pl. 3, Figs. 1–9). We translate his diagnosis as follows:

> Carapace small, subcircular to suboval in outline, with relatively short hinge line, strongly convex. In the central part of the valve there is seen a smooth area of muscle impression. Surface of the valve, except for the muscle impression, penetrated by coarse pores. Carapace inequivalved—left valve larger than the right and over-lapping it along the entire free edge.

Under "remarks," Sarv gave the same diagnosis for *Macronotella,* essentially word-for-word, except that *Macronotella* was said to to be equivalved. Sarv assigned *Baltonotella* to the Leperditellidae, but expressed the opinion that *Macronotella* should be attributed to the family Aparchitidae.

We are extremely skeptical about the importance of overlap in distinguishing paleocopan ostracods. In reality, no ostracod is known that is truly equivalved; the edge of one valve invariably fits over the edge of the other, in some species strongly and in others only slightly. Hence, the inequality of valves differs only in degree. At present we do not know how the two valves of *Macronotella scofieldi* fit together in a complete carapace. Furthermore, before the synonymy of *Baltonotella* and *Macronotella* can

be settled, an extensive search must be made for possible female dimorphs of *B. kuckersiana* (Bonnema).

As will be discussed below, the Devonian species previously assigned to *Macronotella* are here placed in a new genus, tentatively thought to belong to the Aparchitidae.

Macronotella scofieldi Ulrich, 1894

(Pl. I, Figs. 1–3; Pl. II, Figs. 1–2; Pl. III, Figs. 1–4)

Macronotella scofieldi Ulrich, 1894, p. 684, Pl. 43, Figs. 30–32 (not Figs. 33–34). Grabau and Shimer, 1909, pp. 348–49, Fig. 1657*v* (not Fig. 1657*u*). Ulrich and Bassler, 1923, p. 316, Fig. 22, No. 7. Bassler and Kellett, 1934, p. 32, Fig. 13, No. 4. Moore, Lalicker, and Fischer, 1952, p. 525, Fig. 14–2, No. 1. Jones, 1956, p. 161, ?Fig. 8.9, No. 11. *Et al.* (All references are *partim,* inasmuch as they are based in part on a cotype that is not of the species.)

Description of female.—Valves strongly convex. Outline, exclusive of frill, truncate subcircular. Dorsal border straight, about six-sevenths as long as the valve. Greatest height nearly central; greatest width immediately behind central bare spot. Cardinal angles obtuse, the anterior about 110° and the posterior about 100°. Lateral surface rising steeply from posterior and posteroventral borders and more gradually from the anterior and anteroventral. Lateral surface ornamented with coarse pits around central subovate bare spot, thought to mark the external position of the internal adductor-muscle scar, and progressively smaller pits distally, with the anterior, dorsal, and posterior margins smooth. Pits extending ventrally and anteroventrally to the frill. Pits with well-defined borders and rather steep sides, but shallow.

Frill restricted, extending from the middle of the anterior to the posteroventral border, wide, its width about one-fourth the entire height (including frill). Frill slightly undulating but not incurved, distinctly radially striate and faintly ornamented by concentric, very small, low crests. Every second or third radial element of the frill extending much farther onto the lateral surface than those intervening.

Dimensions of hypotype, UMMP 37231, the only known female specimen, a left valve: length (exclusive of frill), 1.76 mm; height (including frill), 1.46 mm; and dorsal border, 1.60 mm.

Description of male.—Like the female in convexity of valves, dorsal border, cardinal angles, surface ornamentation, and size, but lacking a frill. Each valve with slight swing, so that greatest height is a little anterior. Pitted area not reaching the ventral border. At the free border, edge of the lateral surface forming a bend (*Umbiegungskante*), visible in ventral and

end views, interpreted to be the velate structure. Bend evenly curved, with no trace of ridge or crest beyond the lateral surface, as seen laterally; bend separated from marginal ridge by a narrow groove.

TABLE IV
DIMENSIONS IN MILLIMETERS

Specimen	Valve	Length	Height	Width	Dorsal Border
USNM 41848*	left	1.65	1.10	0.43	1.40
UMMP 37253	right	1.65	1.08	0.48	1.40
UMMP 37269	right	1.88	1.28	0.52	1.60

* Lectotype

Remarks.—Each of two valves, UMMP 37269 (Pl. III, Figs. 1–2) and USNM 41848 (Pl. I, Fig. 3), has a low, faint, narrow, curved ridge leading from the bare central spot to the dorsal border. This appears to be the result of a slight buckling of the valve along a line of weakness. The other two valves show no such structure.

The female valve, unfortunately, is embedded in matrix so as to obscure the ventral surface betweeen the frill and the free edge. As a result, we do not know that the frill joins the rest of the valve along the bend. This lack of information casts some doubt on our interpretation of the bend in the male as its velate structure. A female valve must be found with the area beneath the frill exposed. If it shows that the bend lies between the frill and the free edge, we are wrong; but if it shows that the bend coincides with the base of the frill, we are right.

Because the radial elements of the frill do not join the domicilium along a line, we conclude that the base of the frill is thick. Insofar as we are able to judge in the only female valve known, by comparison of its convexity and height of domicilium with those in male valves, the admarginal side of the frill must lie on or very close to the bend. In our opinion, the dimorphism in *Macronotella scofieldi,* except for the lack of convexity in the frill, duplicates that in *Oepikella tvaerensis* Thorslund, as lucidly described by Jaanusson (1957, pp. 269–73).

Occurrence.—Lectotype from near Cannon Falls, Goodhue County, Minnesota; Middle Ordovician Black River group, Platteville formation, "Lower Buff" (McGregor member according to Kay, 1940, p. 244, but Pecatonica member acording to Ellis and Messina, 1952). Hypotypes from Bony Falls, Delta County, Michigan; Middle Ordovician Black River group, Bony Falls limestone, unit 4 (for details see *Locality* and *stratigraphy* in the Introduction).

? *Macronotella* sp. A

(Pl. I, Fig. 4)

Macronotella scofieldi Ulrich (*partim*), 1894, p. 684, Pl. 43, Figs. 33–34 (not Figs. 30–32). Grabau and Shimer (*partim*), 1909, pp. 348–49, Fig. 1657*u* (not Fig. 1657*v*). *Et al.*

Description.—Valve moderately convex, subovate in lateral view. Dorsal border straight, only a little shorter than valve. Greatest height and width nearly central. Cardinal angles slightly obtuse, the anterior slightly larger. Lateral surface, except for small oval bare spot in the center, ornamented with evenly distributed, medium-sized pits; pitted area extending to free border.

Distinct furrow in marginal surface, separating marginal ridge from rounded bend.

Dimensions of illustrated specimen, USNM 41849, a left valve: length, 2.30 mm; height, 1.40 mm; and dorsal border, 2.20 mm.

Remarks.—The illustrated specimen, one of the cotypes of *Macronotella scofieldi,* is somewhat distorted, making interpretation of its original form difficult. In the posterior region, the valve has been dorsoventrally compressed so that it buckled and cracked. It is more strongly convex in the central region, but we cannot be certain that the somewhat flattened ventral region of the lateral surface is not the result of crushing. In addition, the marginal area is not quite perpendicular to the plane of the contact margin; perhaps the bend was displaced dorsally in conjunction with the compression. The anterior part of the valve has been abraded; without the coating of ammonium chloride (as in Pl. I, Fig. 4), however, the pits in this area are discernible. Obviously, this specimen would not be a good type for erecting a new species.

This species differs from *Macronotella scofieldi* in being more elongate and in having its pits smaller, more uniform, and distributed evenly to the free border.

Occurrence.—High Bridge, Jessamine County, Kentucky; Middle Ordovician Black River group, Lowville limestone ("Birdseye" limestone).

Illustrated specimen.—A left valve, one of the cotypes of *Macronotella scofieldi,* USNM 41849.

? *Macronotella* sp. B

(Pl. III, Fig. 5)

Description.—Valve large, very strongly convex. Outline subcircular, truncated by straight dorsal border. Greatest height central, greatest width a little below and behind center. Cardinal angles obtuse, but corners

rounded, making measurement of angles difficult. Dorsal half of lateral surface, particularly the corner regions, less convex than ventral half. Surface, except for small central bare spot, ornamented with numerous shallow punctae, subequal except near the periphery, there smaller and fainter.

Marginal surface not exposed. Dimensions of illustrated specimen, UMMP 37268, a right valve: length, 2.60 mm; height, 1.84 mm; and dorsal border, 1.96 mm.

Remarks.—This species appears to differ from *Macronotella bonnemai* Öpik, 1937, to which it shows great similarity, in having proportionally greater height, shallower and somewhat fewer punctae, smaller central bare spot, and greater convexity. Neither this species nor *M. bonnemai* are sufficiently well understoood to make accurate comparisons.

Occurrence.—Bony Falls, Delta County, Michigan; Middle Ordovician Black River group, Bony Falls limestone, unit 4.

Illustrated specimen.—A right valve, UMMP 37268.

DEVONIAN SPECIES PREVIOUSLY ASSIGNED TO *Macronotella*

Of the Devonian species that have been assigned to *Macronotella,* none are known to be dimorphic. Furthermore, the bend along the free border, because it is not distally bordered by a groove, does not appear to form a rudimentary velate structure as in *Macronotella.* Perhaps the species most completely described and illustrated is *Macronotella hypercala* Kesling and Kilgore, from the Middle Devonian Traverse group, Genshaw formation, of Michigan. For that reason, it is chosen as the type species of the following new genus, which is named in honor of Dr. George Marion Ehlers on the occasion of his terminal year before retirement as Professor in the Department of Geology and Curator of Paleozoic Invertebrates in the Museum of Paleontology at The University of Michigan.

Ehlersia, gen. nov.

Type species.—Here designated, *Macronotella hypercala* Kesling and Kilgore, 1952, p. 2, Pl. 1, Figs. 25–36.

Generic diagnosis.—Straight-hinged, nearly equivalved ostracods with evenly convex, subcircular to subovate lateral surfaces, ornamented with pits or punctae except for a central bare spot. Lateral and marginal surfaces joined at a simple bend, not velate by any interpretation.

Description.—Carapace distinctly biconvex, with straight hinge and nearly equal valves. Valves in lateral view subcircular to subovate. Dorsal border straight or very gently convex. Lateral surface joined to marginal surface along a bend (*Umbiegungskante*) forming a simple angulation and

not a rudimentary velate ridge. Bend separated from marginal ridge by a nearly flat surface or, at most, a shallow channel.

Lateral surface, except for a narrow peripheral rim (in some species wider in the corner areas) and a central bare spot, ornamented with distinct pits or punctae. Marginal surface smooth. Marginal ridge strongly developed in overlapping valve, much weaker in overlapped valve. Cardinal angles definitely obtuse.

Remarks.—From the central position of the bare spot, assumed to mark the external position of the internal adductor-muscle scar, it is difficult to orient many specimens. In asymmetrical valves, however, we think the plenate end is posterior, rather than anterior as in *Macronotella.* We cannot confirm this at present. If there is a rimlike peripheral development, it is on the lateral surface in *Ehlersia,* in contrast to the laterally confluent velate bend in *Macronotella,* which cannot be recognized in lateral view. The remarkable similarity of ornamentation in *Ehlersia* and *Macronotella* may be regarded as an unusual example of convergence. There is no reason to think that the two genera are closely related.

Ehlersia also bears some resemblance to *Paraschmidtella* Swartz (1936, p. 563) in shape of the free border and ornamentation, but it lacks the dorsal hump characteristic of the latter and shows a clearly defined central bare spot.

Kirkbya ? dubia Tolmachoff (1926, p. 28, Pl. 1, Figs. 22–23) seems clearly to belong to *Ehlersia.* It is doubtful whether two other Devonian species, *Aparchites variolatus huntonensis* Roth (1929, pp. 332–33, Pl. 35, Figs. 1a–b) and *Aparchites punctinellus* Wilson (1935, p. 633, Pl. 77, Figs. 1*a–c*), should be assigned to *Ehlersia.* They and the Silurian species *Leperditia praelonga* Steusloff (1894, p. 781, Pl. 58, Fig. 3) should be restudied before generic placement is revised.

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EXPLANATION OF PLATE I

(All figures × 25)

PAGE

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FIG. 1. Lateral sterogram of male right valve, UMMP 37252. A ventral stereogram of this specimen is shown in Pl. III, Fig. 3.

FIG. 2. Lateral stereogram of female left valve, UMMP 37231, the only female specimen known.

FIG. 3. Lateral stereogram of lectotype, a male left valve, USNM 41848. A ventral stereogram of this specimen is shown in Pl. III, Fig. 4, and an enlarged lateral view in Pl. II, Fig. 1. Patteville formation, near Cannon Falls, Minnesota.

? Macronotella sp. A. 306

FIG. 4. Lateral stereogram of male left valve, USNM 41849, designated as a cotype of *Macronotella scofieldi* by Ulrich but not conspecific with the lectotype designated here. Lowville limestone, High Bridge, Kentucky.

PLATE I

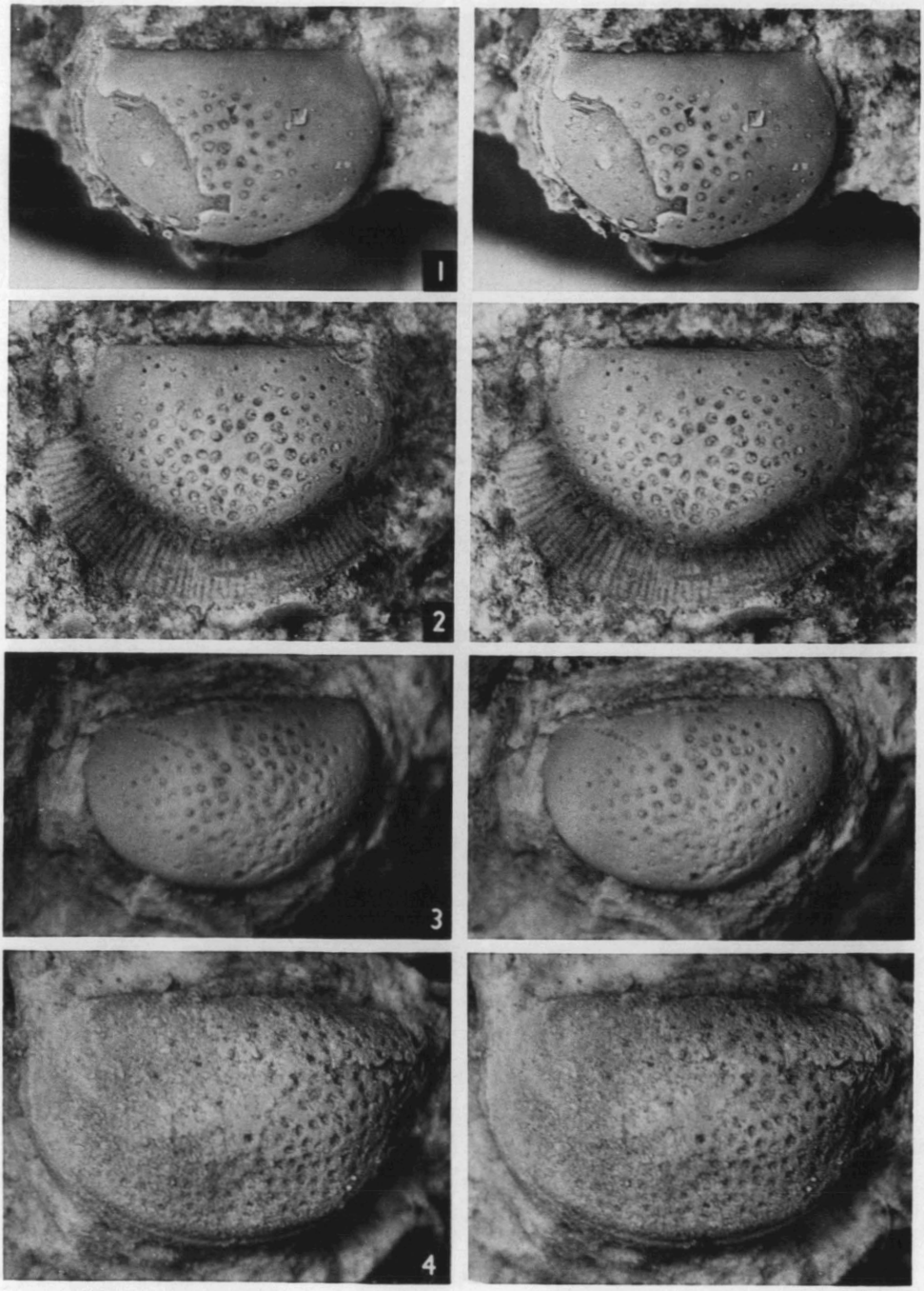
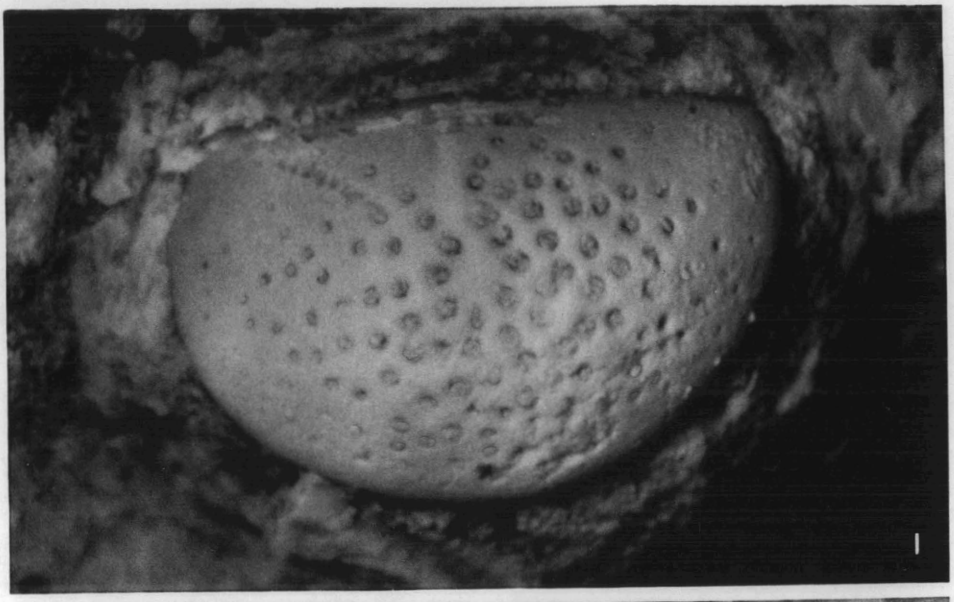
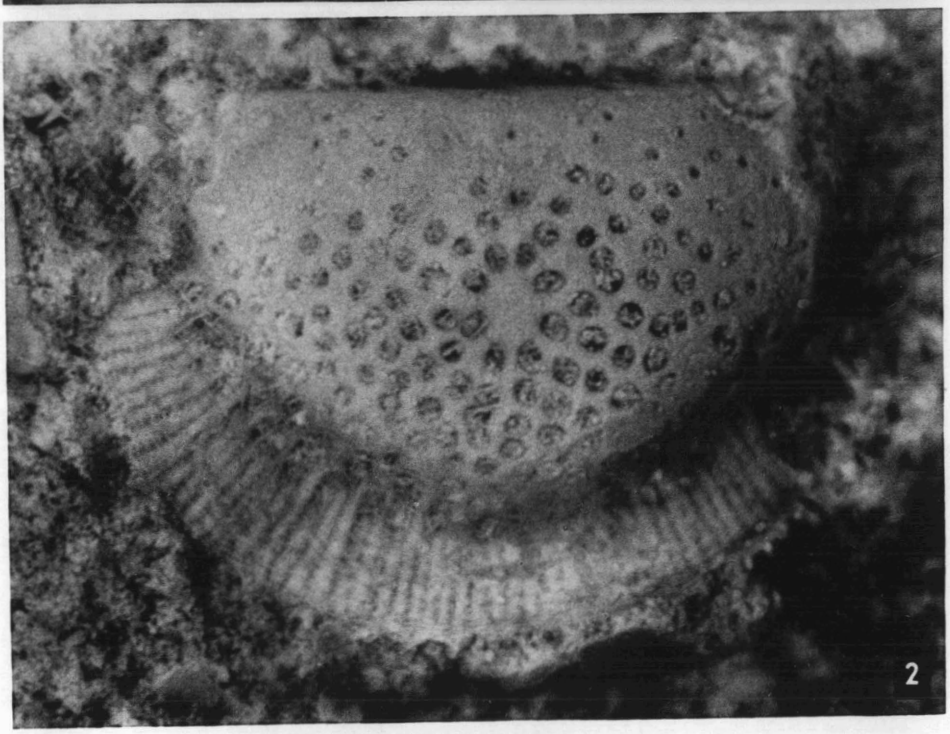


PLATE II





EXPLANATION OF PLATE II

(Both figures × 50)

FIG. 1. Lateral view of lectotype, a male left valve, USNM 41848. Note the scratch along the dorsal part of this specimen.

FIG. 2. Lateral view of female left valve, UMMP 37231. This specimen is tilted slightly to show the full width of the frill; actually, the central bare spot is at about midheight on the domicilium. It is illustrated on the same plate and at the same magnification as the lectotype to emphasize the similarities of the dimorphs.

EXPLANATION OF PLATE III

(All figures × 25)

PAGE

Macronotella scofieldi Ulrich 304

FIGS. 1–2. Inclined dorsal and lateral stereograms of male right valve, UMMP 37269. This specimen has a very low ridge between the dorsal border and the central bare spot, like that in the lectotype (Pl. I, Fig. 3).

FIG. 3. Ventral stereogram of male right valve, UMMP 37253. Compare with lateral stereogram shown in Pl. I, Fig. 1.

FIG. 4. Ventral stereogram of lectotype, a male left valve, USNM 41848. Compare with lateral stereogram shown in Plate I, Fig. 3.

? Macronotella sp. A. 306

FIG. 5. Lateral stereogram of right valve, presumed to be a male, UMMP 37268.

PLATE III