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Chonetacean Brachiopods of the "Pink *Chonetes*" Zone, Onondaga Limestone (Devonian, Eifelian), Central New York

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ABSTRACT

The "*Chonetes*" Community of the Seneca Member, Onondaga Limestone (Devonian, Eifelian), is redefined. The chonetacean brachiopods found therein belong to three different taxa: (1) *Hallinetes lineatus,* n. gen., which is distinguished from other chonetacean genera by its disymmetrically arranged spines perpendicular to the hinge line and for which a neotype has been designated, (2) *Longispina mucronata* and "*Eodevonaria*" *hemispherica* for which lectotypes have been designated. *Hallinetes* is the most common chonetid found on the bedding planes (92%) while *Longispina* and "*Eodevonaria*" are much less common (5.4% and 2%, respectively). The *Hallinetes* Community of the "Pink *Chonetes*" Zone corresponds to the assemblage within the mudstone matrix rather than to that on the bedding planes. It is a low-diversity community representative of a quiet water environment, probably in a Benthic Assemblage 4 position of Boucot (1975).

INTRODUCTION

The Onondaga Limestone in central New York (fig. 1) can be divided into four members (Oliver, 1954; Feldman, 1980, 1985): from base to top, the Edgecliff, Nedrow, Moorehouse, and Seneca. The total thickness of the formation in Jamesville, New York (AMNH Locality 3128) is 69.5 ft (Feldman, 1985). In the eastern and western part of the state, that is, away from the basinal axis, the total thickness approximately doubles. The

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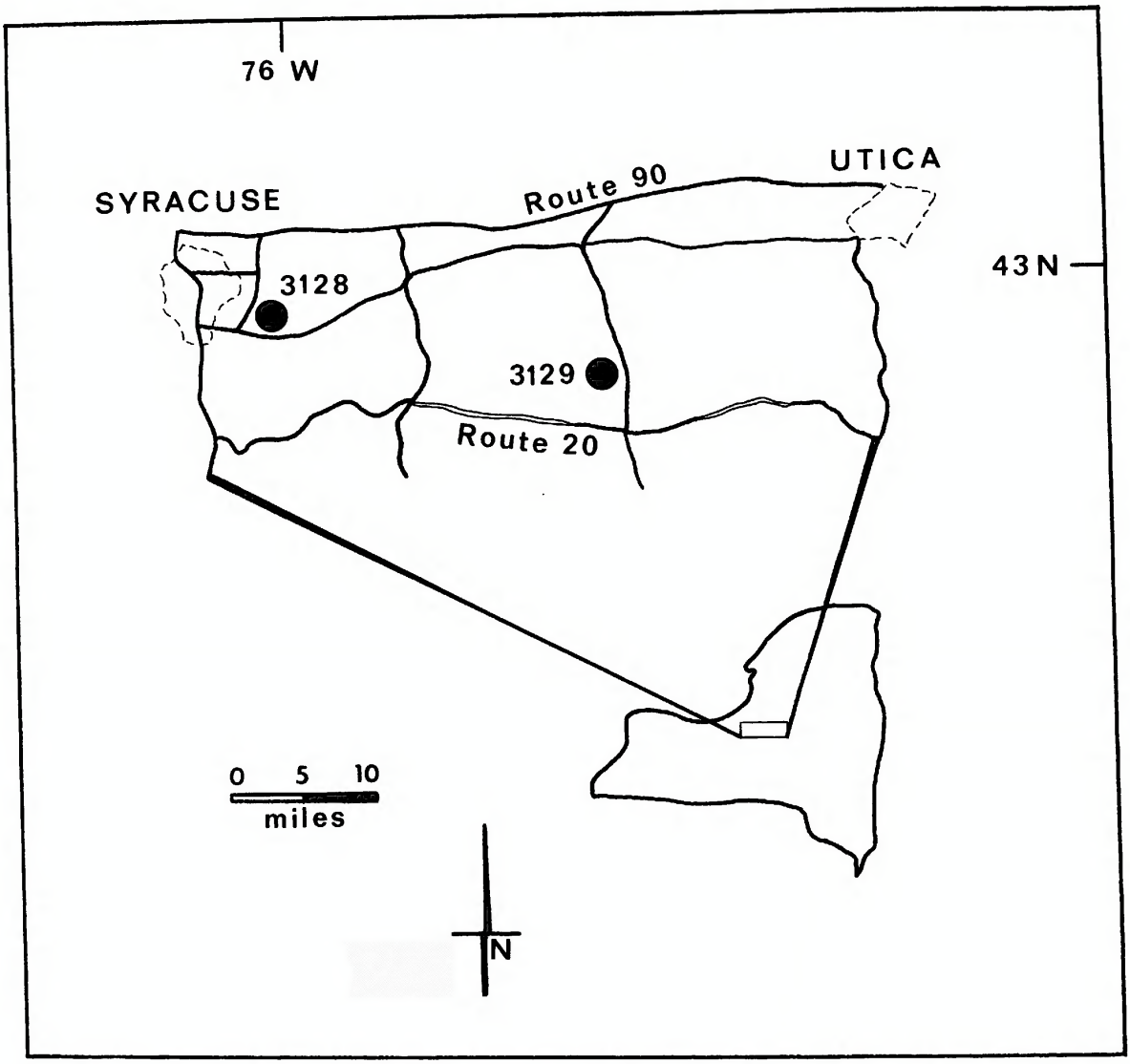

Fig. 1. Index map of collecting localities in the "Pink *Chonetes*" Zone, Onondaga Limestone, central New York. Numbers refer to AMNH Localities (see text for detail).

"Pink *Chonetes*" Zone (Oliver, 1954) in central New York is located in the Seneca Member, 10 ft above the base of a greenish gray to ochre-colored volcanic ash layer, the Tioga Bentonite (fig. 2) and is characterized in many localities by numerous stylolites. Overlying the Seneca in central New York is the Union Springs Black Shale, a correlative of the Marcellus Shale in the Cherry Valley area, which represents a westerly advance of terrigenous sedimentation and relatively deep, poorly oxygenated water (Feldman, 1980).

Vanuxem (1839) recognized a nearly chert-free limestone unit with abundant "*Strophomena* (*Chonetes*)" *lineata* above the Corniferous Limestone, which he referred to as the Seneca Limestone. He considered the Seneca to be a separate unit, as is evidenced by his annual report (1839) and final report (1842). Workers have studied the biostratigraphy of the "Pink *Chonetes*" Zone (Oliver, 1954; Feldman and Lindemann, 1986), its community structure (Feldman, 1980; Lindemann and Feldman, 1981), the taxonomy of its brachiopod fauna (Feldman, 1985), and even reasons for the "pink" coloration of its

dominant chonetid brachiopods (Zenger, 1967). Oliver (1954), in his classic study of the Onondaga Limestone in central New York, referred to the "Pink *Chonetes*" Zone of the Seneca Member as Zone J. He described it as a very thinly bedded limestone, about 4 ft thick and composed almost entirely of shells of *C. lineatus,* many of which are stained pink. Oliver (1954) noted that a bed of chert, similar to that of Zone I (8 ft thick), occurs at most localities about 6 in. below the top of Zone J in western New York. This chert bed, according to Oliver, includes the hyolithid *Coleolus crenatocinctum* and gastropod *Loxonema sicula.*

Oliver (1954: 641) found the following brachiopod fauna in the "Pink *Chonetes*" Zone of western New York:

Camarotoechia tethys
Atrypa "reticularis"
A. spinosa
Coelospira camilla
Atlanticocoelia acutiplicata
Elytha fimbriata
Acrospirifer duodenarius
Athyris spiriferoides
"Schuchertella" pandora
Levenea lenticularis
"Chonetes" lineatus
Chonetes mucronatus
Pentagonia unisulcata
Meristella nasuta

He also noted the presence of the trilobite *Odontocephalus selenurus* and fish teeth.

In central New York, Oliver (1954: 635) found the following brachiopod fauna in the "Pink *Chonetes*" Zone:

Coelospira camilla
Atrypa "reticularis"
A. spinosa
Chonostrophia reversa
Levenea lenticularis
"Schuchertella" pandora
Chonetes "lineatus"
Meristella sp. A

He also found the corals *Amplexiphyllum hamiltoniae* and *Heterophrentis* sp. B.

Feldman (1985) found the following additional brachiopods in the "Pink *Chonetes*" Zone in central New York (AMNH locs. 3128A, 3129):

Megakozlowskiella raricosta
Leptaena aff. *"rhomboidalis"*
Pentamerella arata
Athyris sp. A
Megastrophia
orthotetacids indet.

Additional faunal constituents found by Feldman (1985) include the corals "*Heterophrentis*" and *Amplexiphyllum,* trilobites *Phacops cristata* and *Odontocephalus,* euomphalacean gastropod fragments, and camerate? crinoid columnals.

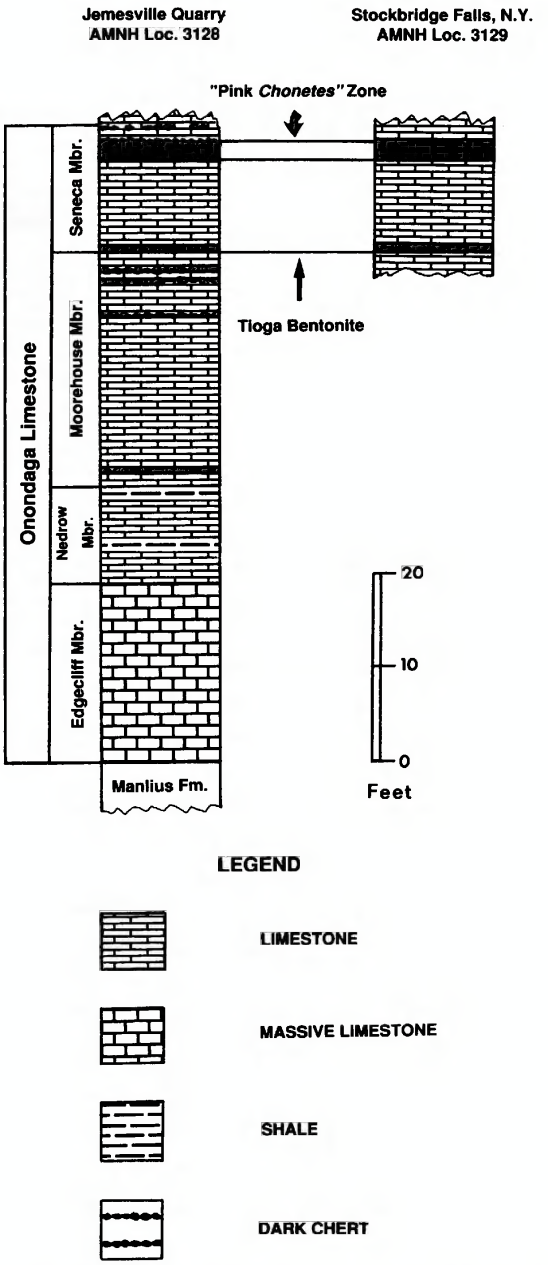

Fig. 2. Measured stratigraphic sections of AMNH Loc. 3128 and 3129, Onondaga Limestone, central New York.

In this paper we revise the taxonomy of the chonetacean brachiopods found in the "Pink *Chonetes*" Zone of the Onondaga Limestone in central New York and redefine the community based on new paleoecologic and taxonomic information.

ACKNOWLEDGMENTS

We thank Drs. Arthur J. Boucot (Department of Zoology, Oregon State University), Paul Copper (Department of Geology, Laurentian University), Neil Landman (Department of Invertebrates) and David Grimaldi (Department of Entomology) both of the American Museum of Natural History, for critically reading and commenting on the manuscript and offering valuable suggestions for improvement.

ABBREVIATIONS

Institutions and Localities

AMNH	American Museum of Natural History, Department of Invertebrates
AMNH Loc.	American Museum of Natural History locality number
ANSP	Academy of Natural Sciences, Philadelphia
NYSM	New York State Museum, Albany
USNM	United States National Museum of Natural History, Department of Paleobiology, Smithsonian Institution

Measurements

(L)	maximum length of shell
(W)	maximum width of shell
(T)	maximum thickness of shell
mm	millimeters
est.	estimated
b.v.	brachial valve
p.v.	pedicle valve
b.p.	bedding plane
art.	articulated
ext.	exterior

SYSTEMATIC PALEONTOLOGY

PHYLUM BRACHIOPODA
ORDER STROPHOMENIDA
SUPERFAMILY CHONETACEA BRONN, 1862
FAMILY CHONETIDAE BRONN, 1862
SUBFAMILY DEVONOCHONETINAE
MUIR-WOOD, 1962

Hallinetes, new genus
Figures 3–5

TYPE SPECIES: *Strophomena lineata* Conrad, 1839.

ETYMOLOGY: In honor of New York State paleontologist James Hall.

DIAGNOSIS: Chonetid with vertical disymmetrically arranged hinge spines (4′—1, 2, 3). Brachial interior with a median septum not supporting the cardinal process. Alveolus well developed in juvenile brachial valves. Anderidia posteriorly fused with the elevated medial part of the inner cristae. No accessory septa.

REMARKS: *Hallinetes* is provisionally assigned to the subfamily Devonochonetinae based on brachial interior morphology. The lack of accessory septa links the new genus to the "*Devonochonetes coronatus*" group (see Racheboeuf, 1981: 141; Racheboeuf and Branisa, 1985: 1439 for discussion). *Hallinetes* can easily be distinguished from all other chonetacean genera by its spines which are perpendicular to the hinge line and disymmetrically arranged.

Morphology and arrangement of spines closely resemble those of the genus *Johnsonetes* Racheboeuf, 1987, from the Emsian Blue Fiord Formation of the Canadian Arctic Archipelago. However, *Hallinetes* lacks the median enlarged capilla and differs in its brachial interior, which is strongly pustulose with more divergent anderidia, and by the presence of a large alveolus.

Hallinetes resembles *Aseptonetes* Isaacson, 1977 from the Emsian Sicasica Formation of Bolivia, in its radial ornamentation as well as in spine morphology, but the latter possesses symmetrically arranged spines; both genera lack accessory septa.

The posteromedian part of the brachial interior of *Hallinetes* is somewhat similar to that of the genus *Saharonetes* Havlicek, 1984, from the Lower Carboniferous Ashkidah and Marar formations of Libya, as the inner cristae medially bend posteriorly toward the inner lobes of the cardinal process. But in *Hallinetes* the inner cristae are much better developed, spines are oriented vertically instead of obliquely, and there are no accessory septa.

Although *Hallinetes* resembles *Johnsonetes, Aseptonetes,* and *Saharonetes* there is no generic relationship evident between them, only morphological similarities.

Species questionably assigned to *Hallinetes,* new genus:

Strophomena setigera Hall, 1843.

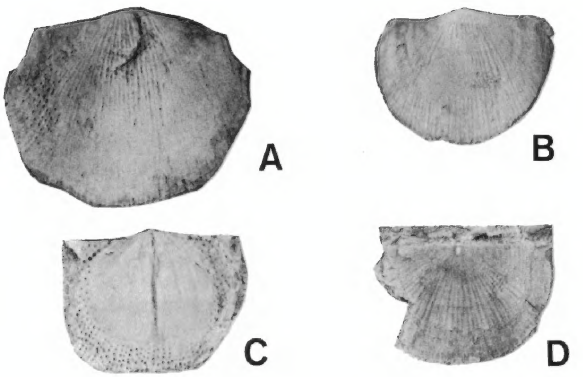

Fig. 3. *Hallinetes lineatus* (Conrad, 1839). **A.** Pedicle valve, original of *Chonetes glabra* Hall, 1857, 1867, pl. 20, fig. 3d, AMNH 37235, ×3. **B.** Pedicle valve, figured by Hall, 1867, pl. 20, fig. 3a, AMNH 37233a, × 3. **C.** Pedicle interior, Hall's original, 1867, pl. 20., fig. 3e, AMNH 37233c, ×3. **D.** Brachial exterior, Hall's original, 1867, pl. 20, fig. 3c, AMNH 37233B, ×3.

Chonetes cf. *setigerus* (Hall), Kindle, 1912: 71, pl. 3, fig. 17.

Hallinetes lineatus (Conrad, 1839)

Figures 3–5

Strophomena lineata Conrad, 1839: 64; Vanuxem, 1842: 139; Hall, 1843: 175, fig. 8.
Chonetes glabra Hall, 1867: 117, figs. 1–8.
Chonetes lineata Hall, 1867: 121, pl. 20, fig. 3; Hall and Clarke, 1892: pl. 16, fig. 34.
"*Chonetes*" *lineatus* Zenger, 1967: 161, fig. 1.
"*Chonetes*" aff. *lineata* Feldman, 1985: 321, figs. 26–28 (non 25).

NEOTYPE: Unsuccessful attempts were made to locate the genotype of *Hallinetes* at various institutions (USNM, NYSM, ANSP, AMNH) for purposes of comparison. Since the genotype is apparently lost we are herein designating a neotype, AMNH 37233a (fig. 3B herein).

TYPE LOCALITY: Unknown; according to Hall, 1843: 175, this shell is abundant in Seneca County but rare farther west. Substitute type locality herein designated as AMNH Loc. 3128, Jamesville Quarry, Jamesville, New York.

REMARKS: The species name *lineata* was first used by Conrad (1839), associated with the genus name *Strophomena*. James Hall was the first to establish the assignment of the species *lineata* to the genus *Chonetes* (table 1), and gave the first complete description of the species. He considered Vanuxem as the author, and stated that the previously described species *Chonetes glabra* Hall, 1857 was a junior synonym of *Chonetes lineata* Vanuxem (Hall, 1867: 121).

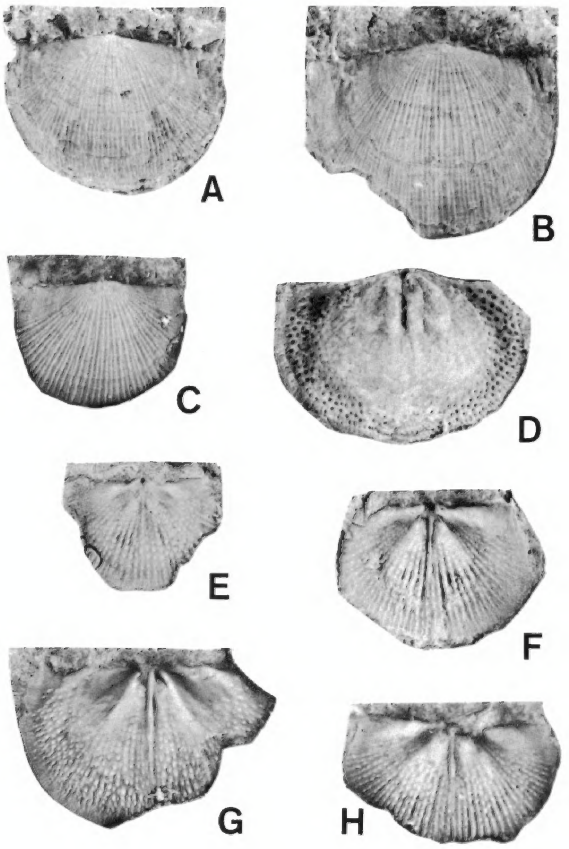

Fig. 4. *Hallinetes lineatus* (Conrad, 1839). **A.** Pedicle valve, block 2, AMNH Loc. 3128, AMNH 43693, ×3. **B.** Pedicle valve, AMNH Loc. 3128, AMNH 43694, ×3. **C.** Latex mold of an immature pedicle valve, AMNH Loc. 3128, AMNH 43695, ×3. **D.** Pedicle interior, AMNH 43695, ×3. **E.** Latex cast of a damaged immature brachial interior, AMNH Loc. 3128, AMNH 43696, ×3. **F.** Latex cast of a brachial interior, AMNH Loc. 3129, AMNH 43697, ×3. **G.** Latex cast of a large, damaged brachial interior, AMNH Loc. 3128, AMNH 43698, ×3. **H.** Brachial interior, latex, AMNH Loc. 3128, AMNH 43695, ×3.

EXTERIOR: Small shell with maximum width at hingeline in juvenile specimens but at midlength in adults. Maximum length about 9.0 mm; corresponding width about 11.0 mm; length/width ratio decreasing from

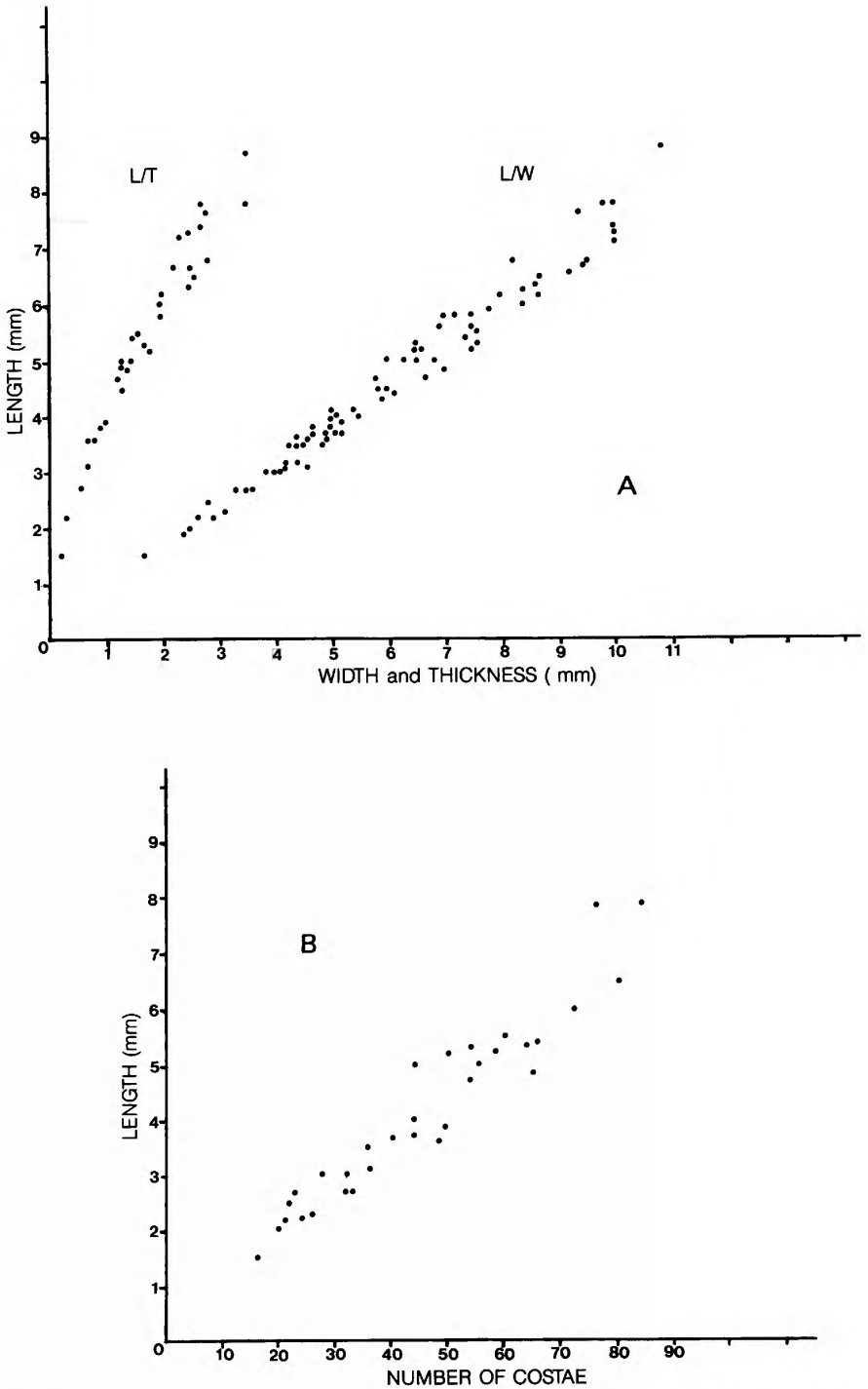

Fig. 5. *Hallinetes lineatus* (Conrad, 1839). Scattergram showing: **A.** Length/width and length/thickness, and **B.** length/total number of costae.

0.95 to 0.75 during ontogeny. Longitudinal profile weakly concavoconvex in small shells, becoming strongly arched in larger specimens; length/thickness decreasing from 7.5 to a mean value of 2.4 during ontogeny. Pedicle valve weakly flattened at the top. Umbo

TABLE 1

Measurements (in millimeters) of *Chonetes lineata* Hall, 1867 (originals of *Chonetes glabra* Hall, 1867)

Specimen	(L)	(W)	(T)	No. costae per mm	Original specimen
AMNH 37235	8.2	—	4.1	4	Hall, 1867, pl. pl. 20, fig. 3d
AMNH 37233a lectotype	5.8	8.0	—	5	Hall, 1867, pl. 20, fig. 3a
AMNH 43707	5.8	8.0	2.2	5	
AMNH 43708	3.0	4.0	0.7	5	
AMNH 43709	6.8	8.5	2.8	5	
AMNH 43710[a]	5.8	8.2	—	—	
AMNH 43711	5.3	7.4	1.8	5	
AMNH 43712	3.4	4.6	0.8	5	
AMNH 43713	7.5	10.0	3.0	5	
AMNH 43714	6.5	8.3	2.6	5	

[a] Pedicle interior.

TABLE 2

Distribution of Hinge Spines on *Hallinetes lineatus*

No. spines	4′	1	2	3
Distance from beak (mean, mm)	3.63	0.32	0.94	2.46
No. observations	5	3	23	16

relatively small, narrow, strongly arched longitudinally. Ears small, triangular, often ill defined and smooth. Ornamentation of low, rounded radial costellae with wider rounded interspaces; costellae increasing by intercalation on the pedicle valve and by bifurcation on the brachial valve; on the pedicle valve the first intercalation occurs about 1.2 mm from the beak. Two mm anterior of beak, costellae number 5 per mm; along anterior margin they number 5–6 per mm. Costellae progressively narrower from beak to anterior margin as intercalations increase. Total number of costellae between 72 and 84 for shells which are more than 6.0 mm in length. Due to difficulties in preparing the material the pseudodeltidium and chilidium have not been observed. Pedicle interarea concave and apsacline; brachial interarea almost linear and hypercline. In largest shells, three spines are inserted on the right side of the beak, only one on left side. Spines are straight, perpendicular to hingeline, of orthomorph type. Their distribution is: 4′—1, 2, 3 (see fig. 4A) (table 2).

PEDICLE VALVE INTERIOR: Visceral cavity well defined. Stout myophragm extending anteriorly to midlength or two-thirds of the valve in largest specimens; myophragm narrows anteriorly, dividing a deeply impressed muscle field with subcircular adductor scars and subtriangular, anteriorly rounded diductor scars. Muscle field extending anteriorly up to one-third of the valve length. Vascular trunks originating at the anterior margin of adductors. Posterior ridges relatively low, wide, and rounded, anteriorly divergent at about 100°. Teeth stout, transversely elongate, subparallel to hingeline. Visceral cavity deep, smooth, well defined anterolaterally. Posterolateral parts of valve coarsely pustulose; anterolateral margins with radially arranged endospines.

BRACHIAL VALVE INTERIOR: Posteromedian part of valve deeply depressed between cardinal process, median septum, and proximal part of inner cristae. Median septum forms low, rounded ridge extending progressively toward anterior margin during growth; length about ¼ valve length in small shells, reaching ⅔ valve length in largest specimens. Outer cristae reduced to very low and narrow linear ridges along hingeline. Inner cristae strongly developed as two stout rounded ridges almost parallel to hingeline, not fusing medially with anterior part of cardinal process. Posterior edge of inner cristae deeply notched by dental sockets. Cardinal process internally bilobed, each lobe fusing anterolaterally with proximal part of inner cristae. Myophore quadrilobed. Anderidia anteriorly divergent at about 50–55°, as straight, narrow, and elongated ridges posteriorly fusing with inner cristae. Adductor scars deeply impressed in the valve floor of largest shells. Brachial platform strongly convex, elevated above median septum, pustulose in juvenile specimens, smooth in adult shells. Posterolateral part of valve between inner cristae and brachial platform depressed. Inner surface covered with relatively strong endospines, radially arranged, except for the inner cristae, muscle field and brachial platform.

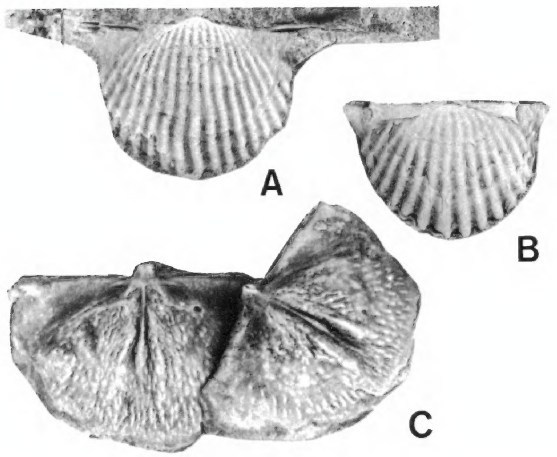

Fig. 6. *Longispina mucronata* (Hall, 1843). **A.** Lectotype, pedicle valve with spines. Hall's original, 1867, pl. 21, fig. 1, AMNH 37246, ×3. **B.** Brachial exterior, original of *Chonetes laticosta* Hall, 1857, figured in Hall, 1867, pl. 20, fig. 2, AMNH 37244, ×3. **C.**Brachial interiors, original of *Chonetes scitula* Hall, 1857, figured in Hall, 1867, pl. 21, fig. 4f, AMNH 37254, ×3.

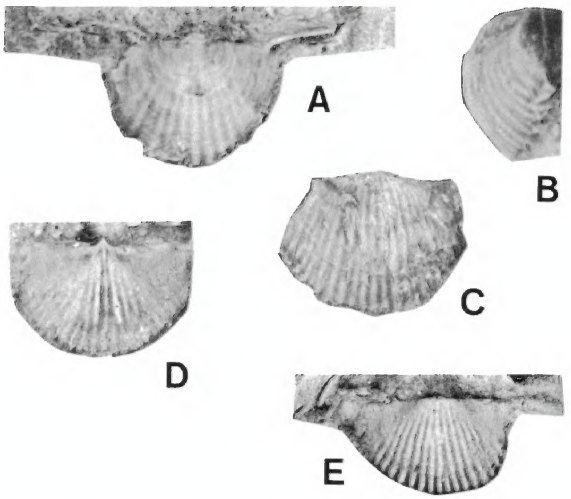

Fig. 7. *Longispina mucronata* (Hall, 1843). **A.** Pedicle valve with spines, AMNH Loc. 3128, AMNH 43699, ×5. **B, C.** Pedicle valve, lateral and ventral views, AMNH Loc. 3123128, AMNH 43700, ×3. **D.** Latex cast of a brachial valve, AMNH Loc. 3123129, AMNH 43701, ×3. **E.** Latex cast of an incomplete pedicle valve, AMNH Loc. 3123128, AMNH 43706, ×3.

MATERIAL: Several hundred isolated valves and articulated shells, all from two localities in the "Pink *Chonetes*" Zone, central New York.

STRATIGRAPHIC OCCURRENCE: The shells were collected from two localities, both within the Seneca Member, Onondaga Limestone.

The first (AMNH Loc. 3129A) is in the Jamesville Quarry #3 pit which is the most complete section of the Onondaga in the central part of New York. Collecting in this quarry is difficult since it is very active. Not only is it hard to find weathered bedding surfaces but the rocks are continually being blasted and removed, making it difficult to locate and recover fossil material. The Seneca Member here is 14 ft thick, with the Tioga Bentonite at the base. Ten feet above the Tioga is found the "Pink *Chonetes*" Zone which consists of a fine-grained limestone with a fresh dark gray surface. There are wavy contacts between bedding planes and stylolites present.

The second (AMNH Loc. 3129) is located just west of Stockbridge Falls, New York, along Stockbridge Falls Road and Oneida Creek. Here, 10–15 ft of the Seneca Member is exposed, with an upper contact with the Union Springs Black Shale. The Seneca here is a fine-grained, jointed limestone, medium to thinly bedded, heavily weathered and muddy on weathered surfaces but dark gray on fresh surfaces.

SUBFAMILY RETICHONETINAE
MUIR-WOOD, 1962
GENUS *LONGISPINA* COOPER, 1942

Longispina mucronata (Hall, 1843)
Figures 6–8, 12

Strophomena mucronata Hall, 1843: 180, fig. 3.
Chonetes laticosta Hall, 1857: 119.
Chonetes mucronata Hall, 1867: 124, pl. 20, fig. 1; pl. 21, fig. 1.
Chonetes mucronata Hall and Clarke, 1892: pl. 16, figs. 6, 7; 1894, pl. 20, fig. 3.

TYPE SPECIES: *Chonetes emmetensis* Winchell, 1866: 92.

LECTOTYPE: Pedicle valve, AMNH 37246, figured in Hall, 1867 (pl. 21, fig. 1a–c) (fig. 6A herein; table 3).

TYPE LOCALITY: Ontario County, New York State (more specific information unavailable; Hall, 1857: 120, described the locality as a

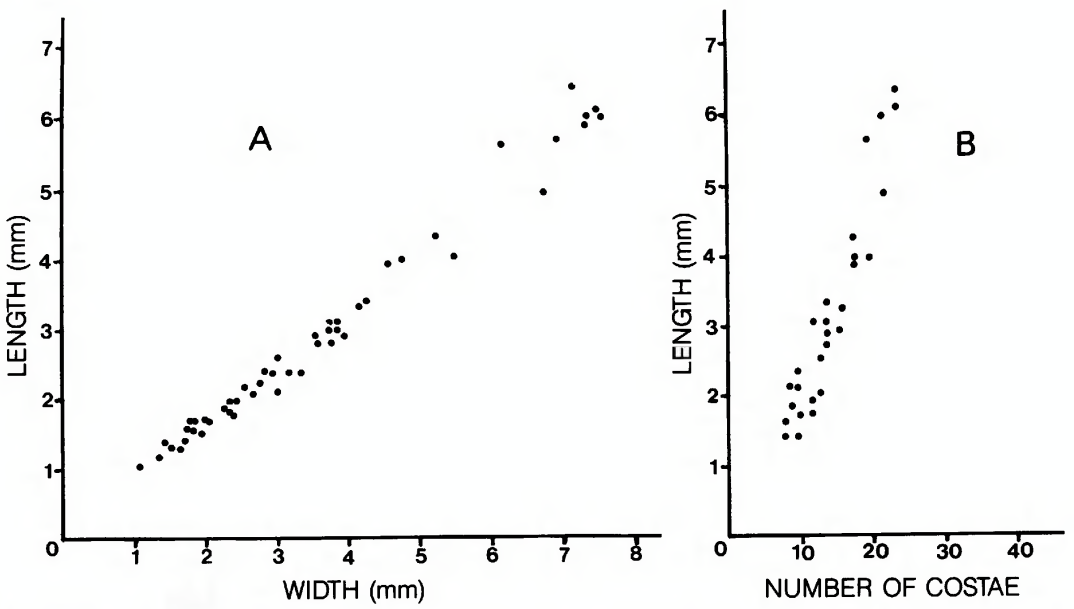

Fig. 8. *Longispina mucronata* (Hall, 1843). Scattergram showing: **A.** Length/width, and **B.** Length/total number of costae for 55 pedicle valves.

limestone a few miles southeast of Buffalo and in shales of the Hamilton Group on Canandaigua Lake). Substitute type locality herein designated as AMNH Loc. 3128, Jamesville Quarry, Jamesville, New York.

EXTERIOR: Small shells, moderately concavoconvex with maximum width at hingeline. Anterior margin regularly rounded; lateral margins parallel or slightly divergent posteriorly. Maximum length about 6.0 mm; corresponding width about 7.5 mm. Length/width ratio between 0.75 and 0.8 mm. Umbo relatively small, weakly overlapping posterior edge of ventral interarea. Pedicle interarea concave and anacline; brachial interarea linear. Pseudodeltidium and chilidium not observed. Ornamentation consists of rounded, radial costae; along margins costae number 12 to 24 during growth; costae usually simple, progressively widening from umbo to margins. Costae wider than interspaces on pedicle valve while narrower than interspaces on brachial valve. Along anterior margin costae number 3 per 2 mm. Costae crossed by thin and regular concentric growth lines. According to Hall (1867: 125) some costae originate by bifurcation or by intercalation; this was not observed on the specimens from the Seneca Member. Three spines on each side of the beak of largest specimens; spines typical for the genus and symmetrically arranged.

PEDICLE VALVE INTERIOR: The myophragm does not exceed one-third valve length. Muscle field deeply impressed on valve floor with well-defined diductor scars. Adductors narrow, posteriorly situated. Vascular trunks strongly developed, anteriorly divergent from anterior end of myophragm. Visceral cavity well defined, peripheral margin of valve impressed by external radial costae. Teeth not observed on material available.

BRACHIAL VALVE INTERIOR: Typical for the genus in every aspect of its morphology, with a low and narrow median septum supporting

TABLE 3
Measurements (in millimeters) of *Longispina mucronata* (Hall, 1843)

Specimen	(L)	(W)	Total no. costae
AMNH 37246 lectotype, p.v.	6.6	8.5	20
AMNH 37247 p.v.	3.1	4.2	13
AMNH 37244 original *Chonetes laticosta*, p.v.	5.9	6.8	17

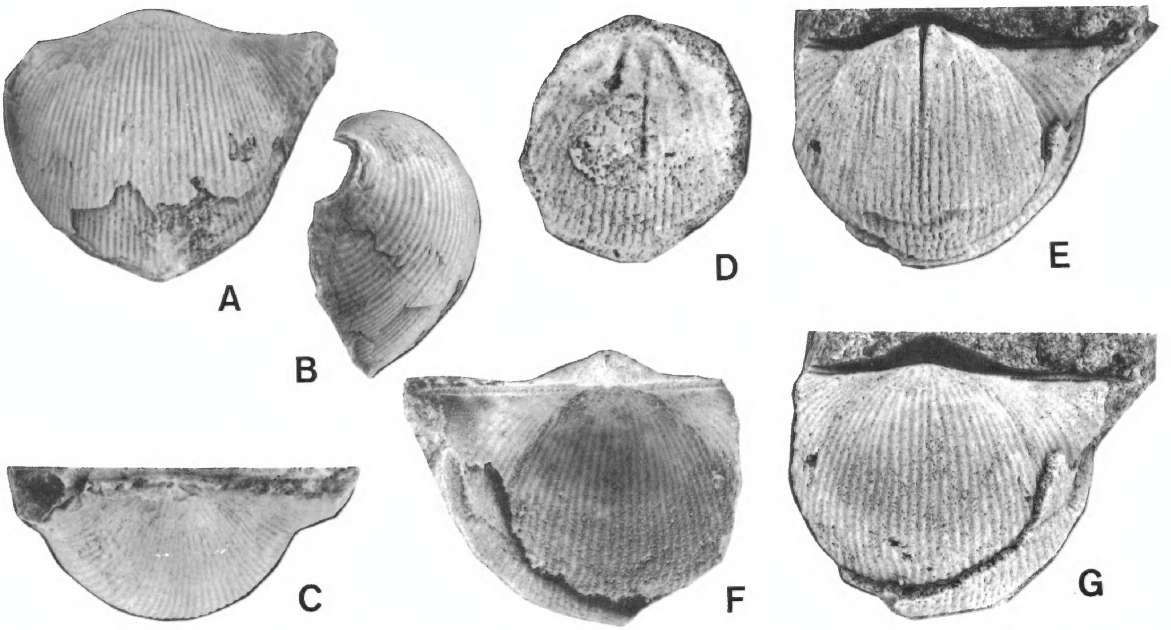

Fig. 9. "*Eodevonaria*" *hemispherica* (Hall, 1857). **A–C.** Lectotype, pedicle valve in ventral (**A**), lateral (**B**), and posterior (**C**) views. Hall's original, 1857, p. 116, fig. 1; 1867, pl. 20, fig. 6b–d, AMNH 2825, ×2. **D–G.** Decalcified articulated damaged shell, brachial interior (**D**), pedicle interior (**E**), latex cast of the brachial exterior (**F**), and interior (**G**), AMNH 37224, ×2.

the cardinal process and extending anteriorly up to two-thirds the valve length; posteriorly elongated and narrow cardinal process; a pair of well-developed accessory septa and anderidia anteriorly divergent at 70°.

DISCUSSION: *Strophomena mucronata* Hall, 1857, is a typical representative of the genus *Longispina* Cooper 1942, as attested by the shell shape and spine morphology, as well as interiors of both valves. The original of *Chonetes laticosta* Hall, 1857, figured in 1867 (AMNH 37244, pl. 20, fig. 2) is a brachial exterior or *L. mucronata,* as stated by Hall (1867: 125). Two dorsal interiors (AMNH 37254), one of which was figured by Hall (1867: pl. 21, fig. 2f) as *Chonetes scitula,* are undoubtedly representatives of the genus *Longispina*; according to our own observations they must be assigned to the species *L. mucronata,* but *L. mucronata* and "*Chonetes*" *scitula* are distinct species.

STRATIGRAPHIC OCCURRENCE: *Longispina mucronata* is a common species of the Nedrow, Moorehouse, and Seneca members of the Onondaga Limestone; it is rare or very rare within the Edgecliff Member according to Oliver (1954, 1956). It is also found in the overlying Hamilton Group, specifically in the Marcellus Shale.

MATERIAL: A total of 105 specimens from the *Hallinetes* Community, mostly complete juvenile shells; only one brachial valve and two pedicle valves were available for preparing the interiors; AMNH Locs. 3128, 3129.

FAMILY EODEVONARIIDAE SOKOLSKAYA, 1960
GENUS *EODEVONARIA* BREGER, 1906

"*Eodevonaria*" *hemispherica* (Hall, 1857)
Figures 9–12

Chonetes hemispherica Hall, 1857: 116; 1867: 118–119, pl. 20, fig. 6A–D.
Chonetes hemisphaerica Hall and Clarke, 1892: pl. 16, fig. 14.

TYPE SPECIES: *Chonetes arcuata* Hall, 1857.

LECTOTYPE: Pedicle valve AMNH 2825 figured in 1857 (p. 116, fig. 1), 1867 (pl. 20, figs. 6b, c), 1892 (pl. 16, fig. 14).

TYPE LOCALITY: Schoharie Grit (Hall, 1857: 116). Substitute type locality herein designated as AMNH Loc. 3128, Jamesville Quarry, Jamesville, New York.

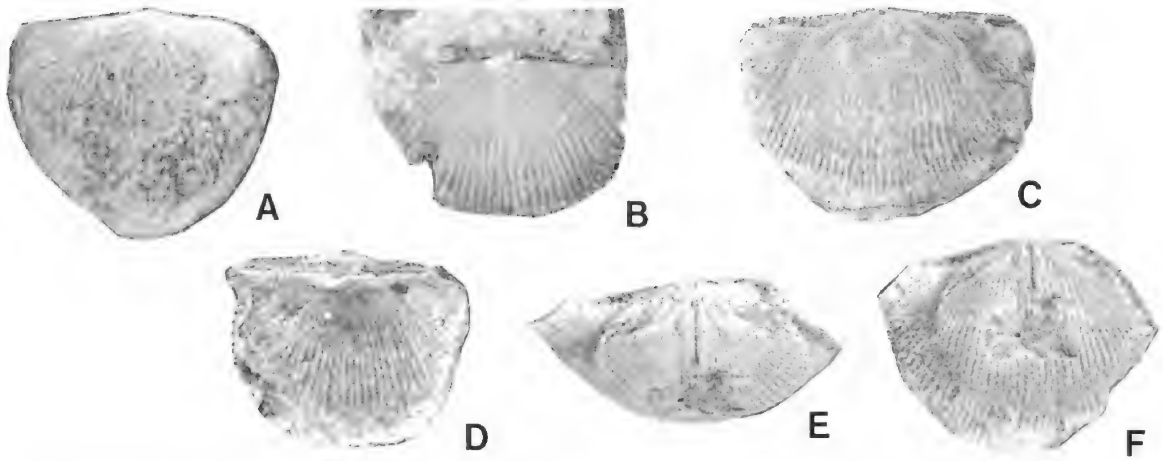

Fig. 10. "*Eodevonaria*" *hemispherica* (Hall, 1857). **A.** Pedicle valve, latex cast, AMNH Loc. 3128, AMNH 43702, ×3. **B.** Juvenile pedicle valve with spines, AMNH Loc. 3128, AMNH 43703, ×3. **C.** Pedicle interior, AMNH Loc. 3128, AMNH 43704, ×3. **D.** Articulated shell in dorsal view, AMNH Loc. 3129, AMNH 43705, ×3. **E, F.** Damaged pedicle interior, posteroventral and ventral views, AMNH Loc. 3128, AMNH 43706, ×3.

EXTERIOR: Large shell, strongly concavo-convex with maximum width at hingeline. Maximum length about 20 mm; length/width ratio about 0.66; length/height ratio about 0.5. Umbo widely rounded, strongly arched dorsally, posteriorly overhanging hingeline by more than 2 mm in largest specimens. Ears triangular, strongly convex and well differentiated from the body of the pedicle valve. Ornamentation of low, rounded radial costae increases by bifurcation on the pedicle valve and by intercalation on the brachial valve. Along anterior margin costae number 3 to 4 per mm. At 2 mm anterior to the beak the total number of costae is about 15 while at 5 mm from the beak the number increases to 35. Maximum number of costae 70 (estimated) in largest shells. On pedicle valve first bifurcation occurs at 2.5 mm from the beak. Costae separated by narrower spaces. Pseudodeltidium reduced to small triangular, convex plate at apex of delthyrium; chilidium not observed. Pedicle interarea strongly concave and catacline, almost perpendicular to commissural plane. At least 6 spines on each side of beak; spines high angled and oblique at their base.

PEDICLE VALVE INTERIOR: Only one specimen (AMNH 37224) was available for study. Muscle field longitudinally divided by stout myophragm extending anteriorly up to mid-length. Diductor scars ill defined, poorly impressed on valve floor, wide, radially grooved, occupying posterior half of visceral cavity. Adductor scars relatively large, semioval in outline, almost semicircular; length about 4 mm and corresponding width about 3 mm. Two narrow and deeply impressed vascular trunks (vascula media) originate anterior to adductor scars. Whole inner surface impressed by external ribbing except for anterolateral margins of valve where endospines remain distinct, radially arranged. Hingeline strongly denticulate.

TABLE 4
Measurements (in millimeters) of "*Eodevonaria*" *hemispherica* (Hall, 1857)

Specimen	(L)	(W)	(T)	Total no. costae	No. costae per mm
AMNH 2825 lectotype, p.v.	19.7	+30	10	70[a]	3–4
AMNH 37224 b.v. ext.	18.5	24[a]	—	60[a]	3
AMNH 37225 p.v.	13.1	20[a]	7	64[a]	3
AMNH 37226 art.	12[a]	16+	—	—	3

[a] Estimate.

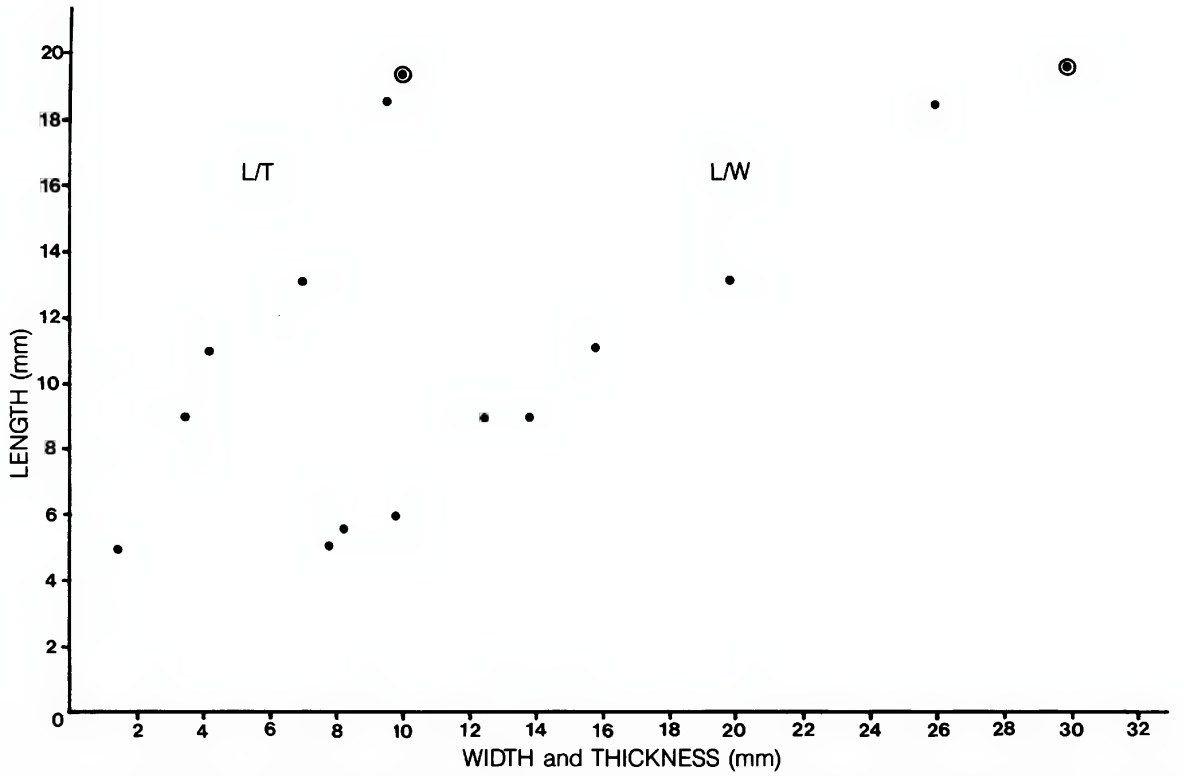

Fig. 11. "*Eodevonaria*" *hemispherica* (Hall, 1857). Scattergram showing length/width and length/thickness. Circle denotes the lectotype.

BRACHIAL VALVE INTERIOR: Known from one incomplete internal mold only (AMNH 37224). A strong median septum extends anteriorly up to midlength; septum progressively widens posteriorly, developing a flattened triangular platform. Anderidia posteriorly fused with the platform, anteriorly diverging at 50°. Cardinalia and other structures unknown. Inner surface covered with radially arranged distinct endospines.

DISCUSSION: The species *hemispherica* (table 4) undoubtedly belongs to the family Eodevonariidae as evidenced by its shape and denticulate hingeline as well as other characters. However, the lack of complete brachial interiors precludes any generic assignment. For this reason *Chonetes hemispherica* Hall is here assigned to "*Eodevonaria*" according to recent recommendations (Racheboeuf, 1986).

The coarse radial ornamentation of this species is very similar to that of several taxa described from Central and South America. *Eodevonaria imperialis* (Caster), *E. subhemispherica* (Weisbord), and *E. inca* Isaacson show very close morphologies and similar ornamentation but more detailed information is needed for better comparisons. However, they would probably represent a group of globose, coarsely costate Eodevonariids distinct from *Chonetes arcuatua* Hall, 1857, type species of the genus *Eodevonaria* Breger.

Specimens from the "Pink *Chonetes*" Zone are globose, coarsely costate eodevonariids which sporadically occur within this biostratigraphic zone. They are here assigned to the species "*Eodevonaria*" *hemispherica*. While mostly represented by fragmentary, isolated valves, this material has the characteristics of Hall's species. However, it differs from the type material in its smaller size; shell shape ornamentation and spines are similar. Specimens from the "Pink *Chonetes*" Zone are probably juveniles and the size difference does not preclude suggested specific assignment. The smaller size may also be due to environmental conditions.

STRATIGRAPHIC OCCURRENCE: According

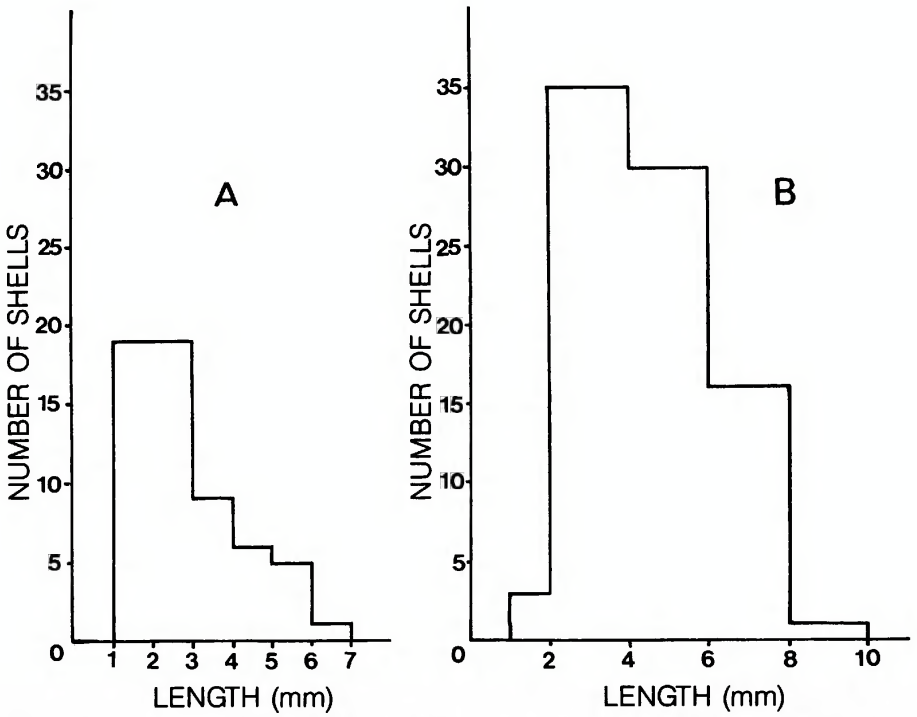

Fig. 12. Histograms for 55 pedicle valves of *Longispina mucronata* (**A**) and 85 pedicle valves of *Hallinetes lineatus* (**B**) from the *Hallinetes* Community within the dark mudstone matrix of the "Pink *Chonetes*" Zone.

to Oliver (1956: 1452, table 1) *Chonetes hemisphericus*? is very rare in normal facies of the Edgecliff fauna and rare in the central facies of the Lower to Middle Moorehouse fauna in the Richfield Springs area (1956: table 3, p. 1462).

MATERIAL: Two articulated shells; 17 broken, or crushed pedicle valves.

THE *HALLINETES* COMMUNITY OF THE "PINK *CHONETES*" ZONE

The "*Chonetes*" Community, which occurs in the mudstones of the Seneca Member, 10 ft above the Tioga Bentonite, was described by Feldman (1980), and was defined as a low-diversity assemblage in which "*Chonetes*" aff. *lineata* is highly dominant (>99%) with a high ratio of living shells (76%) according to the concave-up position of the specimens. While other faunal constituents are similar to those listed previously (Feldman, op. cit.: table 12, p. 40), the community needs redefinition since the chonetacean brachiopods belong to three different taxa. Among these, *Hallinetes lineatus* is by far the most abundant species (92%); *Longispina mucronata* may be listed as common (5.4%) while "*Eodevonaria*" *hemispherica* is rare (2%). After tabulating the above results, based on a count of 907 specimens, it became apparent that the relative abundance of the taxa on bedding planes (both top and bottom) on one hand, and within the dark mudstone matrix on the other hand reveals significant differences.

On the studied bedding planes only very few specimens of *Longispina mucronata* (7) and "*Eodevonaria*" *hemispherica* (8) were counted together with 630 isolated valves and articulated shells of *Hallinetes lineatus*. The specimens of *L. mucronata* occurring on the bedding planes are among the largest observed in the material studied.

Within the dark mudstone matrix, 41 small shells of *L. mucronata* and 11 of "*E.*" *hemispherica* have been counted together with 209 specimens of *Hallinetes lineatus*; most of the specimens are articulated shells and the shells of *L. mucronata* are very small to small juveniles.

TABLE 5
Counts of *Hallinetes lineatus* on Bedding Planes and Within the Matrix

Block no.	Specimens	Concave-up position	Convex-up position	% articulated shells	% concave-up articulated shells
1	b.v.	66	22		
Top b.p.	p.v.	89	42	8.3	7.0
	art.	17	3		
	Total	172	67		
3	b.v.	10	6		
Bottom b.p.	p.v.	29	7	11.0	10.0
	art.	6	1		
	Total	45	14		
4	b.v.	15	12		
Top b.p.	p.v.	45	27	9.1	2.7
	art.	3	7		
	Total	63	46		
6	b.v.	6	15		
Top b.p.	p.v.	25	32	8.2	2.3
	art.	5	2		
	Total	36	49		
14	b.v.	9	11		
Top b.p.	p.v.	30	20	6.6	6.6
	art.	5	—		
	Total	44	31		
14	b.v.	15	6		
Bottom b.p.	p.v.	25	14	6.7	3.1
	art.	2	1		
	Total	42	21		
1	b.v.	8	14		
Middle bed	p.v.	44	26	2.1	2.1
	art.	2	—		
	Total	54	40		
4	b.v.	11	6		
Middle bed	p.v.	21	26	9.8	5.6
	art.	4	3		
	Total	36	35		

Counting shows that the same chonetacean taxa occur on the bedding planes and within the mudstone matrix, but their relative abundance is different. Relative frequencies are, respectively, as follows: *Longispina mucronata* 1 and 15%; "*Eodevonaria*" *hemispherica* 1.2 and 4.2%; *Hallinetes lineatus* 97 and 80%. The fact that only large shells lie on the bedding planes probably indicates that the tiny juvenile shells of *L. mucronata* have been winnowed away. This conforms with the isolated valves of *H. lineatus* found on the bedding surfaces, even if shells in a concave-up position are common (see table 5). It is probable that the number of articulated shells in the concave-up position has been underestimated; in some cases the brachial valve of such oriented specimens appears to have been weathered off. In any case, the relative frequency of articulated shells in a concave-up position would not exceed twice the total number of specimens found.

Most of the shells lying on the bedding planes have broken spines while spines are nicely preserved, and always found, on shells encased within the matrix. This fact is further support for the interpretation that bedding plane assemblages are post mortem accumulations.

In conclusion, from the new observations of the chonetaceans from the "Pink *Chonetes*" Zone, the true *Hallinetes* Community corresponds to the assemblage within the dark mudstone matrix rather than to the shells distributed on the bedding plane surfaces. The *Hallinetes* Community of the Seneca Member is a low-diversity, "highly dominated" (although not monospecific) community within a quiet water environment. This interpretation is supported by the coexistence of long-spined chonetaceans as well as by the reduced number of spines on the shells (Racheboeuf, in prep.).

The Benthic Assemblage position (cf. Boucot, 1975) is more difficult to pinpoint but in this case, a Benthic Assemblage 4 position is most probable since it is below the lower limit for active photosynthesis and reef building activity (Yu et al., 1987: 6) as evidenced by a lack of reef building corals and scarcity of solitary corals (Feldman, 1980: 40). A normal marine environment is indicated by the presence of some bioturbation, which increases dramatically at the top of the formation. The fine-grained limestone matrix and dominance of *Hallinetes* are consistent with low (to intermittent) current activity and lower than normal oxygen, but not quite dysaerobic conditions since trilobites, gastropods, and crinoids are present, although rare. The cause of relatively low diversity here is uncertain.

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