

A BEYRICHIID OSTRACOD FROM THE MIDDLE
DEVONIAN WANAKAH SHALE

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INTRODUCTION

A beyrichiid ostracod from the Wanakah shale belongs to a new genus. This species has been known only from an incomplete, badly-weathered immature right valve from the Windom beds of western New York, and was erroneously assigned to the genus *Amphissites*.

The adult female of this species has a pouch in each valve. This pouch differs from the pouches of other Beyrichiidae in being mostly in the posteroventral part of the valve instead of the anteroventral. Many immature specimens occur in the shale. Seven immature instars can be recognized in the young ostracods, and these have been studied for additional evidence on the problems of growth and orientation.

In addition to the unusual pouch of the female and the preservation of many immature specimens, this species is remarkable for its unique stratigraphic occurrence — it is the first beyrichiid species known from the Hamilton group of North America.

I am deeply grateful to Mr. Raymond R. Hibbard of Buffalo, New York, for generously supplying samples of Devonian strata in western New York. All specimens described in this paper are from samples which he collected.

I also wish to thank the Horace H. Rackham School of Graduate Studies, University of Michigan, for providing special photographic equipment used in preparation of the plates in this paper.

FOSSIL LOCALITIES

The species was found in both the *Stropheodonta demissa* and the *Pleurodictyum* beds of the Wanakah member, Ludlowville formation at the following localities:

1. Exposure along Rush Creek, near abandoned electric railroad at Highland Acres, Erie County, New York. Hamilton group, Ludlowville formation, Wanakah member, *Stropheodonta demissa* beds.

2. Abandoned quarry at Bay View, Erie County, New York. Hamilton group, Ludlowville formation, Wanakah member, *Pleurodictyum* bed.

3. Abandoned shale pit off Big Tree Road, just east of the railroads at Bay View, Erie County, New York. Hamilton group, Ludlowville formation, Wanakah shale member, *Pleurodictyum* bed. About 4 or 5 feet below the lowest trilobite bed of Grabau (see Grabau 1899, p. 236).

SYSTEMATIC DESCRIPTION

Phylum ARTHROPODA

Class CRUSTACEA

Order OSTRACODA

Superfamily BEYRICHIACEA

Family BEYRICHIIDAE

HIBBARDIA, gen. nov.

GENOTYPE — *Amphissites lacrimosus*
Swartz and Oriol, 1948, pp. 553-554, Pl. 79, Fig. 15.

FEMALE.—Carapace subovate, tumid. Hinge line straight. Pouch in posteroventral part of each valve. Bilobate. L1 large, bounded anteriorly by the frill and posteriorly by S2. No L2. L3 very large, vertically elongate. S2 a shallow groove from dorsal border to distinct central pit. Frill extending around most of free border. Marginal ridge around free edge. Right valve overlapping left valve, the overlap greatest in ventral part of carapace.

ADULT MALE.—General shape of carapace, lobation, and overlap same as those of the female. No pouch. Frill complete from anterior to posterior corner without interruption.

REMARKS. — This genus is closely related to *Treposella* from the Onondaga limestone. It differs from that genus in having posteroventral pouches instead of ventral, in having a distinct pit at the ventral end of S2, and in lacking an L2. The location of the pouch in *beyrichioid* ostracods suggests an evolutionary trend. The pouch is anteroventral in the Silurian *Beyrichia*, ventral in the Onondaga *Treposella*, and the posteroventral in the Hamilton *Hibbardia*, gen. nov.

This genus is named for Mr. Raymond R. Hibbard, who collected the material containing the specimens used in this study.

The genotype adults resemble topotype specimens of *Treposella lyoni* (Ulrich) in their reticulation, development of L3,

type of dimorphism, and shape of pouches in the female. Because *Hibbardia lacrimosa* (Swartz and Oriol) is imperfectly known, it is described in detail below.

HIBBARDIA LACRIMOSA

(Swartz and Oriol)

Pl. 8, Figs. 1-29; Pl. 9, Figs. 1-18

Amphisites lacrimosus Swartz and Oriol, 1948, pp. 553-554, Pl. 79, Fig. 15.

FEMALE. — Carapace subovate, tumid. Hinge line straight. Anterior border round, ventral border slightly indented, and posterior border gently subround. L1 large, arched upward steeply from S2 and sloping gently to its anterior junction with the frill, ventrally confluent with a short ventral lobe. L3 very large, strongly arched outward, sloping evenly toward the posterodorsal corner, terminated ventrally by the pouch. S2 a shallow groove from the dorsal border to the prominent central pit. Pit slightly anterior, vertically elongate, dorsally acuminate. No S1 or S3.

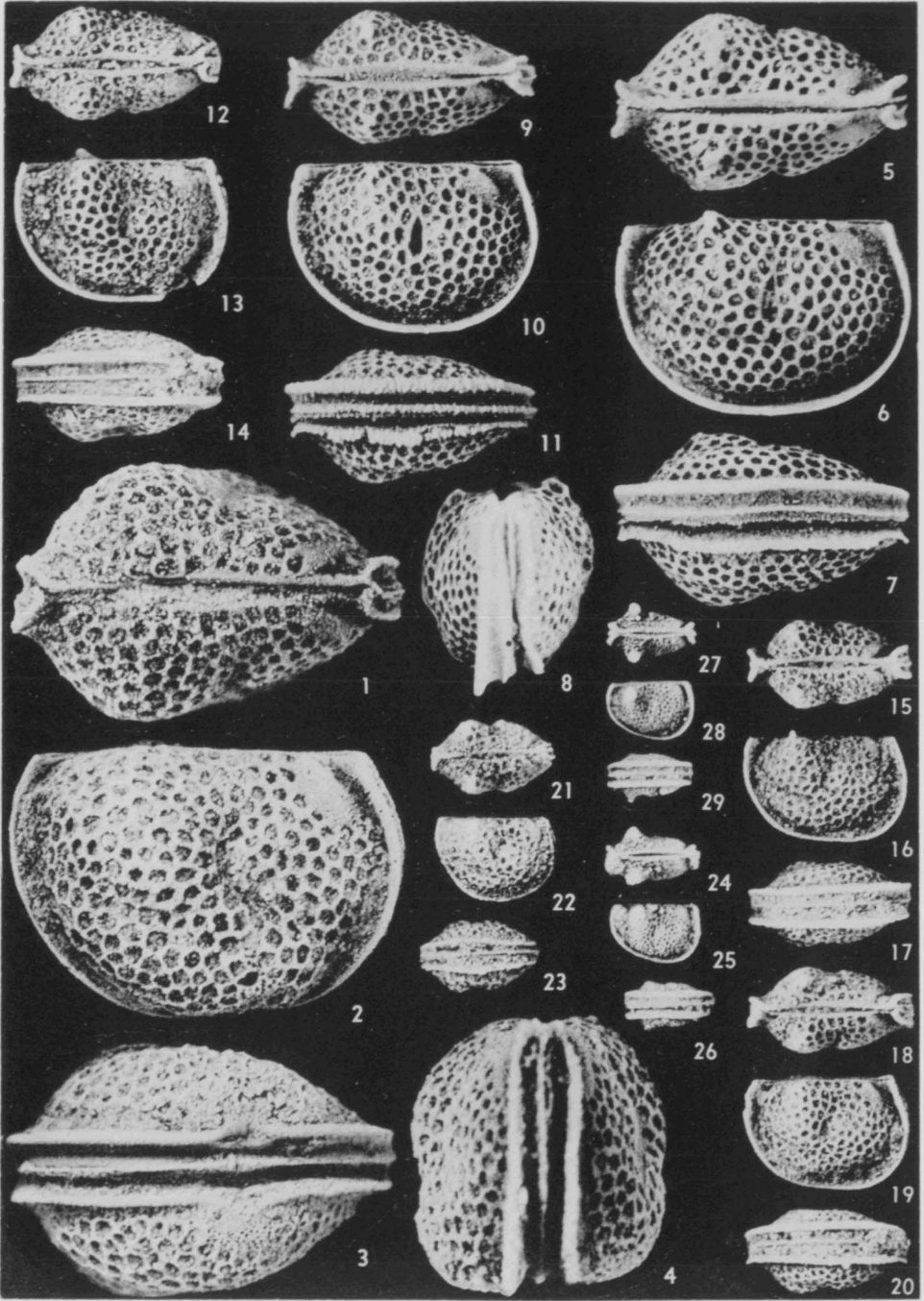
Pouch in posteroventral part of each valve, subovate, its anterior end extending below and in front of the pit, separated from the ventral lobe by a shallow depression. Posterodorsal end of pouch joining L3 along a shallow depression in the posterocentral part of the valve. Anteroventral part of pouch terminated a little in front of the indentation of the ventral border.

EXPLANATION OF PLATE 8

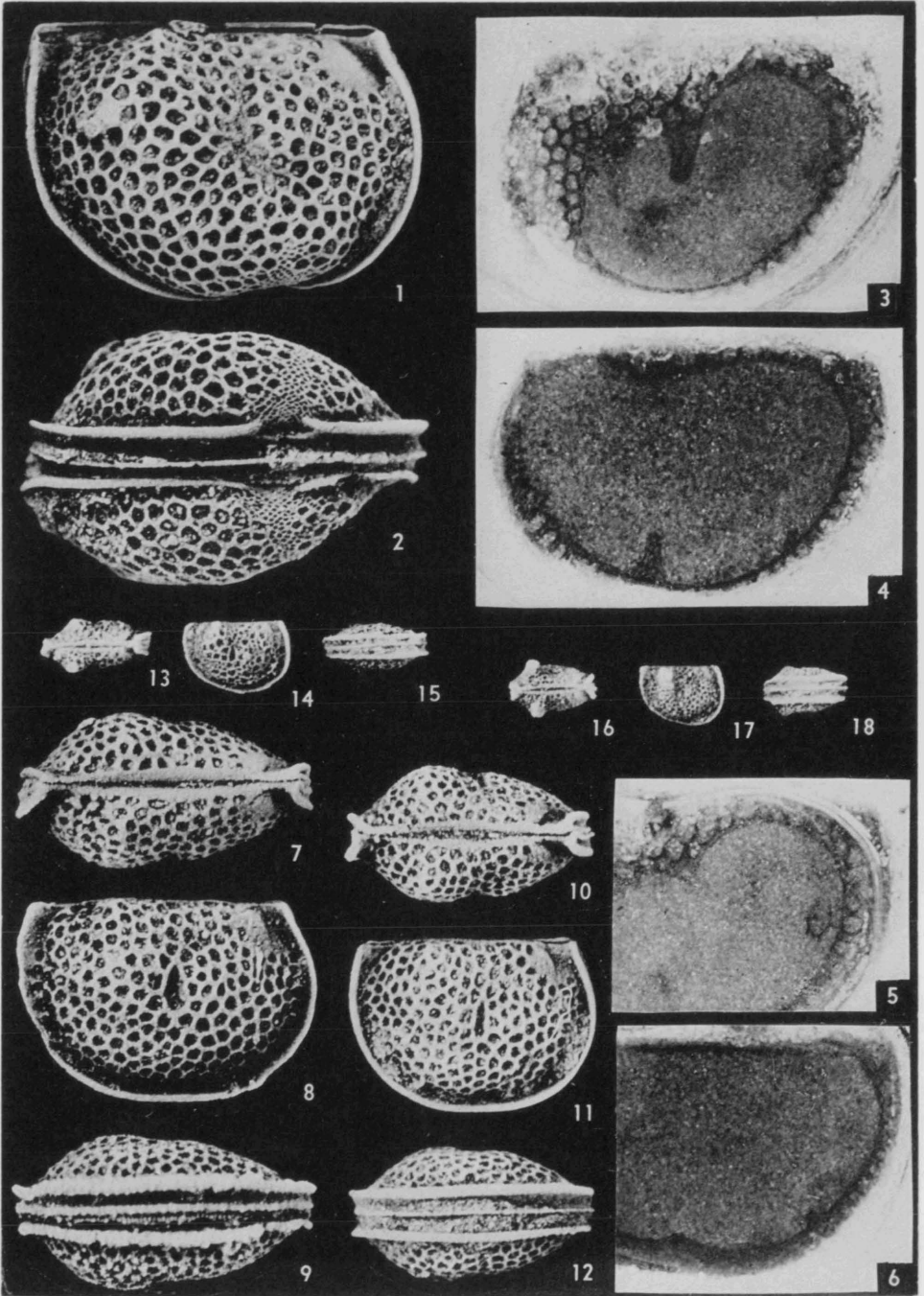
All figures X 30

Hibbardia lacrimosa (Swartz and Oriol).

Figs. 1-4, Dorsal, right lateral, ventral, and anterior views of adult female carapace, No. 28455. 5-8, Dorsal, right lateral, ventral, and anterior views of seventh instar, No. 28458. 9-11, Dorsal, right lateral, and ventral views of sixth instar, No. 28466. 12-14, Dorsal, right lateral, and ventral views of fifth instar, No. 28481. 15-17, Dorsal, right lateral, and ventral views of fourth instar, No. 28493. 18-20, Dorsal, right lateral, and ventral views of fourth instar, No. 28492. 21-23, Dorsal, right lateral, and ventral views of third instar, No. 28502. 24-26, Dorsal, right lateral, and ventral views of second instar, No. 28512. 27-29, Dorsal, right lateral, and ventral views of first instar, No. 28515.



KESLING: BEYRICHIID OSTRACOD FROM WANAKAH SHALE



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Narrow frill around free border from anterior corner to the ventral indentation and from the indentation to the posterior corner. At the indentation the proximal part of the frill continuing as a small low ridge and the distal part flaring outward to become tangent to the surface of the anteroventral part of the pouch (Pl. 8, Fig. 3; Pl. 9, Fig. 2). Laterally, the frill delineated by a distinct groove around its inner margin. A small marginal ridge along the free edge of the contact margin, separated from the frill by a flat, shallow, smooth channel.

Right valve overlapping left around free edge, overlap widest in ventral part. Large subtriangular sockets on inside corners of right valve, fitting around the projecting corners of the left valve (Pl. 9, Fig. 6).

Surface coarsely reticulate, with small distinct ridges surrounding polygonal areas. Anterior corner surface smooth. Anteroventral parts of pouches ornamented by very fine reticulation (Pl. 9, Fig. 2) not found in the male or immature specimens.

Muscle scar of adductor muscles on interior of each valve slightly in front of the center, on the inward projection formed by the prominent exterior pit. Surface of scar finely papillose.

Unusual partition-like ridges on interior

of each valve marking the ventral extensions of the pouch. Anterior ridge narrow, about .25 mm. high, extending across the ventral part of the valve from the lateral surface to the free edge, decreasing in height as it nears the free edge. Posterior ridge very small, extending across the posteroventral part of the valve (Pl. 9, Figs. 4, 6).

Anterior cardinal angle about 120° ; posterior cardinal angle about 95° .

ADULT MALE.—Known only from a left valve. General shape, lobation, ornamentation, and muscle scar about the same as those of the female. Greatest width posterior, through L3. No pouch. Dorsal tip of L3 developed as a blunt spine. Frill complete around free border. No indentation of ventral border. Ventral part of valve coarsely reticulate like rest of valve.

SEVENTH INSTAR.—General form and ornamentation same as those of the adult male. Central pit very prominent. As seen in dorsal view, the tip of each L3 closer to the hinge line than to the outline of lateral surface. As seen in ventral view, the contact margin of right valve ornamented with tiny (0.017 mm. diameter) closely-spaced denticles (Pl. 8, Fig. 7). These appear to be fragile, and may have been broken from most specimens.

EXPLANATION OF PLATE 9
All figures X 30

Hibbardia lacrimosa (Swartz and Oriol).

Figs. 1-2, Right lateral and ventral views of adult female carapace, No. 28456. This carapace is shown in polished surfaces in Figs. 3-6. 3, Polished surface of left valve of female carapace, showing sulcus and pit. 4, Polished surface of left valve near proximal longitudinal plane, showing ventral interior partition-like structures. 5, Polished surface of left valve, showing young instar (?) in posterodorsal part of pouch. 6, Polished surface of left valve of female carapace near the proximal longitudinal plane, showing corner of left valve fitting into socket of right valve and ventral interior structures. 7-9, Dorsal, right lateral, and ventral views of seventh instar, No. 28461. 10-12, Dorsal, right lateral, and ventral views of sixth instar, No. 28472. 13-15, Dorsal, right lateral, and ventral views of second instar, No. 28508. 16-18, Dorsal, right lateral, and ventral views of first instar, No. 28514.

SIXTH INSTAR.—Central pit proportionately larger than that of seventh instar. As seen in dorsal view, the tip of each L3 closer to outline of lateral surface than to the hinge line.

FIFTH INSTAR.—Muscle scar and external pit almost exactly in the middle of the length. Dorsal tip of each L3 more sharply pointed and the channel between marginal ridge and frill proportionately wider than in older instars.

FOURTH INSTAR.—Short spine on dorsal tip of L3 sharply pointed, its tip broken off from many specimens. As seen in dorsal view, each spine near the outline of lateral surface. Carapace less tumid than those of older instars.

THIRD INSTAR.—Frill apparently more fragile than that of any older instar, and parts of frill broken off from most specimens. Pit and muscle scar slightly posterior.

SECOND INSTAR.—Lateral outline with a definite swing not seen in older instars. In dorsal view, the spinose tip of each L3 extending beyond outline of lateral surface. Muscle scar and pit in posterocentral part of each valve.

FIRST INSTAR.—Lateral outline with swing, making posteroventral border nearly straight. Spine on dorsal end of each L3 extending farther outward than upward, very prominent in dorsal view.

REMARKS.—The instar described above as the first is the youngest instar found free, and may not actually be the first of the species. Hessland (1949, p. 125, Pl. XIV, Fig. 9) and Spjeldnaes (1951, p. 748, Pl. 103, Figs. 1-2) have found very young instars inside the pouches of beyrichiid females. The lateral surface of one of the adult female carapaces was polished off by abrasion. These polished longitudinal surfaces revealed that the interior of the carapace is filled with

dark calcite. Two objects seen on polished surfaces may give additional evidence of the ontogeny of this species. The first was a small circle intersected near the lateral surface of the right brood pouch in its dorsal part. The outside diameter of this circle was about .13 mm. and its thickness about .02 mm. as measured from a camera lucida drawing. If this were a fossil egg, and if its other dimension were also .13 mm., then the product of its length, height, and width would be .002 cu. mm., or about one-eighth the product of the dimensions of the instar described as the first. This would indicate, as far as we may interpret such evidence, that, in addition to the egg, there were two instars still younger than the youngest one found free. The second object found on successive polished surfaces was in the posterodorsal part of the pouch of the left valve (Pl. 9, Fig. 5). It appears to be a section through a small carapace. The width of this carapace is about .11 mm., indicating that it was probably two instars younger than the youngest one found free. The dark color of the calcite inside the carapace makes interpretation of polished surfaces difficult, and additional female carapaces should be made into thin sections to confirm this meager evidence.

OCCURRENCE.—This species is represented by well-preserved specimens in the Wanakah member of the Ludlowville formation, and specimens were found only in that member. They are more common in the *Pleurodictyum* beds (below the trilobite beds) than in the *Stropheodonta demissa* beds (above the trilobite beds). None were found in samples of the Windom and Kashong members of the Moscow formation above. None were found in samples of the underlying members of the Ludlowville formation, the Ledyard shale and the Centerfield limestone. The occurrence of

a single worn valve in the Windom material studied by Swartz and Oriol (1948) may be a redeposition from the older Wanakah shale.

SPECIMENS.—Many specimens of the intermediate instars were found, and only the best-preserved carapaces were used for measurements. The hypotypes, all deposited in the Museum of Paleontology, University of Michigan, include: two adult female carapaces, Nos. 28455 and 28456, the latter specimen used in a study of polished surfaces and now preserved as a thin section; one adult male left valve, No. 28457; five carapaces of seventh instar, Nos. 28458-28462; thirteen carapaces of sixth instar,

Nos. 28463-28475; thirteen carapaces of fifth instar, Nos. 28476-28488; twelve carapaces of fourth instar, Nos. 28489-28500; five carapaces of third instar, Nos. 28501-28505; seven carapaces of second instar, Nos. 28506-28512; and five carapaces of first instar, Nos. 28513-28517. Nos. 28458, 28463, and 28477 are from Locality 2; all other specimens cataloged are from Locality 3.

RATES OF GROWTH

Przibram (1931, p. 26) believed that crustaceans increase their weight (volume) to twice its former value during each period of molting. My investi-

CHART I
MEAN MEASUREMENTS OF CARAPACES OF *Hibbardia lacrimosa*

Instar	Specimens	Length mm.	Growth Factor	Height mm.	Growth Factor	Width mm.	Growth Factor	Product cu. mm.	Growth Factor	MA/L*
I	5	.382		.234		.178		.0159		.523
			1.17		1.18		1.31		1.81	
II	7	.446		.277		.233		.0288		.523
			1.24		1.27		1.35		2.13	
III	5	.554		.352		.314		.0613		.523
			1.28		1.32		1.17		1.97	
IV	12	.708		.465		.366		.1207		.507
			1.23		1.25		1.25		1.92	
V	13	.870		.579		.459		.2320		.507
			1.27		1.27		1.28		2.05	
VI	13	1.102		.733		.588		.4754		.484
			1.29		1.30		1.30		2.20	
VII	5	1.422		.956		.762		1.0457		.472
			1.22		1.26		1.38		2.09	
Females	2	1.735		1.200		1.050		2.1879		.484
Means			1.24		1.26		1.29		2.02	

*MA/L denotes the ratio of the distance from the pit (muscle scar) to the anterior end divided by the length.

gations of size in this and other species confirms this concept. The volume of a carapace can be approximated for comparison with the volumes of other carapaces by the product of its length, height, and width. This product is actually the volume of an enclosing rectangular parallelepiped, but it is relatively accurate for comparisons because the shape of the carapace does not change greatly without affecting the proportions of the three dimensions.

Chart I lists the mean dimensions of the instars of *Hibbardia lacrimosa* (Swartz and Oriel). The growth factor for successive means of the length, height, width, and their product are computed. It can be seen that the product increases by approximately a factor of 2 between successive instars. If the dimensions remained constant, then each dimension would increase by a factor of 1.26 (the cube root of 2). The actual figures, listed in Chart I, indicate that the length increases less than the height and that the width increases more than the height.

The growth of the ostracod through its ontogeny includes, if we may generalize from living species, the successive addition of post-oral appendages and an elongation of the post-oral part of the carapace. As the pre-oral part of the carapace decreases proportionately throughout the ontogeny, the adductor

muscle and its point of attachment shifts progressively forward. This shift of the muscle scar is strikingly illustrated in *Hibbardia lacrimosa* (Swartz and Oriel). As shown in Chart I, the muscle scar in the youngest instars is posterior and in the oldest is anterior.

The ontogenetic migration of the position of the tip of L3 from a lateral position toward the hinge line (Pl. 8, Figs. 1-29) is also progressive and consistent.

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