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by

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BRACHIOPODS OF THE ONONDAGA FORMATION, MOOREHOUSE MEMBER (DEVONIAN, EIFELIAN), IN THE GENESEE VALLEY, WESTERN NEW YORK

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ABSTRACT

In the Genesee Valley of western New York, the Moorehouse Member of the Onondaga Limestone contains 46 species of brachiopods, described herein. Of the 26 species of brachiopods in the underlying Bois Blanc Formation in western New York, 11 also occur in the Onondaga and show no evolutionary change between it and the Onondaga Formation; that is, taxa found in the Bois Blanc–Onondaga interval indicate a high degree of stasis. During Onondaga time there was a progressive increase in relative water depth throughout the basin as indicated by a gradual northward shift of the carbonate facies as well as a northward migration of the overlying Hamilton Group. The Nedrow Member represents a minor transgressive cycle due to an influx of mud from the east, and the Moorehouse Member to Seneca Member interval represents a major transgression. Brachiopods in the Moorehouse Member include *Charionoides* and *Pentagonia*, genera endemic to the Appohimchi Subprovince. *Atribonium halli* and *Discomyorthis*? sp. are the only species herein not previously reported from Onondaga strata in western New York. Two new species are erected, *Athyris boucoti* and *A. leoni*. The most significant change in brachiopod faunas across the state during Moorehouse time is the increasing abundance of strophеodontids towards the west.

INTRODUCTION

As a continuation of my previous studies of Onondaga brachiopod taxonomy and paleoecology (Feldman, 1980, 1985; Feldman and Lindemann, 1986; Lindemann and Feldman, 1981, 1987; Racheboeuf and Feldman, 1990) I have sampled and described the brachiopod fauna in the Genesee Valley of western New York (Text-figure 1). The outcrop belt of the Onondaga Limestone in New York extends from Port Jervis (Tristate area) in the southeastern part of the state, northeastward to Kingston and the Helderbergs, and then westward towards Syracuse, Rochester and Buffalo. All of the brachiopods studied were recovered from the Moorehouse Member (see section on stratigraphic setting), a hard, dense limestone with little shale.

Two methods of collecting were employed: Firstly, weathered fossils were collected from extensive, but rather rare, bedding surfaces in abandoned quarries and, secondly, blocks of limestone with silicified specimens were recovered, processed, and etched in an acid bath. Approximately 180 kg of limestone yielded 190 silicified shells. The brachiopod fauna of the Onondaga Limestone is particularly challenging to study because collecting is almost impossible unless bedding planes are accessible. Vertical roadcut faces are often not useful as faunal identification is difficult, and outcrops with well-silicified shells are not always exposed. As in the mid-Hudson Valley, silicification is sporadic and the degree of silicification ranges from poor to very good.

This study improves our understanding of brachiopod abundance and evolution in the Lower Middle Devonian, provides data for ecological and biogeographical studies, and improves correlations with more westerly limestone suites such as the Detroit River Group (Anderdon Limestone, Lucas Dolomite, Amherstburg Dolomite, Sylvania Sandstone) of the Michigan Basin, southwestern Ontario and north–central Ohio. Previous paleocommunity and stratigraphic studies of the non-reefal aspects of the Onondaga Limestone (Oliver, 1954, 1956) have resulted in a fairly good understanding of the formation in southeastern New York (except for the area between Ellenville and Port Jervis where outcrops and complete sections are sparse) and central New York (Syracuse). The area around Rochester (i.e. Genesee Valley), however, has not been studied in detail until now.

ACKNOWLEDGEMENTS

I thank Arthur J. Boucot (Oregon State University, Corvallis, Oregon) for his continued assistance, encouragement, and support over the past decade, as my studies of the Onondaga Limestone have progressed from the mid-Hudson Valley, westward across New York State. He reviewed the manuscript and made numerous valuable suggestions for improvement. Touro College contributed $500.00 toward publication of this paper.

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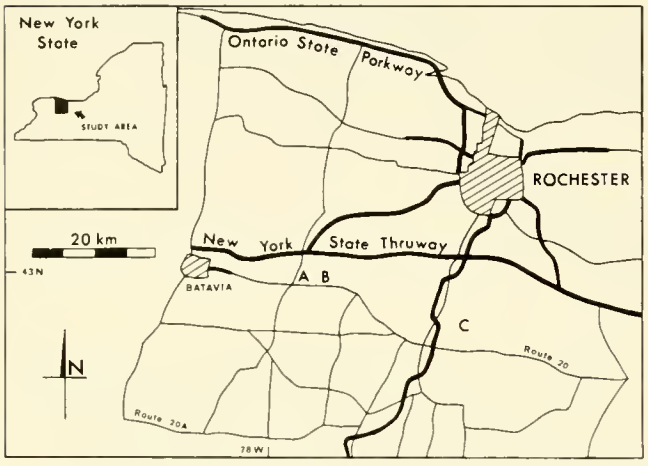


Text-figure 1.— Index map of collecting localities in the Onondaga Limestone [Moorehouse Member] Genesee Valley, western New York. A, AMNH Loc. 3152; A large exposure on the floor of eastern part of an abandoned quarry, Lower Moorehouse Member; B, AMNH Loc. 3154; Numerous exposures at the southwest corner of an active quarry operated by the Penfield Dolomite Company, Lower Moorehouse Member; C, AMNH Loc. 3153; Small exposures along the southeast part of an active quarry operated by the General Crushed Stone Company; Upper Moorehouse Member (for exact locations see Appendix).

Carlton E. Brett, The University of Rochester (Rochester, New York), Gordon C. Baird, State University College at Fredonia (New York) and George C. McIntosh, Rochester Museum and Science Center (Rochester, New York) spent valuable time with me in the field, and helped immensely in interpreting Onondaga stratigraphy in western New York State.

Paul Copper, Laurentian University and J. Thomas Dutro, Jr., U.S. Geological Survey (Washington, D.C.), deserve thanks for critical comments on the manuscript. Ed Landing, New York State Museum and Science Service (Albany, New York), made the brachiopod collections in Albany available for study; I thank him for his hospitality. Fred Collier, (U.S. National Museum of Natural History, Washington, D.C.) enabled me to examine the collections under his care and kindly loaned me specimens from the National collection in Washington.

Andrew Modell and Susan Klofak (both of the American Museum of Natural History, New York), deserve thanks for photographic work and specimen preparation, respectively. Laura Lynne Gallo, Sarah Lawrence College (Bronxville, New York) graciously assisted me in the field and during my examination of the collection in Albany, New York.

STRATIGRAPHIC SETTING

Five members of the Onondaga Limestone occur in the study area (Text-figure 2), the Edgecliff, Clarence, Nedrow, Moorehouse and Seneca. A brief description of the lithologies of these members is provided here, but detailed stratigraphic descriptions may be found in Oliver (1954).

Edgecliff Member.—In western New York the Edgecliff is a massive, light-gray, coarse, crystalline limestone about 5 m thick, packed with solitary rugose and tabulate corals which form biostromes in many places. Typical of the Edgecliff are large crinoid columnals and stems up to about 2.5 cm in diameter. Near Buffalo the Edgecliff undergoes a facies change with at least one large, lens-shaped, biohermal ("reef") structure, which contains extremely irregular bedding (Oliver, 1954, p. 635). Oliver (1954, p. 636) also reports the occurrence of small "micro-reefs" exposed in the biostrome at Clarence, 20 km east of Williamsville. In both western and eastern New York, bioherms occur in the Onondaga, representing favorable conditions for the growth of corals and crinoids. The Edgecliff is thought to be a moderately high energy, shallow-water, shelf carbonate which, in the western part of the state, becomes a crinoidal grainstone (Woodrow *et al.*, 1989).

Clarence Member.—The Clarence, 11.5 m thick, interfingers with the Edgecliff in places and essentially underlies the Nedrow Member in western New York. Some workers believe that the Clarence replaces the Nedrow in the western part of the state (Ozol, 1963). The extremely cherty Clarence (up to 75% by volume; April *et al.*, 1984) consists of both vertically and horizontally coalescing chert nodules enclosing fine-grained lime mudstones (Selleck, 1985) and is easily recognized in outcrop. The rate of clastic deposition in the Clarence exceeded that of the Edgecliff, as indicated by the greater volume of clays. The Clarence Member represents slightly deeper water deposition than the Edgecliff; most of the silica was derived biogenically from dissolution and reprecipitation of sponge spicules and, possibly radiolaria (Selleck, 1985). Accoring to Woodrow *et al.* (1989) the Clarence may represent a facies belt enriched in siliceous organisms.

Nedrow Member.—The Nedrow, 13 m thick, is a light- to dark-gray highly argillaceous limestone which forms recessed ledges when extensively weathered. Fresh cuts, as at Jamesville, New York (AMNH Loc. 3128) do not have the typical appearance of the Nedrow. In eastern New York, the Nedrow becomes less argillaceous and is more difficult to recognize in outcrop, even when extensively weathered. The Nedrow is thought to represent deeper and muddier water deposition than the rest of the lower part of the formation and probably represents a minor transgressive cycle associated with an influx of clastics from the east (Woodrow *et al.*, 1989).

Moorehouse Member.—Typically uniformly bed-

ded, the Moorehouse, 11 m thick, is a medium-gray, fine-grained micritic limestone with abundant dark-weathering chert. During Moorehouse time, there apparently were shallowing conditions similar to those that prevailed during Edgecliff–Clarence time (Kissling and Moshier, 1981). The top of the Moorehouse is marked by the occurrence of the Onondaga Indian Nation metabentonite (= Tioga B metabentonite) which is not always present in the various quarries visited. Most of the brachiopods studied in the Onondaga in the last decade were recovered from the Moorehouse Member due, in part, to accessibility of the fossils.

Seneca Member.—The base of the Seneca Member (4 m thick in western New York) is marked by the "Tioga B" ash layer (about 15 cm thick). The Seneca is a medium- to dark-gray, light-weathering wackestone, sparsely fossiliferous, with occasional chert nodules throughout. The "Pink *Hallinetes* Zone" (= Zone J of Oliver, 1954), 3 m above the ash layer and 1.8 m thick, is a thinly bedded limestone packed with chonetid brachiopods many of which are stained pink. At most localities in western New York, a bed of chert can be found about 15 cm below the top of Zone J. The upper part of the Seneca is more argillaceous and distinctly darker in appearance and is capped by a bone bed making the contact with the overlying basal Hamilton Group (Oatka Creek Shale) sharply defined in most places.

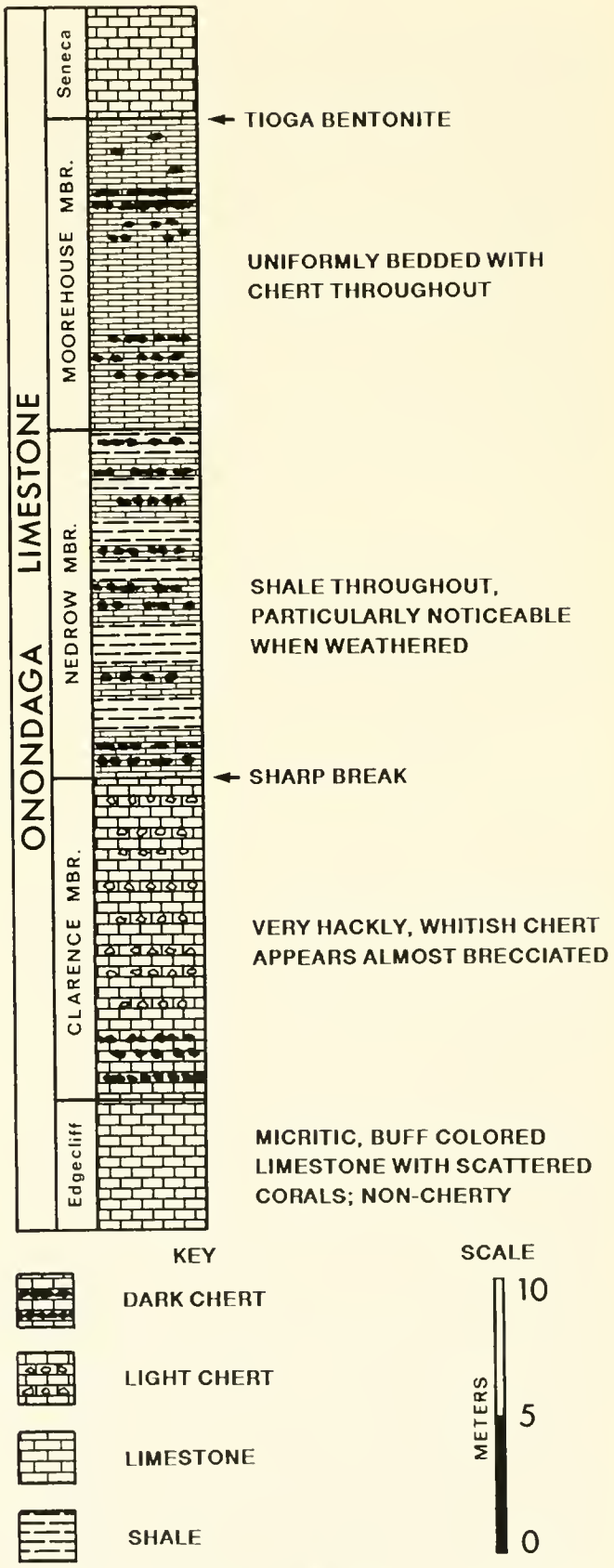
During Onondaga time there was a general increase in water depth throughout the basin as indicated by a gradual northward shift of all carbonate facies comprising the successive members and by northward migration with time of the Marcellus Shale (Kissling and Moshier, 1981). According to Woodrow *et al.* (1989), the Moorehouse-to-Seneca stratigraphic succession represents a major transgression, with the upper Moorehouse and lowermost Seneca aerobic facies passing upwards into a dysaerobic, deeper water upper Seneca facies which is finally succeeded by the minimally dysaerobic to anaerobic Union Springs environment.

SYSTEMATIC PALEONTOLOGY

INTRODUCTION

Philosophical Considerations

One of the goals of this project is to help refine our understanding of the "invasion" of European taxa into eastern North America by providing data for a biogeographic study of the Early Middle Devonian faunas in New York. Species recognition is an integral part of this work. A biological definition of a species is: a group of populations which replace each other geographically or ecologically and of which the neighboring ones in-



Text-figure 2.—Generalized stratigraphic column for the Onondaga Limestone in the Genesee Valley.

tergrade or hybridize wherever they are in contact or which are potentially capable of doing so (with one or more of the populations) in those cases where contact is prevented by geographical or ecological barriers (Mayr, 1976). In other words, the modern biological concept of a species is based on an organism's having the potential to interbreed and produce fertile offspring in natural conditions (Guensburg, 1984). The biological definition is untestable using fossils and, species have therefore been reported in this study based on morphology (i.e. morphospecies) in the sense of Hoover (1981). Although the concept of a species may and sometimes does differ among paleontologists depending on the group studied and the preservation of the particular collections on hand (Sohn, 1983), I consider, as do Cooper and Dutro (1982), species names merely conveniences for discussing clusters of morphologic variability within what are, for the most part, well-established generic concepts. Taxonomic names are, as Hoover (1981) has noted, "handles" for discussion of a definite group of specimens, and their correspondence to genetic groups becomes increasingly vague as the temporal distance from the Recent increases. I consider myself neither a "lumper" nor a "splitter." Of the two new species erected herein, one is based on 45 specimens while the other is based on four specimens. As Raup and Stanley (1978) have so aptly stated, the fact that species discrimination depends largely on the experience of the person making the discrimination has led to an informal definition of the species that is invoked with surprising frequency: "A species is a species if a competent specialist says it is." After studying the morphology of the new taxa I have decided that they do indeed represent new forms and do not belong to any previously named species.

A Note on the Use of Open Nomenclature

The intent of the International Code of Zoological Nomenclature (Stoll *et al.*, 1961) is to promote stability and universality in the scientific names of animals, and to insure that each name is unique and distinct. According to the Code, all its provisions are subservient to these ends, and none restricts the freedom of taxonomic thought or action. Matthews (1973) noted that although the Code sets a limit on its provisions, it does not in any way intend to impinge on the individual taxonomist's exercise of his or her judgement. Since the Code provides no explicit guidelines for the use of "open nomenclature," I make the following brief comments regarding my use of it in this monograph. Additional insight into the question of open nomenclature may be found in Bengston (1988), Kornicker (1979), Matthews (1973), and Richter (1943, 1948).

Open nomenclature is a device whereby an author expresses his or her judgement of his or her own material (Matthews, 1973). It is the procedure by which a taxonomist comments upon the identity of a specimen that cannot be readily or securely determined (Bengston, 1988). The use of "cf." before a species-group name indicates a provisional determination for the species. Here, "cf." stands for *confer*, not *conformis*, and means "compare to" and not "compare with" (*sensu* Bengston, 1988). I follow Bengston's (1988) concept that the wording "compare to" expresses a possible identity, which is what most taxonomists have in mind when they use "cf.", whereas "compare with" rather implies a distinction. Further, "cf." is inserted between the genus and species name as in *Levenea* cf. *subcarinata*, and not *Levenea* cf. *L. subcarinata* as advocated by Lucas (1986). As noted by Bengston (1988), the former expression conveys in an unambiguous way the message that the author considers the specimen in question to be "probably or possibly the species *subcarinata*, although there is not enough material to be sure, but if it is *subcarinata* it should be referred to the genus *Levenea*."

The use of "aff." indicates a new, undescribed taxon and relates it to a named taxon (*sensu* Bengston, 1988). The use of "? sp." indicates an uncertain identification and, that specific identification is not possible with the specimens at hand because of poorly preserved present or original material.

Terminology

The morphologic terms used herein follow the glossary in the brachiopod volume of the Treatise on Invertebrate Paleontology (Williams *et al.*, 1965, pp. H139–H155).

Abbreviations of Repository Institutions and Localities

Repository of all [unnumbered] specimens unless otherwise indicated:

AMNH: American Museum of Natural History, New York, New York.

AMNH Loc.: American Museum of Natural History locality number.

MCZ: Museum of Comparative Zoology, Harvard University, Cambridge Massachusetts.

NYSM: New York State Museum and Science Service, Albany, New York.

UMMP: University of Michigan Museum of Paleontology, Ann Arbor, Michigan.

USNM: United States National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Measurement Abbreviations and Subscripts

In the tables of measurements: a.v. = articulated valves; p.v. = pedicle valve; b.v. = brachial valve; m = meters; cm = centimeters; mm = millimeters; kg = kilograms; L = maximum length; W = maximum width; T = maximum thickness. Several subscripts are used to qualify measurements. The subscript d indicates damage in that orientation and that the measurement was estimated to the nearest tenth of a millimeter. The subscript c indicates compression of the shell due to compaction, and the subscript e indicates exfoliation of the shell exterior. Measurement across a structure with bilateral symmetry, such as the hinge width, may be estimated, in cases of incompleteness, by doubling the half-measure [distance from symmetry plane to distal extremity]. The subscript h indicates use of this procedure. The subscript t indicates that the measurement was estimated [e.g. number of plications on a flank].

SYSTEMATICS

Phylum **BRACHIOPODA** Duméril, 1806

Order **ORTHIDA** Schuchert and Cooper, 1932

Suborder **DALMANELLOIDEA** Moore, 1952

Superfamily **DALMANELLACEA** Schuchert, 1913

Family **DALMANELLIDAE** Schuchert, 1913

Subfamily **ISORTHINAE** Schuchert and Cooper, 1931

Genus **LEVENEA** Schuchert and Cooper, 1931

Type species.—*Orthis subcarinata* Hall, 1857, p. 43.

Levenea cf. **subcarinata** (Hall, 1857)
Plate 1, figures 1–4

Orthis subcarinata Hall, 1857, p. 43; 1859, p. 169, pl. 12, figs. 7–21.
Levenea subcarinata Schuchert and Cooper, 1932, p. 123, pl. 18, figs. 19–23, 25–32; Cooper, 1944, p. 353, pl. 138, figs. 21–23.
Levenea aff. *subcarinata* Feldman, 1985, p. 304, fig. 3.

Description.

Exterior.—Shell medium-sized (L = 17.0 mm, est.; W = 17.7 mm, est.), transversely suboval in outline, subcarinate; ventral interarea short, incurved and apsacline with triangular delthyrium which encloses angle of 60 degrees; rounded, radial costellae which increase anteriorly by bifurcation; 25 costellae per 5 mm at midlength.

Pedicle valve interior.—Hinge teeth strong, short, triangular in horizontal section, supported by very short dental lamellae; muscle field subpentagonal, about 25 percent of valve length; diductor tracks impressed longitudinally on valve floor.

Discussion.—*Levenea* cf. *subcarinata* is identical to *L.* aff. *subcarinata* from the mid-Hudson Valley (Feldman, 1985, p. 304, fig. 3D). Apparently the species becomes rare toward the western part of the state; only one specimen was recovered in the Genesee Valley.

The general outline of the ventral muscle field of *Levenea* cf. *subcarinata* (Boucot *et al.*, 1970, p. 8, pl. 2, figs. 3–5) is similar to the Genesee Valley shell.

The pedicle valves in Johnson's *Levenea fagerholmi* (1970, p. 77, pl. 2, figs. 8–18) are flatter and larger than in the Onondaga shell, while his *L. navicula* (p. 75, pl. 2, figs. 19–22; pl. 3, figs. 1–19) shows greater biconvexity. Johnson's (1970, p. 74, pl. 2, figs. 1–7) *Levenea* sp. A may be differentiated from *L.* cf. *subcarinata* by its more prominent strong, rounded radial costellae.

Material.—One pedicle valve.

Occurrence.—AMNH Loc. 3152.

Family **RHIPIDOMELLIDAE** Schuchert, 1913

Subfamily **RHIPIDOMELLINAE** Schuchert, 1913

Genus **DALEJINA** Havlicek, 1953

Type species.—*Dalejina hanusi* Havlicek, 1953, p. 5.

Dalejina cf. **alsa** (Hall, 1863)
Plate 1, figures 5–12

Orthis alsus Hall, 1863, p. 33.
Rhipidomella alsa Hall, 1867, p. 36, pl. 4, figs. 2–7; Grabau, 1906, p. 181, fig. 95.
Dalejina aff. *alsa* Feldman, 1985, p. 307, figs. 5, 6, 7, 8A–D.
Dalejina alsa Boucot and Johnson, 1968, p. B7, p. 1, figs. 11–27; Fagerstrom, 1971, pl. 1, figs. 1, 2.

Description.

Exterior.—Shells range in size from small to medium-sized (Table 1), are dorsibiconvex with pedicle valve more arched posteriorly, and transversely suboval in outline; hingeline short and straight in apical area but becomes rounded as lateral margins approached; maximum width attained at or just anterior to midlength; in some adult shells pedicle valve bears slight median depression while brachial valve bears corresponding ridge (these features too indistinct to be called sulcus and fold); anterior commissure rectimarginate to very slightly sulcate; ventral interarea apsacline, narrow, short; dorsal interarea anacline; radial costellae increase by both intercalation and bifurcation; 12 to 15 costellae per 5 mm; costellae crossed by concentric growth lines near anterior margins.

Pedicle valve interior.—Pointed hinge teeth expand anteriorly, widely divergent and supported by short dental lamellae; shallow crural fossettes present; umbonal cavity shallow, poorly defined, bounded laterally by dental lamellae; muscle scars not clearly impressed;

Table 1.—Measurements (in mm) of *Dalejina* cf. *alsa* (Hall, 1863). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	5.9	6.7	2.7	a.v.
3152	10.7	12.9	2.9	a.v.
3152	19.1	21.7	4.4	a.v.
3152	11.7	14.2	2.9	a.v.
3152	4.2	17.9	5.3	a.v.
3152	16.6	20.0	6.6	a.v.
3152	6.7	8.8	2.7	a.v.
3152	9.1	16.4	3.2	a.v.
3152	16.9	20.3	4.2	a.v.
3152	5.2	5.9	2.0	a.v.
3152	16.1	20.0	3.4	a.v.
3152	15.7	20.9	5.2	a.v.
3152	3.8	16.4	4.8	a.v.
3152	17.0	21.5	4.6	a.v.
3152	13.1	16.3	4.0	a.v.
3152	16.1	19.1	4.0	a.v.
3152	14.0	18.2	—	a.v.
3152	10.8	12.8	2.1	a.v.
3152	4.0	4.6	1.0	a.v.
3152	5.9	6.7	2.0	a.v.
3152	7.1	8.9	2.7	a.v.
3152	6.7	7.2	2.5	a.v.
3152	9.8	6.5	1.8	a.v.
3152	6.8	7.8	1.8	a.v.
3152	5.0	5.9	1.4	a.v.
3152	3.6	4.2	1.1	a.v.
3152	5.0	5.9	2.0	a.v.

small, low myophragm visible on silicified specimen; valve floor crenulated at periphery by impress of costellae.

Brachial valve interior.—Sockets deep, broaden anteriorly; brachiophores worn and diverge at angle of ninety degrees; cardinal process single lobe resting on deposit of secondary shell material in notothyrial cavity; neither myophragm nor muscle impressions preserved; internal periphery crenulated by impress of costellae.

Discussion.—*Dalejina* is distinguished from *Rhipidomella* by the medially grooved, flat crenulations found on the lateral and anterior margins of the shell. As most of the specimens in the collection are articulated it is difficult to distinguish these shells from *Rhipidomella*. They are, however, assigned to *Dalejina* for two reasons: [1] there are vague indications of flat, medially grooved internal crenulations on several shells that were ground and polished at the anterior commissures and, [2] the Genesee Valley shells are identical to *Dalejina* from the mid-Hudson Valley (Feldman, 1985, p. 306, figs. 5–8A–D); no specimens of *Rhipidomella* were found there.

Based largely on external morphology *Dalejina* cf. *alsa* from the Genesee Valley is identical to the mid-Hudson Valley shells as noted above. *Dalejina alsa* from the underlying Bois Blanc Formation (Boucot and Johnson, 1968, p. B7, pl. 1, figs. 11–27) differs in that the brachiophores are more widely divergent in Boucot and Johnson (see pl. 1, fig. 23). Both, however, have similar cardinal processes extending from secondary shell material in the notothyrial cavity. Externally they are also very similar, although the Genesee Valley shells are more commonly transversely suboval rather than transversely subcircular in outline.

Material.—95 articulated, six pedicle, three brachial valves.

Occurrence.—AMNH Loc. 3152.

Genus **DISCOMYORTHIS** Johnson, 1970

Type species.—*Orthis musculosa* Hall, 1857, p. 46.

Discomyorthis? sp.
Plate 1, figures 13–15

Discussion.—These two shells are assigned to the genus *Discomyorthis* based on their larger size and large, flabellate (?) muscle field in one exfoliated shell. *Discomyorthis* from the Great Basin (Johnson, 1970, p. 84) is differentiated from *Dalejina* by its nearly planar pedicle valve and its unusually large ventral diductor scars. The only distinction between *Discomyorthis* and *Dalejina* is that the former is simply a large example of the latter. According to A.J. Boucot (oral commun., 1991) *Discomyorthis* is a large Eastern Americas Realm *Dalejina*, as contrasted with the much smaller *Dalejina* known from coeval beds elsewhere. Although the pedicle valves in the Genesee Valley shells are not planar they are provisionally assigned to *Discomyorthis*.

Material.—Two articulated valves.

Occurrence.—AMNH Loc. 3152.

Superfamily **ENTELETACEA** Waagen, 1884

Family **SCHIZOPHORIIDAE**
Schuchert and LeVene, 1929

Subfamily **SCHIZOPHORIINAE**
Schuchert and LeVene, 1929

Genus **SCHIZOPHORIA** King, 1850

Type species.—*Conchyolithus anomites resupinatus* Martin, 1809, pl. 49, figs. 13, 14.

Schizophoria cf. **multistriata**
Hall (1859–1861)
Plate 1, figures 16–25

Conchyolithus anomites resupinatus Martin, 1809, pl. 49, figs. 13, 14.

Schizophoria multistriata Grabau, 1906, p. 156, fig. 69; Goldring,

1935, p. 119, figs. 41J, K; 1943, p. 183, figs. 33n, o; Cooper, 1944, p. 357, pl. 140, figs. 10, 11.
Schizophoria cf. *multistriata* Feldman, 1985, p. 309, figs. 9, 10.

Description.

Exterior.—Shells range from small to medium (Table 2), more subquadrate than suboval in outline and unequally biconvex; in most shells brachial valve deeper and more uniformly convex; broad, shallow sulcus developed on pedicle valve in ephebic specimens, although occasionally present on neanic shells; not all shells have developed sulcus; slight fold may or may not oppose sulcus; hingeline short, varies from straight to slightly rounded; maximum width attained just past midlength; ventral interarea apsacline, triangular while dorsal interarea narrower and may be apsacline or orthocline; rounded, radial costellae with interspaces that range from broad and flat to rounded and narrow; costellae inrease anteriorly by intercalation; about 17–19 costellae in a 5 mm space; older specimens have about 10 costellae in same interval.

Pedicle valve interior.—Hinge teeth poorly preserved in most specimens and variable in shape; in neanic forms they tend to be subpyriform in cross section while in ephebic shells they are more ovate; teeth supported by thin, anterolaterally diverging dental lemallae which join valve floor at about one-fifth length; diductor scars bisected by median, raised adductor platform which gives muscle field bilobed appearance; in one nonsilicified shell this platform carries five striae for its entire length; striae not preserved in silicified specimens; lateral margins of diductor field either subparallel to adductor platform or diverge laterally; in either case muscle field has distinct bilobed appearance; delthyrial angle ranges from 40–50 degrees and delthyrium opens into small foramen apically; costellae not impressed on internal periphery due to poor preservation.

Brachial valve interior.—Neanic shell has small, knoblike cardinal process deep in notothyrial cavity; sockets deep, curved, bounded anterolaterally by poorly preserved fulcral plates; concave brachiophore bases, attached to posterior ends of fulcral plates, directed ventrally end in concave apophyses; muscle field somewhat ovate and easily distinguished from pedicle valve muscle field; low myophragm divides adductor scars in ephebic shell but absent in neanic specimen; in larger shell anterior rim of muscle field raised above valve floor but, in smaller shell muscle field merges with valve floor anteriorly and no rim present; anterior internal periphery crenulated due to impress of costellae, but not well preserved due to etching.

Discussion.—The Genesee Valley shells differ from *Schizophoria* cf. *multistriata* collected in southeastern New York (Feldman, 1985, p. 309, figs. 9, 10) in that some specimens are quite globose, are more subquadrate in outline and have more numerous costellae. As will be seen from the discussion below, variability in the ventral muscle field is such that this character cannot be used to define species.

Table 2.—Measurements (in mm) of *Schizophoria* cf. *multistriata* Hall (1859–1861). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	11.3	16.3	7.9	a.v.
3152	14.0	20.3	9.6	a.v.
3152	6.5	9.3	3.9	a.v.
3152	18.3	21.9	11.7	a.v.
3152	20.4	24.4	13.2	a.v.
3152	19.9	—	13.8	a.v.
3152	15.0	16.4	7.3	a.v.
3152	4.9	5.6	2.4	a.v.
3152	7.0	8.7	3.2	a.v.
3152	10.2	—	5.1	a.v.
3152	12.3	14.0	5.4	a.v.
3152	—	20.3	7.6	a.v.
3152	16.4	19.7	7.9	a.v.
3152	8.0	19.0	9.4	a.v.
3152	23.6	29.1	9.6	a.v.
3152	25.6 dh	32.4	14.7	a.v.
3152	19.8	24.4	11.8	a.v.
3152	16.1	23.0	12.2	a.v.
3152	18.4	23.4	9.4	a.v.
3152	16.2	19.0	7.0	a.v.
3153	15.8	—	10.7	a.v.
3153	16.9	—	8.0	a.v.
3153	17.6	—	9.6	a.v.
3153	21.6	—	11.4	a.v.
3153	19.7	—	8.1	a.v.

Schizophoria parafragilis (Johnson, 1970, p. 91, pl. 8, figs. 1–12) from the McMonnigal Limestone of the Great Basin differs from the Onondaga forms in that its ventral muscle field is more elongate and more evenly bilobate. The same kind of elongate muscle field is found in *Schizophoria*? from the Coeymans Limestone, Green Pond Outlier, New York (Boucot *et al.*, 1970, p. 91, pl. 2, figs. 2a, b).

Lenz (1977, p. 62, pl. 4, figs. 11, 12, 15–37, 40, 42–44) described *Schizophoria* cf. *paraprima* and *Schizophoria* sp. from Lower Lochkovian and Pragian strata of Royal Creek, Yukon, which are more ovate in outline than the Genesee Valley shells. The ventral muscle fields of both species from the Yukon are quite variable (note figs. 11, 21, 38 for elongate scars and figs. 20, 24, 26, and 43 for more diverging, almost pyriform scars) as are the Onondaga specimens. Similar variability is noted in Johnson's *S. nevadaensis*

Table 3.—Measurements (in mm) of *Pentameralla arata* (Conrad, 1841). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	15.0	16.2	9.2	a.v.
3152	15.1	15.8	9.9	a.v.
3152	—	14.9	8.3	a.v.
3152	12.2	—	8.8	a.v.
3152	11.3	15.0	—	p.v.
3152	15.5	17.6	—	p.v.
3152	19.4	20.1	—	p.v.
3152	23.7	24.9	—	p.v.
3152	18.2	17.7	—	p.v.
3152	12.9	14.8	—	p.v.
3152	18.3	23.5	—	p.v.
3152	17.7	19.1	—	p.v.
3153	19.6	25.0	—	p.v.
3153	13.6	13.3 dh	—	p.v.

(1970, pl. 9, fig. 12) which also has a pyriform muscle field.

Schizophoria traversensis from the Genshaw Formation, Traverse Group, Michigan (Imbrie, 1959, p. 364, pl. 48, figs. 8–14) has a similar ventral muscle field to those forms described above from Nevada and the Yukon in that it is also pyriform. It is also similar in its ornamentation, with 20 costellae per 5 mm at a distance of 15 mm from the pedicle beak. It differs, however, in its subelliptical outline. *S. ferronensis* from the Ferron Point Formation, Michigan (Imbrie, 1959, p. 364, pl. 48, figs. 1–7) is smaller and has a shorter and more lobate ventral muscle field than does *S.* cf. *multistriata*.

Material.—50 articulated shells, 38 pedicle valves, four brachial valves.

Occurrence.—AMNH Locs. 3152, 3153.

Order **PENTAMERIDA** Schuchert and Cooper, 1931

Suborder **PENTAMEROIDEA**
Schuchert and Cooper, 1931

Superfamily **PENTAMERACEA** M'Coy, 1844

Family **GYPIDULIDAE** Schuchert and LeVene, 1929

Subfamily **GYPIDULINAE**
Schuchert and LeVene, 1929

Genus **PENTAMERELLA** Hall, 1867

Type species.—*Atrypa arata* Conrad, 1841, p. 55.

Pentamerella arata (Conrad, 1841)
Plate 1, figures 26–29; Plate 2, figures 1–3

Atrypa arata Conrad, 1841, p. 55.

Pentamerella arata Hall, 1867, p. 375, pl. 58, figs. 1–12; Kindle, 1901, pl. 615; Grabau, 1906, p. 184, fig. 100; Amsden, 1964, p. 233, pl. 40, figs. 9–14, text-fig. 5; Boucot and Johnson, 1968, p. B8, pl. 1, figs. 28–36; Feldman, 1985, p. 312, figs. 11A, B, D, 12A–D, 13.

Description.

Exterior.—Shells small to medium-sized (Table 3), subglobose, pyriform in outline and ventribiconvex; pedicle valve bears shallow, but distinct sulcus while brachial valve bears corresponding fold; anterior commissure crenulate and sulcate; hingeline short, curved with narrow pedicle interarea which decreases in height laterally; no interarea on brachial valve; small delthyrium present which encloses angle of 40 degrees; in young shells delthyrium open, however probably no pedicle present since opening leads directly to spondylium which held diductor muscles (there would have been no room for pedicle); maximum width attained just past midlength; pedicle beak short, slightly incurved; brachial beak smaller, erect; rounded plications increase anteriorly by bifurcation; interspaces U-shaped and about same width as plications; four plications found in sulcus and five on fold; concentric growth lines, more numerous anteriorly.

Pedicle valve interior.—Hinge teeth small, triangular; short, deeply excavated spondylium supported by thin, bladelike median septum which is confined to posterior portion of valve; valve floor crenulated anteriorly due to impress of the plications.

Brachial valve interior.—Sockets shallow, well worn, poorly preserved; large, V-shaped (in cross section), deeply excavated, elongate cruralium extends anteriorly and unites with valve floor dorsally; adductor muscles attach directly to cruralium; notothyrial cavity small, shallow; valve floor crenulated due to impress of plications.

Discussion.—Boucot and Johnson (1968, p. B8, pl. 1, figs. 28–36) describe three pedicle valves of *Pentamerella* cf. *arata* from the Bois Blanc Formation in western New York that are identical to the specimens recovered from the overlying Onondaga Limestone in the Genesee Valley. The latter specimens represent a larger sample and consequently display greater variation. For example, the Onondaga shells are not all rectimarginate, as are the Bois Blanc specimens and, when well preserved, they have a distinct pedicle interarea.

Hall (1867, p. 375, pl. 58, figs. 1–21) illustrated *Pentamerella arata* from the Schoharie Grit and limestones of the Upper Helderberg Group in Albany and Schoharie counties. The Genesee Valley shells very closely resemble Hall's specimen illustrated in his figures 5–8, which differs only in that the lateral commissure of Hall's shell is ventrally arched. Internally, Hall's brachial valve interior (fig. 17) is identical and his pedicle valve interior (fig. 18) differs in the greater length of the spondylium, a very variable character in

Pentamerella (some of the Onondaga shells have an incomplete spondylium which suggests a greater length).

Imbric (1959, p. 370) described several new species of *Pentamerella* from the Traverse Group of Michigan but did not illustrate any interiors. All show affinities to *P. arata* from the Genesee Valley but some differences are noted: *P. pericosta* is more pyriform in outline, *P. lingua* is more coarsely costate, *P. aftonensis* has a more inflated pedicle valve while *P. tumida* is significantly larger.

Material.—Seven articulated shells, 57 pedicle valves, four brachial valves.

Occurrence.—AMNH Locs. 3152, 3154.

Order **STROPHOMENIDA** Öpik, 1934

Suborder **STROPHOMENOIDEA** Öpik, 1934

Superfamily **STROPHOMENACEA** King, 1846

Family **STROPHOMENIDAE** King, 1846

Subfamily **LEPTAENINAE** Dalman, 1828

Genus **LEPTAENA** Dalman, 1828

Type species.—*Leptaena rugosa* Dalman, 1828, pl. 1, fig. 1.

Leptaena sp.
Plate 2, figures 4–7

Leptaena rugosa Dalman, 1828, p. 93.
Laptaena aff. "*rhomboidalis*" Boucot, 1973, p. 20, pl. 6, figs. 12–16; Feldman, 1985, p. 315, figs. 14–16.

Description.

Exterior.—Shells typically thick (Table 4), transversely subrectangular to shield-shaped in outline, medium to large; maximum width in some shells at straight hingeline but in others almost at anterior commissure; ears short, pointed; shells concavoconvex with pedicle valve strongly geniculate at anterior and lateral commissure; brachial valve correspondingly geniculate; trail very variable in length, ranging from just under one-half length in one specimen to more commonly one-fourth to one-third length of shell; pedicle interarea linear, flat, apsacline; delthyrium wide, 90 degrees, partially preserved in only two shells; no pseudodeltidium evident; brachial interarea flat, anacline, narrower than pedicle interarea; notothyrium and chilidium not preserved; 12 to 15 radial costellae in a distance of 5 mm, posterior to point of geniculation, and extending onto trail; six to 10 low, rounded rugae cover disc but absent on trail.

Pedicle valve interior.—Delthyrial cavity broadly triangular, floored by lamellose layers of shell material near apex; one short, stubby, anterolaterally directed hinge tooth rests on low dental lamella fused to ridges bounding muscle field; muscle field circular and bounded by low, continuous ridge; suggestion of low myophragm at anterior one-half of muscle field; adductor and diductor differentiation not possible here, but it is likely that addcutors bisected by myophragm and diductors positioned lateral to them; pustules present on valve floor.

Table 4.—Measurements (in mm) of *Leptaena* sp. See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	16.3	17.6	3.3	a.v.
3152	17.6	19.5 dh	2.9	a.v.
3152	23.7	—	3.9	a.v.
3152	24.0	—	6.6	a.v.
3152	22.4	31.2	—	b.v.
3152	20.2	26.6	—	b.v.
3152	25.8	26.1	—	p.v.
3152	25.0	35.4	—	p.v.
3152	23.4	33.3	—	p.v.
3152	26.2	26.9	—	p.v.

Brachial valve interior.—Shallow sockets, bounded by small socket plates, diverge anterolaterally; large, rounded, bifid cardinal process covered at base by very fine radiating striae; coarsely pustulose disc bounded by apophragm which reaches maximum height anteriorly; apophragm separates disc from geniculate trail, which is also strongly pustulose; deeply impressed muscle field raised on platform above the valve floor; width one-third that of disc and slightly more than one-half its length; low myophragm bisects both posterior and anterior adductor scars; posterior scars subcircular while anterior scars uniform, narrow depressions anteriorly directed; anterior scars have no boundary ridges *sensu stricto*, rather are sunk into muscle platform; posterior scars, however, have strong boundary ridges, especially laterally and anterolaterally.

Discussion.—Assignment to *Leptaena* "*rhomboidalis*" cannot be made for the following reasons: [1] the species "*rhomboidalis*" as restricted by Kelly (1967, p. 591) is a Silurian species from northwestern Europe, i.e., Gotland and the United Kingdom (see also Bassett, 1974, p. 115–116) the youngest forms of which range up into the Leintwardinian, and [2] the morphology differs from *L. rhomboidalis* specifically, in the brachial muscle field and more transverse outline of the Gotland shells.

Leptaena depressa (Bassett, 1974, p. 111, pl. 29, figs. 1–9; pl. 30, figs. 1–8) has weaker and lower rugae and a weaker brachial muscle platform. *L. depressa* also has a more quadrate or rhomboid shape (Kelly, 1967, pl. 98, figs. 4–9). Bowen's (1967, p. 32, pl. 4, figs. 3–5) *Leptaena* sp. cf. *L.* "*rhomboidalis*" from the Keyser

Limestone of Pennsylvania and Maryland shows affinities to the Genesee Valley shells but differs in its brachial muscle field. Boucot and Johnson's (1968, p. B8, pl. 2, figs. 1–6) *Leptaena* sp. from the Bois Blanc Formation in western New York has a similar pedicle muscle field. Additional collecting should shed light on the relationship of the two forms.

Material.—Five articulated valves, six pedicle valves, four brachial valves.

Occurrence.—AMNH Loc. 3152.

Family **SCHUCHERTELLIDAE** Williams, 1953

Genus **SCHUCHERTELLA** Girty, 1904

Type species.—*Streptorhynchus lens* White, 1862, p. 28.

"Schuchertella" sp.
Plate 2, figure 8

Description.

Exterior.—Shells transversely subelliptical in outline with straight hinge line; pedicle valve planar with maximum width attained just past midlength; pedicle interarea flat, broadly triangular, apsacline, crossed by fine growth lines; delthyrium covered by convex pseudodeltidium; ornamentation consists of radial costellae with eight in a space of 5 mm measured along anterior commissure at midline; occasional weak, concentric growth lamellae cross costellae, which increase in number anteriorly by intercalation.

Pedicle valve interior.—Hinge teeth short, low, triangular in cross section, not supported by dental lamellae; low myophragm separates bilobed, faintly impressed muscle field; costellae impressed along entire internal periphery of shell.

Discussion.—"*Schuchertella*" sp. from the mid-Hudson Valley (Feldman, 1985, p. 316, fig. 17) is similar to the Genesee Valley shells, differing somewhat in musculature of the pedicle interior. This is most likely due to variation or poor preservation. In any case, more material is needed for further meaningful comparisons.

"*Schuchertella*" sp. A of Boucot and Johnson (1968, p. B9, pl. 2, figs. 17–30) from the Bois Blanc Formation of western New York closely resembles the Genesee Valley specimens, again differing significantly only in the pedicle valve muscle field. Their "*Schuchertella*" sp. B (pl. 2, figs. 31–36) is more coarsely costate.

Bowen's (1967, p. 28, pl. 3, figs. 1–7) *Schuchertella prolifica* from the Keyser Limestone differs from the Onondaga shells in its more semielliptical outline and weakly costate internal surface.

Johnson (1970, pp. 106–110, pls. 18, 19) illustrated four species of "*Schuchertella*" from the Great Basin of Nevada of which only "*S.*" sp. B (pl. 18, figs. 15–20) resembles "*S.*" sp. from the Onondaga Limestone of western New York.

Boucot *et al.*, (1970, p. 23, pl. 8, figs. 5a–c, 6–8) described *Schuchertella*? sp. A and sp. B from the Green Pond Outlier in southeastern New York. "*S.*" sp. B (USNM Loc. 11245) resembles the Genesee Valley shells in that it has similar, although smaller, hinge teeth and a relatively broad interarea. "*S.*" sp. A (USNM Loc. 11259) is more coarsely costate, having angular costae.

Boucot (1973, p. 24, pl. 9, figs. 1–11) illustrated "*S.*" *becraftensis* from the Moose River Synclinorium which resembles "*Schuchertella*" sp. from the Genesee Valley in its (narrower) bilobed pedicle muscle field.

Material.—One articulated shell, one pedicle valve.

Occurrence.—AMNH Loc. 3152.

Suborder **STROPHOMENIDINA** Öpik, 1934

Superfamily **STROPHEODONTACEA** Caster, 1939

Family **LEPTOSTROPHIIDAE** Caster, 1939

Subfamily **LEPTOSTROPHIINAE** Caster, 1939

Genus **PROTOLEPTOSTROPIA** Caster, 1939

Type species.—*Strophomena blainvillei* Billings, 1874, pp. 28–29, figs. 1, 1a–1b; pl. 3, fig. 1.

Protoleptostrophia? sp.
Plate 2, figures 9–11

Description.—Maximum width probably at straight hingeline but due to missing posterolateral margin this is not certain; shell wider than long (maximum width = 21.3 mm; maximum length = 18.4 mm), very gently convex and transversely subquadrate in outline; numerous costellae between which are interspaces of about same width; costellae increase anteriorly by intercalation and crossed by concentric rugae-like growth lines.

Discussion.—Differentiation between the genera *Protoleptostrophia* and *Leptostrophia* cannot be made on the basis of pedicle valve morphology alone because there are no reliable criteria known for discriminating between pedicle valves of the two genera (Boucot, 1973). In order to distinguish the two genera one must examine the brachial valve interior; *Protoleptostrophia* lacks socket plates and has a prominent chilidium. True *Leptostrophia* is unknown anywhere in beds of Schoharie and Onondaga age (Boucot, oral commun., 1991).

The shells are similar to those described by Boucot *et al.* (1970, p. 21, pl. 7, figs. 9–12) from the Green Pond Outlier in southeastern New York but adequate material from the Onondaga must be obtained.

Material.—Four pedicle valves.

Occurrence.—AMNH Loc. 3152.

Table 5.—Measurements (in mm) of "*Brachyprion*" cf. *mirabilis* (Johnson, 1970). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*specimen type*
3152	37.6	47.6 dh	p.v.
3152	33.0	48.0 dh	p.v.
3152	—	46.8 dh	p.v.

Family **STROPHEODONTIDAE** Caster, 1939

[*nom. transl.* Sokolskaya, 1960
(*ex* Tribe Stropheodontini Caster, 1939, p. 30)]

Subfamily **BRACHYPRIONINAE**
Harper and Boucot, 1978

Genus **BRACHYPRION** Shaler, 1865

Type species.—*Strophomena leda* Billings, 1860, p. 55, figs. 2, 3.

"Brachyprion" cf. mirabilis (Johnson, 1970)
Plate 2, figures 12–13

Description.—Shells available for study range in size from small to large (Table 5) and are moderately concavoconvex in lateral profile. Hingeline straight, long, denticulate; maximum width at hingeline; pedicle interarea narrow, concave outwards, orthocline; no brachial interareas nor pedicle interiors preserved; ornamentation unequally parvicostellate; fine costellae develop anterior to umbo in some specimens while in others entire shell surface parvicostellate; costellae superimpose upon and interrupt concentric rugae; on one shell (AMNH 44173) rugae tend to be somewhat zigzag in umbonal region.

Discussion.—Harper and Boucot (1978, p. 127) noted that cymostrophid ornamentation is developed elsewhere in the Stropheodontids and, by itself, is not an indication of affinity. Because no muscle scars are preserved and no brachial valves are in the collection, it is difficult to identify these shells to the species or genus level; they are tentatively assigned to "*B.*" *mirabilis*. *Cymostrophia* differs in its transverse outline and strongly concavoconvex geniculate profile with the trail longer than the central disk. *Shaleriella* is commonly smaller and has better developed zig zag rugae interrupted by primary costellae. The Onondaga shells show the closest affinity to "*B.*" *mirabilis* (Johnson, 1970, p. 115, pl. 22, figs. 1–12) in that both have parvicostellate ornamentation superimposed upon a concentric development of interrupted rugae. As noted by Johnson (1970, p. 115), "*B.*" *mirabilis* from Nevada needs a new generic name but the material available for study is insufficient to establish a new genus. The same holds true for the Onondaga shells.

Material.—Five pedicle valves.

Occurrence.—AMNH Loc. 3152.

Table 6.—Measurements (in mm) of *Brachyprion*? sp. See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*specimen type*
3152	27.5	29.0	p.v.
3152	28.0	38.5	p.v.
3152	33.7	44.0 d	p.v.
3152	26.5	37.6 d	p.v.
3152	25.5 d	33.4	p.v.
3152	26.8	40.0 dh	p.v.
3152	19.9	34.0	p.v.
3152	19.6	38.8 d	p.v.
3152	14.0	22.0 dh	p.v.
3152	19.2	—	p.v.
3152	22.8	—	p.v.
3152	21.8	33.4 dh	p.v.
3152	23.7	—	p.v.

Brachyprion? sp.
Plate 2, figures 14–17

Description.—Shells medium-sized to large (Table 6), moderately to strongly concavoconvex, apsacline to anacline, often wider than long, somewhat alate, generally poorly preserved except for some details of ornament on pedicle valve exterior; hingeline denticulate; number and quality of denticles varies greatly (maximum of 25); sometimes vaguely preserved, in others hingeline incomplete; ornamentation unequally parvicostellate with three to eight costellae between widely spaced costae.

Discussion.—These shells are provisionally assigned to *Brachyprion* (*Protomegastrophia*) because of their size and ornamentation. *Brachyprion* (*Brachyprion*) is usually smaller in size (less than 2 cm). *Brachyprion* (*Eomegastrophia*) is very similar in morphology but differs in that it can have uniformly costate ornamentation (Sheehan, 1971, p. 240) and is restricted to the late Llandoverian through early Wenlockian (Harper and Boucot, 1978, p. 15) whereas *Brachyprion* (*Protomegastrophia*) ranges into the Gedinnian (Harper and Boucot, 1978, p. 18). The shells are not assigned to *Strophonella* nor *Costistrophonella* because of their parvicostellate ornamentation. *Costistrophonella* also lacks widely spaced costae. As the internal morphology (particularly the muscle field and cardinal process) is unknown, positive generic and specific assignments cannot be made.

Material.—17 pedicle valves.

Occurrence.—AMNH Loc. 3152.

Genus **MEGASTROPHIA** Caster, 1939

Type species.—*Strophomena* (*Strophodonta*) *concava* Hall, 1857, p. 140.

Megastrophia? sp.
Plate 2, figure 18

Description.—Transversely oval muscle field with radial grooves. Diductor scars narrow, elongate longitudinally, subelliptical in outline and separated by very low myophragm; adductors larger, surround diductors anterolaterally, are transversely oval in outline and radially grooved; myophragm separating diductors extends through adductor field and becomes somewhat higher; shell almost identical to another from the Onondaga of the mid-Hudson Valley (Feldman, 1985, p. 318, fig. 21); muscle field very similar to Harper and Boucot's (1978, pl. 40, figs. 9a, b) *Megastrophia* (*Megastrophiella*) but has a more transverse outline; both have a low myophragm separating diductor and adductor muscles.

Material.—One pedicle valve.

Occurrence.—AMNH Loc. 3152.

Genus **PLICOSTROPHEODONTA**
Sokolskaya, 1960

Type species.—*Orthis murchisoni* D'Archiac and de Verneuil, 1842, p. 371, pl. 36, fig. 2.

Plicostropheodonta? sp.
Plate 2, figure 19

Description.—Shell moderately convex, wider than long with interarea flat to very slightly concave outwards, and orthocline to somewhat anacline; hinge denticulate for at least one-half the length but, due to poor preservation, lateral extremities of hinge show no evidence of denticles; delthyrium poorly preserved but open and umbo projects posteriorly past hingeline; coarse, rounded costae separated by interspaces of commonly the same width, but occasionally two times as wide, superimposed on fine, uniform costellae; costae originate at beak and increase anteriorly by bifurcation and intercalation.

Discussion.—Harper and Boucot (1978, p. 21, pl. 44, figs. 1–9; pl. 45, figs. 1a, b) described *Plicostropheodonta murchisoni* which is larger and more coarsely plicate, from the Seifener Series, higher middle Siegenian, Germany. The Onondaga specimen is tentatively assigned to *Plicostropheodonta* because of its relatively coarse costae superimposed on fine uniform costellae. This morphological feature, however, is likely due to evolutionary convergence.

Material.—One pedicle valve.

Occurrence.—AMNH Loc. 3152.

Subfamily **STROPHEODONTINAE** Caster, 1939

Genus **STROPHODONTA** Hall, 1850

Type species.—*Strophomena demissa* Conrad, 1842, p. 258, pl. 14, fig. 14.

Strophodonta demissa (Conrad, 1842)
Plate 2, figures 20–26; Plate 3, figures 1–5

Strophodonta cf. *demissa* Boucot and Johnson, 1968, p. B9, pl. 1, figs. 7–16; Boucot, 1973, p. 21, pl. 6, figs. 7–19; Feldman, 1985, p. 319, fig. 23.

Description.

Pedicle valve exterior.—Shells weakly mucronate, semicircular to shield-shaped in outline, concavoconvex in lateral profile, slightly wider than long (Table 7); pedicle valve umbo extends noticeably past interarea; pedicle interarea orthocline to slightly apsacline; delthyrium open and broadly triangular; flat pseudodeltidium sometimes present; usually pseudodeltidium and chilidium (if present) not easily differentiated; coarse, uniform costae superimposed on finer uniform costellae, commonly increasing anteriorly by bifurcation and intercalation; interspace distance approximately equal to costae width posteriorly but increases to two times, and rarely three times width near anterior commissure; about eight to 10 costae per 5 mm.

Pedicle valve interior.—Muscle field roughly suboval and apparently confined by low ridge anteriorly, although this may simply be a small depression in valve floor; there is an indication of low platform at posterior end of muscle field which probably supported adductors; ventral sockets medium-sized and form pair of pseudoteeth in only one specimen (AMNH 44185), which articulate with pseudosockets in brachial valve floor; shells endospinose on exfoliated surfaces.

Brachial valve interior.—Cardinal process lobes directed posteriorly and joined basally to form U-shaped structure; attachment faces of lobes non-striate and grooved medially; small sockets adjoin cardinal lobes laterally and diverge at angle of about 30 degrees from hingeline; muscle field extends anteriorly for about one-half the length of valve; consists of two sets of adductors elevated on a platform: a medial and posterolateral pair; medial scars extend from middle of posterolateral scars, elongate and divided by low myophragm; laterally, surrounded by raised ridge; posterolateral scars each subelliptical to reniform, shorter in length and separated by low, round myophragm which, in some cases, extends anteriorly and diverges forming lateral ridges which surround medial scars; posterolateral scars commonly more deeply impressed; indications of short breviseptum in some shells, along with slightly diver-

Table 7.—Measurements (in mm) of *Strophodonta demissa* (Conrad, 1842). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	7.9	9.6	2.9	a.v.
3152	7.3	9.4	2.3	a.v.
3152	9.2	11.4	—	a.v.
3152	9.6	7.3	3.2	a.v.
3152	8.5	10.7	—	a.v.
3152	10.1	12.8	2.7	a.v.
3152	8.4	11.0	2.0	a.v.
3152	7.1	9.1	2.7	a.v.
3152	9.7	14.0	—	a.v.
3152	19.8	25.6	9.1	a.v.
3152	18.4	—	6.7	a.v.
3152	16.7	20.9	—	a.v.
3152	18.7	20.8	—	a.v.
3152	19.8	20.5	5.6	a.v.
3152	20.3	21.9	6.0	a.v.
3152	18.0	23.2 dh	5.0	a.v.
3152	15.2	16.9	2.3	a.v.
3152	21.4	24.0 d	—	a.v.
3152	20.1	21.2	7.0	a.v.
3152	19.9	21.9	6.7	a.v.
3152	18.3	20.6	5.1	a.v.
3153	19.1	—	6.6	a.v.
3153	18.4	20.9	5.0	a.v.
3153	15.9	17.4	5.0	a.v.
3153	16.9	17.1	4.8	a.v.

gent (anteriorly) brachial ridges; breviseptum commonly continuous with myophragm; moderately high peripheral ridge present; external ornamentation only impressed on interior of endospinose valve floor at periphery.

Discussion.—The brachial valve interior identical to Hall's (1867) specimen (AMNH 37208) but smaller. In the Onondaga shells, the pedicle valve is more convex than Hall's (1867) specimens (AMNH 5153c, d) but equal in convexity to AMNH 5153a (from the Hamilton of Genesee County, Darien, New York). In general, the Onondaga shells are smaller than Hall's types.

Strophodonta demissa may be differentiated from *Brachyprion* (*Brachyprion*) by its larger, broader cardinal process in which the cardinal lobes are joined basally into a U-shaped structure, its raised brachial valve muscle field, pseudoteeth and pseudosockets. Ornamentation is coarser in *S. demissa* and the Onondaga shells have relatively coarse uniform costellae imposed on finer uniform costae. *Brachyprion* (*Brachyprion*) from the Onondaga, as discussed above, has unequally parvicostellate ornamentation. These shells may show evolutionary convergence with *Plicostrophodonta* as the ornamentation is very similar and the brachial valve interiors are identical.

Table 8.—Measurements (in mm) of *Costistrophonella punctulifera* (Conrad, 1838). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	14.7	24.3	—	a.v.
3152	20.3	32.8 dh	—	a.v.
3152	18.6	—	—	a.v.
3152	17.0	20.2 dh	—	a.v.
3152	18.4	25.5 dh	—	a.v.
3152	9.2	11.0	—	a.v.
3152	18.4	24.8 dh	—	a.v.
3152	—	34.0	—	a.v.
3152	13.0	22.2	—	a.v.

Strophodonta demissa differs from *Megastrophia* in having a less transverse muscle field in the pedicle valve; it is subelliptical to subtrigonal in the brachial valve of *Megastrophia*.

Material.—60 articulated shells, 21 pedicle valves, eight brachial valves.

Occurrence.—AMNH Loc. 3152.

Family **STROPHONELLIDAE** Caster, 1939

[*nom. transl.* Sokolskaya, 1960
(*ex* Strophonellinae Caster, 1939)]

Genus **COSTISTROPHONELLA** Harper and Boucot, 1978

Type species.—*Strophomena punctulifera* Conrad, 1838, p. 117.

Costistrophonella punctulifera (Conrad, 1838)
Plate 3, figures 6–11

Strophomena punctulifera Conrad, 1838, p. 117.
Strophodonta punctulifera Hall, 1859, p. 188, pl. 21, fig. 4; pl. 23, figs. 4, 5, 7e.
Strophonella cf. *punctulifera* Boucot, 1973, p. 23, pl. 8, figs. 14–18; Johnson, 1970, pp. 113–115, pl. 20, figs. 1–6; pl. 21, figs. 13, 14.
Strophonella punctulifera Hall and Clarke, 1892, p. 291, pl. 12, figs. 10–12; Schuchert, 1913, p. 323, pl. 59, figs. 8–10; Cooper, 1944, p. 339, pl. 130, figs. 19, 20; Johnson, 1970, p. 113, pl. 20, figs. 1–6; pl. 21, figs. 13, 14.
Costistrophonella cf. *punctulifera* Feldman, 1985, p. 317, fig. 20.

Description.

Exterior.—Brachial valve strongly convex in largest (Table 8) and most complete specimen (AMNH 44198); pedicle valve strongly concave; shells resupinate in lateral profile; hingeline at least partially denticulate but denticles not well preserved; rounded and angular radial costellae of uniform width which increase by bifurcation in some specimens and by intercalation in

others; costellae separated by interspaces which, in some shells, are same width as costellae, and in other shells range from one to three times their width.

Discussion.—*Costistrophonella punctulifera* differs from *Strophonella* (*Strophonella*) in having costellae of uniform width that are separated by interspaces of one or two times their width. In *Strophonella* (*Strophonella*) the costellae are characteristically more widely spaced. *Costistrophonella punctulifera* from the Onondaga Limestone has identical ornamentation and muscle scars to that of *Costistrophonella* cf. *punctulifera* from the Great Basin of Nevada (Johnson, 1970, p. 113, pl. 20, figs. 2, 4). The cardinal lobes of the Nevada shells vary slightly in that they diverge from one another at a more moderate angle. *Costistrophonella* sp., a Helderberg equivalent (Harper and Boucot, 1978, pl. 17, figs. 9a, b) from the Gedinnian of Gaspé, Quebec, differs in its more angular costellae. The Onondaga brachial valve (AMNH 44198) differs from Harper and Boucot's (1978, pl. 18, fig. 1a) brachial interior and differs only in that it has a T-shaped platform which supports the cardinal lobes.

Costistrophonella punctulifera differs from *C. ampla* (Hall, 1867, pp. 93–96, pl. 14, figs. 1a–i; Harper and Boucot, 1978, pl. 17, figs. 5–8; pl. 18, figs. 4–6) in its coarser and more angular costellae.

Material.—20 articulated shells, two pedicle valves, eight brachial valves.

Occurrence.—AMNH Loc. 3152.

Costistrophonella ampla (Hall, 1857)
Plate 3, figures 12–14

Type species.—*Strophomena ampla* Hall, 1857, p. 111.

Strophomena (*Strophodonta*) *ampla* Hall, 1857, p. 111.
Strophodonta ampla Hall, 1867, pp. 93–96, pl. 14, figs. 1a–i.
Strophonella ampla Hall and Clarke, 1892, pl. 12, figs. 13–15; Clarke, 1908, pp. 197–198, pl. 37, fig. 12.

Description.

Exterior.—Two specimens have been assigned to *Costistrophonella ampla* based on their distinctly finer costaellae.

Brachial valve interior.—Cardinal process lobes low, separated basally and diverge from each other at angle of 45 degrees; each lobe divided by longitudinal groove and is unstriated; small median groove separates cardinal lobes; low myophragm that extends anteriorly from a T-shaped platform splits anteriorly and separates adductor muscle field; muscles impressed more deeply posteriorly and merge imperceptibly with valve floor anteriorly; muscle scars longitudinally striated, somewhat dendritic and roughly oval in outline; internal shell surface endospinose, especially posteriorly.

Discussion.—Shells conform with the finer costellae typical of the species illustrated by Hall (1867, pl. 14, figs. 1a–i). Johnson's (1970, pl. 20, figs. 1–6; pl. 21, figs. 13, 14) species *Costistrophonella* cf. *punctulifera* from the Great Basin of Nevada has more coarse and angular costellae.

Material.—One pedicle valve, one brachial interior.

Occurrence.—AMNH Loc. 3152.

Suborder **CHONETOIDEA** Muir-Wood, 1955

Superfamily **CHONETACEA** Bronn, 1862

Subfamily **RETICHONETINAE** Muir-Wood, 1962

Genus **LONGISPINA** Cooper, 1942

Type species.—*Chonetes emmetensis* Winchell, 1866, p. 92.

Longispina mucronata (Hall, 1843)
Plate 3, figures 15–18

Strophomena mucronata Hall, 1843, p. 180, fig. 3.
Chonetes laticosta Hall, 1857, p. 119.
Chonetes mucronata Hall, 1867, p. 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.
"*Chonetes*" aff. *lineata* Hall. Feldman, 1985, p. 320, fig. 25A.

Description.

Exterior.—All shells in collection small (Table 9), subquadrate, concavoconvex; maximum width at hingeline; anterior commissure rounded while lateral commissures parallel; pedicle interarea concave and anacline; brachial interarea straight; remnant of single pseudodeltidium observed on one specimen but too poorly preserved to describe, other than to note that it includes an angle of approximately 60 degrees and is rather small; no chilidium observed; 12 to 15 rounded costae progressively widen from umbonal area towards margins; costae wider than interspaces on pedicle valve; brachial valve exterior too poorly preserved to comment on ornamentation; three costae per 2 mm along anterior commissure; no growth lines evident; neither intercalation nor bifurcation of costae observed although Hall (1867, p. 125) noted that some costae originated by bifurcation and some by intercalation (in Hall's specimens there were up to 20 costae present); spines not observed.

Pedicle valve interior.—One poorly preserved pedicle valve interior is available for study. The only morphological features of note are indications of two short hinge teeth, a large round muscle field and impress of costae along interior margins of valve floor.

Discussion.—*Longispina emmetensis* (Winchell), 1866 from the Traverse Group of Michigan (Imbrie, 1959, p. 397, pl. 64, figs. 23–26) differs from *L. mucronata* in that it has finer costae and is larger. Also,

Table 9.—Measurements (in mm) of *Longispina mucronata* (Hall, 1843). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	4.0	5.3	—	a.v.
3152	5.9	6.2	—	a.v.
3152	5.1	5.6 dh	—	a.v.
3152	5.0	5.8	1.0	a.v.
3152	4.0	4.6	—	a.v.
3152	6.0	7.0	—	a.v.
3152	5.4	—	1.9	a.v.
3152	3.8	5.1 dh	0.5	a.v.
3152	4.1	5.2	—	a.v.
3152	5.3	—	—	a.v.
3152	5.6	7.3	—	a.v.
3152	4.3	5.7	—	a.v.
3152	3.8	4.9 dh	—	a.v.

the costae of *L. emmetensis* increase very infrequently by both implantation and bifurcation.

Material.—One articulated shell, five pedicle valves.

Occurrence.—AMNH Locs. 3152, 3154.

Family **EODEVONARIIDAE** Sokolskaya, 1960

Genus **EODEVONARIA** Breger, 1906

Type species.—*Chonetes arcuatus* Hall, 1857, p. 76.

"Eodevonaria" cf. hemispherica (Hall, 1857)
Plate 3, figures 19–21

Chonetes hemispherica Hall, 1857, p. 116; 1867, p. 118, pl. 20, fig. 6; Hall and Clarke, 1892, pl. 16, fig. 14.

"Eodevonaria" hemispherica Racheboeuf and Feldman, 1990, pp. 10–13, figs. 9–12.

Chonetes lineata Feldman, 1985, p. 320, fig. 25B.

Description.

Pedicle valve exterior.—Shells large (Table 10), concavoconvex with maximum width at hingeline; umbo strongly arched dorsally, overhangs hingeline; ears strongly convex, triangular, well differentiated from body of pedicle valve; pseudodeltidium small, triangular convex plate at apex of delthyrium; pedicle interarea strongly concave, catacline and almost perpendicular to commissural plane; no spines preserved; ornamentation consists of low, rounded radial costae, separated by narrower interspaces, increase by bifurcation; costae number about two to four per millimeter at anterior commissure; at 5 mm from beak there are approximately 45 costae, while largest shells have about 70 costae at anterior commissure.

Pedicle valve interior.—One poorly preserved specimen studied in the field serves as the basis for this description. Faint myophragm divides muscle field to about midlength; diductor scars with radial striations found at posterior third of visceral cavity; large, oval

Table 10.—Measurements (in mm) of *"Eodevonaria" cf. hemispherica* (Hall, 1857). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*specimen type*
3152	6.9	14.9	p.v.
3152	9.6	14.3	p.v.
3152	10.3	14.2	p.v.
3152	8.0	14.4 dh	p.v.
3152	8.6	—	p.v.
3152	9.8	13.1	p.v.
3152	9.6	13.4	p.v.
3152	8.1	7.8	p.v.
3152	8.0	13.4 dh	p.v.
3152	8.3	13.7	p.v.
3152	8.7	8.8	p.v.
3152	5.7	10.5 dh	p.v.

adductor scars, almost semicircular in outline; hingeline strongly denticulate; internal periphery of anterior commissure grooved due to impress of costae; endospines found on anterolateral margins of valve, arranged in radial sequence.

Discussion.—Due to the lack of internal brachial valve morphology, generic assignment is somewhat questionable although the shape, denticulate hingeline and other characters indicate assignment to the family Eodevonariidae.

Racheboeuf and Feldman (1990) found the same species in the *Hallinetes* Zone (formerly "Pink" *Chonetes* Zone) in central New York (AMNH Locs. 3128, 3219). Both forms have rather coarse radial ornamentation very similar to shells described from Central and South America. *Eodevonaria inca* Isaacson, 1977, *E. imperialis* (Caster, 1939) and *E. subhemispherica* (Weisbord, 1926) have similar ornamentation and morphologies. Although they would probably represent a distinct group of globose, coarsely costate Eodevonariids, more detailed information is necessary for better comparisons.

Material.—10 pedicle valves.

Occurrence.—AMNH Locs. 3152, 3154.

Eodevonaria cf. arcuata (Hall, 1857)
Plate 3, figure 22

Chonetes arcuata Hall, 1857, pp. 116–117; 1867, p. 119, pl. 20, figs. 7a–f.

Eodevonaria arcuata Williams and Breger, 1916, pp. 52–54, pl. 3, figs. 6, 9, 11; Boucot and Harper, 1968, p. 153, pl. 27, figs. 1–7.

E. imperialis Caster, 1939, pp. 122–126, pl. 7, figs. 11–14, 17, 18; pl. 9, fig. 3.

E. imperialis var. *parva* Caster, 1939, pp. 126–128, pl. 7, figs. 9, 10, 15, 16; pl. 9, figs. 4–7.

E. imperialis var. *transversa* Caster, 1939, pp. 128–129, pl. 7, figs. 5, 6; pl. 11, figs. 18–20.

E. sp. cf. *E. arcuata* Boucot, 1959, p. 756, pl. 97, figs. 11–16.

Description.—One pedicle valve exterior along with the posterior section of the brachial valve was exposed from a block after etching in an acid bath. The specimen is silicified and the piece from which it protrudes is chert, making it impossible to further prepare the internal shell morphology. Shell large for Onondaga chonetids (L = 10.5 mm; W = 13 mm), strongly convex and transverse to possibly somewhat subcircular in outline. Maximum width at hingeline; posterolateral margin of pedicle valve flattened; brachial valve not visible; pedicle interarea appears to be flat and orthocline with remnants of small pseudodeltidium present, the convexity of which cannot be determined; very faint sulcus present on pedicle valve; about 17 costellae found in 5 mm interval at distance of 5 mm from beak; 24 denticles along entire length of hingeline; no spines evident.

Discussion.—*Eodevonaria* cf. *arcuata* differs from *Eodevonaria* cf. *hemispherica* in that it is more finely costellate.

Eodevonaria arcuata intermedia (Amsden and Ventress, 1963) from the Sallisaw Formation (early Emsian), Oklahoma, is very similar to *Eodevonaria arcuata* from the Onondaga but is not placed in synonomy for two reasons: the first is due to the observation of Boucot and Harper (1968, p. 156) that the number of costellae in the Oklahoma shells (as well as those from the Camden Chert of Tennessee) is too variable in collections of a single species from a single locality and is thus considered to be of questionable specific value. The second is that the Oklahoma shells lack a pedicle sulcus and the Onondaga specimen has a faint sulcus.

Eodevonaria acutiradiata, first described by Hall (1843, p. 171, fig. 3, as *Strophomena acutiradiata*) and presumed to be from the Onondaga Limestone of New York (see Amsden and Ventress, 1963, p. 168), has a shallower pedicle valve and is more finely costellate (12 to 13 per 5 mm).

Material.—One pedicle valve.

Occurrence.—AMNH Loc. 3153.

Order **RHYNCHONELLIDA** Kuhn, 1949

Suborder **RHYNCHONELLOIDEA** Moore, 1952

Superfamily **CAMAROTOECHIACEA**
Schuchert and LeVene, 1929

[*nom. transl.* Havlicek, 1960
(*ex* Camarotoechiidae Schuchert and LeVene, 1929)]

Family **RHYNCHOTREMATIDAE** Schuchert, 1913

Subfamily **ORTHORHYNCHULINAE** Cooper, 1956

Genus **MACHAERARIA** Cooper, 1955

Type species.—*Rhynchonella formosa* Hall, 1857, p. 76, figs. 1–5.

Machaeraria sp.
Plate 3, figures 23–27

Description.—Shell medium-sized (maximum length 14.5 mm, maximum width 19.2 mm, maximum thickness 10.1 mm), nonstrophic, transversely elliptical in outline, biconvex in lateral profile; brachial valve considerably deeper than pedicle valve; pedicle beak nearly straight, extending just posterior to brachial umbo; beak ridges small, with round, apically located permesothyridid foramen; delthyrium filled by incurved brachial beak thereby obscuring any evidence of delthyrial plates; no interarea present; posterolateral margins almost straight, diverge at angle of slightly greater than ninety degrees; anterior commissure uniplicate; maximum width attained at about midlength; pedicle valve has strong sulcus which dies out posteriorly and disappears altogether at pedicle umbo, while brachial valve has corresponding fold which also becomes obsolescent posteriorly; radial costae angular in cross section with 11 on pedicle flanks and five in sulcus; 10 costae on brachial flanks and six on fold; extremely fine, numerous (20 per mm), evenly spaced concentric growth lines present.

Discussion.—Bowen's (1967) *Machaeraria whittingtoni* from the Keyser Limestone (MCZ 9502a, b) is very similar to *Machaeraria formosa* sp. from the Onondaga Limestone but has three costae in the sulcus and four on the fold. *Machaeraria* from the Becraft Limestone of New York (Hall, 1859, pl. 35, figs. 60p, r) lacks a permesothyridid pedicle foramen. *Machaeraria formosa* seems to consist of two different species, one very slightly sulcate (AMNH 3398, 33401) and the other (AMNH 2481) sulcate and suboval in outline and similar to the Onondaga specimen but having three costae in the sulcus and four on the fold. Boucot (1973, p. 35, pl. 14, figs. 14–21) described *M. mainensis* from the base of the Upper Silurian Hobbstown Formation that is similar to the Onondaga form but again, as in *M. formosa*, it has only three costae in the sulcus and four on the fold. Also, in the Maine shells, as in some of Hall's (1857) types, the pedicle valve sulcus is prolonged into a tongue that abutts against the brachial valve fold; this feature is absent in *Machaeraria* sp. from the Onondaga Limestone. *M. carolina* (Hall), described by Boucot and Johnson (1968, p. B10, pl. 3, figs. 11–20) from the Bois Blanc Formation in western New York is more trigonal in outline, has a shallower sulcus and has 24 costae on the best preserved pedicle valve, five of which are in the sulcus. Of all known specimens of the genus, these shells conform the closest in morphology to the Onondaga specimen.

Until more material becomes available for study, especially of the internal morphology, specific assignment must be deferred. Johnson (1970, p. 142) noted

that the types of "*Rhynchonella*" *carolina* Hall (1867, pl. 54) are actually *Machaeraria* and their probable Eifelian age makes *Carolina* the youngest known species of *Machaeraria*. *Machaeraria* sp. from the Onondaga Limestone is also Eifelian in age (Feldman, 1985, p. 293). The Onondaga form is decidedly distinct from the Silurian and Early Devonian species of *Machaeraria* and may be transitional to *Callipleura* (type species *C. nobilis* Cooper, 1942), a Hamilton age genus.

Material.—One articulated shell.

Occurrence.—AMNH Loc. 3152.

Superfamily **STENOSCISMATACEA** Oehlert, 1887 (1883)

Family **ATRIBONIIDAE** Grant, 1965

Genus **ATRIBONIUM** Grant, 1965

Type species.—*Stenoscisma halli* Fagerstrom, 1961, p. 29, pl. 9, figs. 48–51.

Atribonium halli (Fagerstrom, 1961)
Plate 4, figures 1–11

Stenoscisma halli Fagerstrom, 1961, p. 29, pl. 9, figs. 48–51.
Stenoscisma rhomboidalis (Hall and Clarke) Fagerstrom, 1961, p. 29, pl. 9, figs. 45–47.
Atribonium halli (Fagerstrom) Grant, 1965, p. 52; Feldman, 1985, p. 323, fig. 29.

Description.—Shells small, rostrate, nonstrophic, subpentagonal in outline, ventribiconvex with short, suberect beak, and short, blunt beak ridges; pedicle foramen small; no deltidial plates preserved; anterior commissure uniplicate with prominent brachial fold and deep pedicle sulcus; costae weak, rounded, fading as beak approached, disappearing on both valves just short of midlength; four costae on fold and three on sulcus of larger specimen, but none preserved on smaller one; three costae found on flanks; no visible growth lines evident; both valves geniculate and butt against one another in vertical plane at anterior commissure (a generic character in the Stenoscismatacea); valves also butt against each other at lateral and posterior margins with no overlap; no evidence of incipient frills at commissure.

Discussion.—The shell is almost identical to those collected from the mid-Hudson Valley (Feldman, 1985, p. 323, fig. 29) and differ in number of costae on the sulcus and fold (not necessarily a significant difference when dealing with such a small sample). Grant (1965, p. 52) noted that *Atribonium halli* differs from all other species of the genus in having few (two or three) costae on the fold, and normally the same or a greater number on each flank. Since the Genesee Valley species so closely resembles the mid-Hudson Valley shells, the reader is referred to Feldman (1985, p. 324) for further comparisons which are applicable to both.

Table 11.—Measurements (in mm) of *Cupularostrum*? sp. See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	(L)	(W)	(T)	number of plications: fold	number of plications: sulcus	sulcus begins*
3152	13.9	13.6	6.0	6	5	3.4
3153	—	8.0	—	—	6	5.0

* Measured from the beak; both valves are articulated.

Material.—Three articulated shells.

Occurrence.—AMNH Loc. 3153.

Superfamily **CAMAROTOECHIACEA** Schuchert and LeVene, 1929

Family **TRIGONIRHYNCHIIDAE** McLaren, 1965

Genus **CUPULAROSTRUM** Sartenaer, 1961

Type species.—*Cupularostrum recticostatum* Sartenaer, 1961, p. 6, pl. 1, figs. 1–7; pl. 2, figs. A–C.

Cupularostrum? sp.
Plate 4, figures 12–15

Description.—Two articulated specimens are available for study, one of which is embedded in a piece of chert, pedicle valve up, thus obscuring the anterior margin of the shell. Shells medium-sized for genus (Table 11), subtrigonal in outline; posterolateral margins straight; pedicle beak slightly damaged but appears to be suberect; open, triangular delthyrium evident with a small foramen located apically; no deltidial plates observed; maximum width attained anterior to midlength, almost at anterior commissure; pedicle valve bears sulcus that originates just anterior to umbo; brachial valve bears corresponding, but weaker, fold; 21 simple, sharply rounded to subangular plicae separated by U-shaped interspaces; six plicae in sulcus but number on fold questionable.

Discussion.—Boucot (1973, p. 30) noted that an examination of the cardinalia is crucial to assigning a species to the genus *Cupularostrum* and that external form and ornamentation are not diagnostic. True *Cupularostrum* has a septalium commonly roofed over by a perforate hinge plate along with crenulate dental sockets. *Cupularostrum macrocosta* from the Moose River Synclinorium, Maine (Boucot, 1973, p. 29, pl. 12, figs. 3–11) has four to five plicae in the sulcus of the pedicle valve and seven to nine on the flanks, for a total of 11 to 14. The overall size and outline is similar to the Genesee Valley specimens.

Cupularostrum sp. A from the mid-Hudson Valley (Feldman, 1985, p. 325, figs. 30A–D) is smaller and has only 15 plicae. In all other respects, at least as can be determined from observing the exteriors, they are

Table 12.—Measurements (in mm) of *Atrypa "reticularis"* (Linnaeus, 1767). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	14.4	14.7	8.7	a.v.
3152	18.6	19.6	9.7	a.v.
3152	23.7	23.0	12.1	a.v.
3152	22.2	24.7	14.3	a.v.
3152	17.6	17.4	12.0	a.v.
3152	15.9	17.0	9.0	a.v.
3152	20.0	20.6	11.6	a.v.
3152	19.7	21.9	11.9	a.v.
3152	23.5	22.5	12.7	a.v.
3152	22.9	23.7	9.8	a.v.
3152	22.8	21.1	15.6	a.v.
3152	14.7	16.8	8.9	a.v.
3152	21.0	22.4	12.5	a.v.
3152	14.9	16.0	6.6	a.v.
3152	21.6	22.4	11.5	a.v.
3152	16.9	16.0	8.5	a.v.
3152	10.2	10.3	5.0	a.v.
3152	19.1	17.4	10.7	a.v.
3152	19.8	21.9	11.7	a.v.
3152	20.2	20.3	10.0	a.v.
3153	18.9	22.0	10.8	a.v.
3153	16.7	15.8	9.5	a.v.
3153	13.4	—	6.2	a.v.
3153	15.7	13.8	4.9	a.v.
3153	20.6	24.4	9.3	a.v.

identical. They are also very similar to *Cupularostrum*? sp. from the underlying Bois Blanc Formation of western New York (Boucot and Johnson, 1968, p. B11, pl. 3, figs. 21–29) in outline and external morphology.

Material.—Two articulated shells.

Occurrence.—AMNH Locs. 3152, 3153.

Order **ATRYPIDA** Rzhonsnitskaya, 1964

Superfamily **ATRYPACEA** Gill, 1871

Family **ATRYPIDAE** Gill, 1871

Subfamily **ATRYPINAE** Gill, 1871

Genus **ATRYPA** Dalman, 1828

Type species.—*Anomia reticularis* Linnaeus, 1758, p. 702.

Atrypa "reticularis" (Linnaeus, 1767)
Plate 4, figures 16–24

Anomia reticularis Linnaeus, 1758, p. 702.

Atrypa "reticularis" Boucot, 1959, p. 741, pl. 91, figs. 7–9; Boucot and Johnson, 1968, p. B12, pl. 3, figs. 30–49; Boucot, 1973, p. 36, pl. 15, figs. 1–6; Feldman, 1985, p. 326, fig. 31.

Description.

Exterior.—Shells mostly medium-sized (Table 12), dorsibiconvex, subcircular to elongate suboval in outline; maximum width attained at about midlength; pedicle beak suberect and overhangs brachial umbo partially concealing erect brachial beak; pedicle valve bears sulcus and brachial valve corresponding fold; anterior commissure slightly uniplicate; rounded radial costellae increase anteriorly by bifurcation and intercalation; concentric growth lamellae interrupt costellae becoming more numerous, distinct and frilly anteriorly.

Pedicle valve interior.—Large hinge teeth supported by short, narrow dental lamellae; muscle field flabellate, somewhat trigonal in outline and longitudinally striated with relatively coarse, uniformly sized, slightly radiating low ridges (diductors) which abut anteriorly against very low rim; adductors, located in posterior part of muscle field, represented by two smooth indentations separated by low ridge (myophragm?); ovarian/gonadal depressions deeply pitted.

Brachial valve interior.—Diverging sockets bounded by valve margin posterolaterally and anteromedially by curved hinge plates; socket plate transversely grooved; short, thin crural bases, projecting anteroventrally, attached to inner margins of sockets; no cardinal process observed; adductor muscle scars faintly striated, almost flabellate, subpyramidal and divided by low myophragm which is thick posteriorly, thins anteriorly and bifurcates into two myophragms ending at anterior rim of muscle field; faintly pitted ovarian depression.

Material.—111 articulated valves, 39 pedicle valves, 35 brachial valves.

Occurrence.—AMNH Locs. 3152, 3153, 3154.

Order **ATHYRIDIDA**
Boucot, Johnson and Staton, 1964

[*nom. transl.* Dagis, 1974 (*ex* Suborder Athyridoidea Boucot, Johnson and Staton, 1964, p. 815)]

Family **ANOPLOTHECIDAE** Schuchert, 1894

Subfamily **COELOSPIRINAE** Hall and Clarke, 1895

Genus **COELOSPIRA** Hall, 1863

Type species.—*Leptocoelia concava* Hall, 1857, p. 107.

Coelospira camilla Hall, 1867
Plate 4, figures 25–38

Leptocoelia concava Hall, 1857, p. 107.

Coelospira camilla Hall, 1867, p. 329 (as *Coelospira concava*), pl. 52, figs. 13–19; Hall and Clarke, 1895, pl. 53, figs. 24–31; Boucot and Johnson, 1967, p. 1237, pl. 164, figs. 20–30; pl. 165, figs. 1–15; Boucot and Johnson, 1968, p. B13, pl. 4, figs. 1–25; Boucot *et al.*, 1970, pp. 17–18, pl. 5, figs. 17–19, 21–22; Feldman, 1985, p. 327, fig. 32.

Description.

Exterior.—Shells small (Table 13), concavoconvex, subcircular in outline. Hinge slightly rounded with small

pedicle foramen in well preserved specimens; no interarea evident; pedicle beak incurved and pedicle valve strongly convex; maximum width attained at about one-third length; in some shells brachial valve sulcate medially but planar anteriorly; ornamentation consists of 12 rounded radial plication with U-shaped interspaces of about same width, that become wider as anterolateral margins approached; plications rarely increase anteriorly by bifurcation.

Pedicle valve interior.—Hinge teeth small, thin, generally poorly preserved and supported by obscure dental lamellae; crural fossette on medial side of each hinge tooth; diductor muscle scars bisected by low myophragm of varying thickness which ends at about one-third valve length; scars elongate, subelliptical and fairly deeply impressed in some shells while obscure in others; in former anterior boundary of diductor impressions strongly defined by difference in elevation on valve floor while in latter muscle impressions grade into valve floor imperceptibly; adductor scars represented by subtriangular depression just past anterior end of myophragm sandwiched between extremities of diverging didcutor impressions, located almost in exact center of valve floor, that is faintly crenulated anteriorly due to impress of plications.

Brachial valve interior.—Sockets diverge anterolaterally, deeply excavated and bordered medially by incurved socket plates; cardinal process trilobed, possibly quadrilobed protuberance from the base of which extends short, low, often broad anteriorly tapering myophragm; myophragm begins as swelling before tapering to bisect elongate to suboval adductor muscle field that terminates in raised rim at midlength; valve floor impressed with plications along periphery.

Discussion.—Adductor scars are not preserved in any specimens of *Coelospira camilla* from the mid-Hudson Valley (Feldman, 1985, p. 327, fig. 32); otherwise the shells are identical. The Genesee Valley specimens are almost identical to those collected from the Bois Blanc Limestone of western New York (Boucot and Johnson, 1968, p. B12, pl. 4, figs. 1–25) differing in their slightly finer plicae. Boucot *et al.* (1970, p. 17, pl. 5, figs. 17–19, 21–22) illustrate *Coelospira* sp., which differ in the ornamentation, from the Green Pond Outlier in southeastern New York. The pedicle exterior has a medial fold bearing a thin lira medially that is bounded by two primary costae each giving off a costella abaxially. Laterally three primary costae are present, resulting in a total of 11 costae, costellae and lirae. The brachial exterior bears a progressively thickening costa that supports a fine lira medially. Lateral to medial costae are present with secondary costellae, resulting in a total of 11 to 15 costae, costellae and lira. The shells further differ in that there is a nonlobate cardinal process.

Table 13.—Measurements (in mm) of *Coelospira camilla* Hall, 1867. See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	5.6	5.9	2.1	a.v.
3152	5.3	5.2	1.9	a.v.
3152	5.0	4.8	1.5	a.v.
3152	3.9	4.0	1.5	a.v.
3152	4.0	4.4	1.3	a.v.
3152	3.9	4.1	1.2	a.v.
3152	4.7	4.2	1.2	a.v.
3152	4.5	4.3	2.1	a.v.
3152	5.1	4.9	1.2	a.v.
3152	5.1	5.4	1.2	a.v.
3152	5.1	5.5	1.6	a.v.
3152	5.7	6.0	1.7	a.v.
3152	5.9	5.5	2.1	a.v.
3152	6.0	6.1	2.2	a.v.
3152	6.0	6.6	2.0	a.v.
3152	6.4	5.9	2.0	a.v.
3152	5.5	6.1	1.5	a.v.
3152	5.1	5.0	2.6	a.v.
3152	6.4	6.1	1.6	a.v.
3152	5.0	6.0	2.3	a.v.
3152	6.0	5.7	2.0	a.v.
3152	6.0	5.6	2.3	a.v.
3153	5.3	5.5	1.3	a.v.
3153	5.1	5.1	2.2	a.v.
3152	5.0	5.1	—	a.v.

Additional comparisons and references to the occurrence of *Coelospira camilla* in the United States can be found in Feldman (1985, p. 328) and Boucot and Johnson (1967, p. 1235).

Material.—142 articulated shells, 21 pedicle valves, six brachial valves.

Occurrence.—AMNH Locs. 3152, 3154.

Family MERISTELLIDAE Waagen, 1883

Subfamily CAMAROPHORELLINAE Schuchert and LeVene, 1929

Genus CAMAROSPIRA Hall and Clarke, 1893

Type species.—*Camarophoria eucharis* Hall, 1867, p. 368.

Camarospira? sp.
Plate 5, figures 1–5

Description.—Shell biconvex, elongate with arcuate pedicle valve bearing shallow sulcus and terminating in tonguelike extension; pedicle beak suberect; brachial valve inflated poseriorly and bears correspondingly weak fold; brachial umbo incurved partially concealing delthyrium; no deltidial plates preserved and no evidence of foramen; both valves show external evidence of median septum in form of thin line bisecting umbonal regions; shell smooth but for strong, irregularly spaced growth lines on anterior one-third of shell; spec-

Table 14.—Measurements (in mm) of *Athyris boucoti*, n. sp. See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3153 holotype AMNH 44227	15.3	14.8	11.3	a.v.
3153	12.9	12.2	7.2	a.v.
3152	11.4	12.9 dh	6.6 e	a.v.
3152	10.0 dh	9.6 dh	5.4	a.v.
3152	11.1	—	6.4	a.v.
3152	10.3	11.1	5.3	a.v.
3152	9.5 dh	9.3	3.0 c	a.v.
3152	9.3	11.6	5.3	a.v.
3152	9.0	10.3	2.9 c	a.v.
3152	9.0	9.3 dh	4.0	a.v.
3152	—	8.8	3.9	a.v.
3152	12.0	11.9	6.0	a.v.
3152	11.3	12.1	6.7	a.v.
3152	11.3	—	5.7	a.v.
3152	11.2	11.0	6.3	a.v.
3152	10.9	10.8 d	5.9	a.v.
3152	10.9	10.4	5.9	a.v.
3152	10.1	11.6	5.8 e	a.v.
3152	10.8	8.9	6.0	a.v.
3152	10.6	9.4	5.8	a.v.
3152	9.5	9.3 dh	5.3	a.v.
3152	9.2	10.1 dh	5.2	a.v.
3152	8.7	9.7	5.3	a.v.
3152	8.1	9.7	4.4	a.v.
3152	8.1	8.9	5.0	a.v.
3152	7.2	—	4.4	a.v.
3152	7.0	8.4	4.6	a.v.
3152	5.7	5.9	4.1	a.v.
3152	12.4 dh	12.2 dh	—	p.v.
3152	9.1	11.9	—	p.v.
3152	10.1	9.2	—	p.v.
3152	9.4	10.2	—	p.v.

imen resembles *Camarophoria eucharis* (Hall, 1867, p. 368, pl. 57, figs. 40–45) collected from the Onondaga Limestone (= Corniferous Limestone) of Canada West, Ontario, in its overall external morphology, but it is not as broadly ovate.

Material.—One poorly preserved articulated shell.

Occurrence.—AMNH Loc. 3153.

Family **ATHYRIDIDAE**
Davidson, 1881 (*non* M'Coy, 1844)

[*nom. correct.* Boucot, Johnson and Staton, 1964 (*pro* Athyridae Davidson, 1881, p. 4)]

Subfamily **ATHYRIDINAE**
Davidson, 1881 (*non* M'Coy, 1844)

[*nom. correct.* Boucot, Johnson and Staton, 1964 (*pro* Athyridinae Davidson, 1881, *nom. transl.* Waagen, 1883, p. 450) (*ex* Athyridae Davidson, 1881, p. 4)]

Genus **ATHYRIS** M'Coy, 1844

Type species.—*Terebratula concentrica* von Buch, 1834, p. 123 by subsequent designation of King, 1850, p. 136.

Athyris boucoti new species
Plate 5, figures 6–15

Athyris sp. A, Feldman, 1985, p. 331, figs. 38A–J.

Diagnosis.—Small athyrids with strong, concave, raised cardinal process bounded by thick lateral margins forming elevated ridges; narrow muscle field with striated adductor scars two-thirds the valve length; small hinge teeth supported by weak, curved, divergent dental lamellae; shallow, narrow sulcus with corresponding fold extending to umbonal region; lamellose exterior.

Description.

Exterior.—Shells small (Table 14), transversely suboval in outline and ventribiconvex; small, round pedicle foramen located at termination of suberect beak which overhangs incurved brachial beak; shallow, narrow sulcus, beginning just anterior to umbo and widening slightly anteriorly, commonly present on pedicle valve, while brachial valve bears corresponding fold, resulting in weakly uniplicate anterior commissure; some specimens with an underdeveloped sulcus and fold have more rectimarginate anterior commissure; shell surface of well preserved specimens covered by fine, concentric lamellose growth lines; occasional worn shells completely exfoliated.

Pedicle valve interior.—The following descriptions of the pedicle and brachial valve interiors are based partly on a single silicified specimen which has a small gape allowing an internal view. It was decided not to dissect the specimen and thus destroy the silicified shell, as the umbonal cavity and cardinalia were visible with a binocular microscope. Small hinge teeth dorsally directed, pointed and supported by weak dental lamellae which curve medially and diverge at about 45 degree angle; umbonal cavity thickened laterally forming slight ridge, but anteriorly merges with valve floor; no muscle scars preserved.

Brachial valve interior.—Sockets short, U-shaped and diverge at about thirty degree angle; cardinal process strong, typically concave and raised from valve floor; lateral margins thickened and form elevated ridges which border sockets; muscle field narrow, about one-fourth valve width, with striated adductor scars extending to about two-thirds valve length where they merge imperceptibly with valve floor; no jugum or spiralia preserved.

Discussion.—*Athyris boucoti* also occurs in the mid-Hudson Valley and is illustrated by Feldman (1985,

figs. 38A–J) as *Athyris* sp. A. *Athyris boucoti* is homeomorphic with *Protathyris praecursor* from the Lower Devonian Mitkov beds of Podolia, in the Ukraine (Nikiforova *et al.*, 1985, p. 55, pl. 15, figs. 1–4), but can be easily differentiated internally by the cardinal process, which in *Protathyris* is large and trilobate. *Athyris cora* from the Hamilton Group at Delphi, New York (Hall, 1867, p. 291, pl. 47, figs. 1–7) and the Middle Devonian Formosa Reef Limestone of southwestern Ontario (Fagerstrom, 1961, p. 34, pl. 11, figs. 37–41), a somewhat larger species, lacks the lamellose ornamentation of *Athyris boucoti*, has fine concentric growth lines on the surface and has a much narrower sulcus and fold. Specimens from the Skaneateles Formation in Hamilton, New York (USNM 447208–211), are nonlamellose, much larger and more robust than the Onondaga shells and range from weakly to strongly sulcate. *Athyris minuta* of the Formosa Reef Limestone (Fagerstrom, 1961, pp. 34–35, pl. 11, figs. 42–44) is similar in size but differs in its equally biconvex valves, subpentagonal outline and weak sulcus and fold. Internal comparisons must be deferred due to lack of *A. minuta* brachial interiors. *Athyris nuculoidea* described by Cooper from the St. Laurent Limestone, Missouri (1945, p. 485, pl. 64, figs. 12–19) closely resembles *Athyris boucoti* in its small size and ornamentation but differs in that it has a wider and shorter pedicle sulcus (and corresponding fold), is pentagonal to heptagonal in outline, and has straight dental lamellae which rise from the pedicle valve floor at a ninety degree angle; in *Athyris boucoti* the dental lamellae are curved and divergent.

Etymology.—After Professor Arthur J. Boucot, Oregon State University, Corvallis, Oregon.

Material.—40 articulated shells, five pedicle valves.

Occurrence.—AMNH Locs. 3152, 3153.

Athyris leoni new species
Plate 5, figures 16–23

Athyris sp. B, Feldman, 1985, p. 332, figs. 38k, l.

Diagnosis.—Medium-sized athyrid with a triangular, almost flat cardinal process, without dorsal (= visceral) foramen, narrowly elliptical brachial adductor impression and pyriform diductor scar.

Description.

Exterior.—Shells large (Table 15), transversely suboval in outline and ventribiconvex; pedicle beak suberect with poorly preserved foramen, while brachial beak is smaller, incurved; hingeline short, round; pedicle valve bears shallow sulcus which originates just anterior to umbo and diverges widely as it nears anterior commissure where it forms distinct but poorly preserved tongue; brachial valve bears corresponding fold that becomes more distinct anteriorly; ornamentation consists of concentric, lamellose growth lines on both valves that become quite crowded anteriorly, especially at anterior one-third of shell.

Table 15.—Measurements (in mm) of *Athyris leoni*, n. sp. See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152 holotype AMNH 44231	22.0 dh	25.8	16.5	a.v.
3152	—	29.3 d	—	b.v.
3152	22.9	30.0 d	—	p.v.

Pedicle valve interior.—Hinge teeth small, pointed, dorsally directed and supported by straight, stout dental lamellae; delthyrium relatively narrow, encompassing angle of approximately 25 degrees; diductor(?) muscle field is an extension of umbonal cavity, clearly pyriform in outline, and merges with valve floor anteriorly; laterally it is bordered by ridge that is continuous dorsally with dental lamellae; bisecting anterior part of muscle field is low myophragm; larger transversely suboval adductor(?) muscle scar may occupy even greater area of valve floor (two-thirds) but is not clearly preserved; it, as well as smaller scar, is striated.

Brachial valve interior.—Sockets very deeply excavated, broadly U-shaped in cross section, slightly flattened at base, widen anterolaterally and shallow out somewhat; cardinal process triangular, almost flat, with raised inner socket margins; no dorsal (= visceral) foramen evident; anterior rim of cardinal process also raised, although not as high, resulting in elevated border completely surrounding cardinal process; at base of cardinal process, below and posterior to raised rim, is an invagination, pointing posteriorly and ending in small pit-like structure; adductor muscle impression narrowly elliptical and, although worn, appears to have been striated with low myophragm found only at posterior one-fifth of scar.

Discussion.—*Athyris leoni* also occurs in the mid-Hudson Valley (AMNH Loc. 3138A) and is illustrated by Feldman (1985, figs. 38k, l) as *Athyris* sp. B. *Athyris leoni* from the Onondaga Limestone resembles *Athyris spiriferoides* from the Hamilton Group (AMNH 42351–42353) externally but differs internally in the following ways: [1] The pedicle muscle field of *Athyris leoni* is pyriform in outline whereas *Athyris spiriferoides* has an elliptical to suboval scar (also illustrated in Hall and Clarke, 1894, pl. 35, fig. 5) and, [2] The cardinal process of *Athyris leoni* is almost flat whereas in *Athyris spi-*

Table 16.—Measurements (in mm) of *Meristina* cf. *nasuta* (Conrad, 1842). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*distance between hinge teeth*	*length of muscle field*	*width of muscle field*	*specimen type*
3152	6.0	8.4	11.1	p.v.
3152	6.5	6.3	9.0	p.v.
3152	4.2	5.6	7.2	p.v.
3152	5.3	4.2	7.3	p.v.
3152	4.7	6.3	7.2	p.v.
3152	4.6	3.9	4.6	p.v.
3152	5.5	4.1	4.8	p.v.
3152	4.0	5.0	6.5	p.v.
3152	—	8.1	6.8	p.v.
3152	—	4.9	8.4	p.v.
3152	—	8.2	8.5	p.v.
3152	—	6.3	8.1	p.v.
3152	—	4.5	6.1	p.v.
3152	—	5.3	5.9	p.v.
3152	—	5.1	6.1	p.v.
3152	—	2.9	3.4	p.v.

riferoides it is concave to spoon-shaped, almost quadrilobed in appearance. Cooper (1944, p. 333, pl. 127, figs. 39–43) illustrated *Athyris spiriferoides* from the Upper Hamilton Group of New York; this form differs from the Onondaga species in its larger size (more than 38 mm in width), shallower sockets and pedicle muscle field with straight lateral margins. Hall (1867, p. 288) noted that the lowest range of *Athyris spiriferoides* is in the Onondaga (= Corniferous) Limestone and it becomes abundant in the Hamilton. This is entirely possible since I have observed specimens *in situ* (but not recoverable) in the field which more closely resemble *Athyris spiriferoides* but do not grade morphologically into *Athyris leoni*. These shells were seen in the mid-Hudson Valley but not in western New York, thus conforming with Hall's observation (1867, p. 288) that *Athyris spiriferoides* occurs in Albany and Schoharie counties but is rarely seen in equivalent rocks in the western part of the state.

Athyris vittata from the Hamilton Group (AMNH 37503) differs from *Athyris leoni* in its ovate to subquadrate outline, strong pedicle sulcus and brachial fold and generally smaller size. Hall and Clarke (1894, p. 777, pl. 35, figs. 1–3) illustrated *Athyris vittata* from the Hamilton Group which distinctly differs from the Onondaga shells in that it has a trilobate cardinal process.

Etymology.—After Dr. Leon A. Feldman, Professor Emeritus, Rutgers University, New Brunswick, New Jersey.

Material.—Two pedicle valves, two brachial valves.

Occurrence.—AMNH Loc. 3152.

Athyris sp. A
Plate 5, figure 24

Description.—This shell differs somewhat in outline and convexity from known athyrid species. The cardinal process is typically raised and concave, with bounding lateral ridges. The sockets are short, deeply excavated and no muscle impression preserved.

Material.—One brachial valve.

Occurrence.—AMNH Loc. 3153.

Subfamily **MERISTELLINAE** Waagen, 1883

Genus **MERISTINA** Hall, 1867

Type species.—*Meristella maria* Hall, 1863, p. 212.

Meristina cf. **nasuta** (Conrad, 1842)
Plate 5, figures 25–31

Atrypa nasuta Conrad, 1842, p. 265.

Meristella nasuta (Conrad, 1842), Hall, 1860, p. 93; Hall, 1867, p. 299, pl. 48, figs. 1–25; Fagerstrom, 1961, p. 33, pl. 11, figs. 1–4; Shimer and Shrock, 1944, p. 333, pl. 127, figs. 26, 27.

Meristina nasuta Boucot and Johnson, 1968, pp. B13–B14, pl. 4, figs. 26–43; Fagerstrom, 1971, p. 38, pl. 4, fig. 1; Feldman, 1985, p. 332, fig. 39.

Description.

Pedicle valve exterior.—Pedicle valve medium-sized (Table 16), strongly convex, pyriform in outline; most specimens (17 of 19) incomplete to some extent, usually lacking anterior commissure; no brachial valves in collection; maximum width just anterior to midlength; open, triangular delthyrium and incomplete pedicle foramen due to lack of preservation of any delthyrial covering or plate; no articulated shells available for study so exact shape of the foramen is unknown but, appears to have been small and circular; beak erect to slightly incurved; no interarea and no indication of a sulcus in any shells studied, however, on one specimen growth lines near anterior commissure developed pointed tonguelike projection anteriorly similar to Boucot and Johnson's (1968, p. B13) shells from Bois Blanc Formation on which anterior commissure extended into increasingly greater prolongation; irregularly spaced, numerous growth lines, increasing in number anteriorly; on most shells no growth lines evident due to lack of preservation and weak silicification.

Pedicle valve interior.—Hinge teeth small and range in shape from elongate subpyriform to crescent shaped, with convex part of cresent projecting laterally; supported by thin dental lamellae that converge, often strongly, toward valve floor and then again diverge laterally at posterolateral boundary of muscle field; posterior region of shell, especially in adults, has been thickened by secondary shell material; diductor scars strongly impressed on valve floor in form of subtrian-

gular outline with radial striae; center of muscle field in one specimen (AMNH 44236) has medial depression; anterior boundary of muscle field is well-defined in most shells, but in some grades imperceptibly into valve floor; adult shells with secondary deposition show acute angle between muscle impressions and base of dental lamellae; although on some shells muscle impressions weak, there are none with no scars at all.

Discussion.—Differentiation between *Meristina* and *Meristella* is difficult without preservation of the jugum. Boucot *et al.* (1964, p. 820) established the genus *Meristina* based on the nature of the dental lamellae and the muscle field configuration. They noted that there is some variation in large suites of the genus, particularly those containing large shells, in that some are found with the dental lamellae obsolete and others completely lack the bounding ridges adjacent to the muscle scar. These authors and Hall (1867) noted the resemblance of "*Meristella*" *nasuta* to *Meristina*. Bowen (1967, p. 35) noted that in *Meristella* the dental plates are characteristically short, whereas those in *Meristina* are long. The dental plates in the Onondaga specimens are shorter than those in various species of *Meristella* studied. The muscle field is not restricted to the region between the dental lamellae, as in *M. nasuta* from the Detroit River Group (Fagerstrom, 1971, p. 37). According to Amsden and Ventress (1963, p. 123), *Meristella* is characterized by deeply impressed muscle scars with the dental lamellae becoming obscure in mature shells by the deposition of secondary shell material. This is not the case in the Onondaga shells where the dental lamellae are quite distinct even though there is secondary shell deposition. Based on overall morphology and the fact that the genus *Meristina* is found in the underlying Bois Blanc Formation (Boucot and Johnson, 1968, p. B13), the Onondaga shells are placed in the genus *Meristina* until more material, especially brachial interiors, becomes available for study.

Boucot and Johnson (1968, p. B13) described *Meristina nasuta* from the Bois Blanc Formation of western New York and note that it has a faint sulcus on the pedicle valve, but is modified by the development of a low, rounded, medial plication that effectively extends the anterior commissure into increasingly greater prolongation on the larger specimens. The Onondaga shells lack this sulcus and medial plication. Also, *Meristina* cf. *nasuta* from the Onondaga has a slightly more elongate and less broad delthyrium and is somewhat smaller in size. *Meristina* cf. *nasuta* from the Onondaga of the mid-Hudson Valley (Feldman, 1985, p. 332, fig. 39) is similar to the shells described herein; both are convex, elongate, have no interareas, and one of the shells (AMNH 39900) has concentric growth lamellae along the internal margins. *Meristella nasuta* described by Shimer and Shrock (1944, p. 333, pl. 127, figs. 26, 27) is considerably larger, with a more rounded beak region than the Onondaga shells. Their articulated specimen precludes comparison of pedicle interiors. *Meristina haskinsi* from the Hamilton Group of Canandaigua Lake, New York (NYSM 1552) differs from the Onondaga shells in the following respects: [1] there is no secondary shell material and consequently the shell is rather thin, [2] the muscle scars are barely impressed on the (pedicle) valve floor, [3] the outline in plan view is suboval rather than subpyriform, [4] the dental lamellae are longer, [5] the shell is faintly sulcate, and [6] the delthyrium is smaller and wider.

Meristella princeps from the Port Ewen Limestone, Gross Quarry, Rondout, New York (NYSM E2850) approximates *Meristina nasuta* in size and general morphology but differs in having considerably less prominent dental lamellae. *Meristella lentiformis* from the Glenerie Limestone, Glenerie, New York (NYSM E2900; USNM 163805-6 [Dutro, 1971, pl. 1, figs. 1–4]) has a much shallower pedicle valve and is transversely elliptical in outline while *Meristina lata* from the same formation (NYSM E2902) has much more secondary shell material in the posterior region of the pedicle valve which resorb, to some extent, the dental lamellae, has a more flaring muscle field and is more convex in lateral profile. (See also Amsden and Ventress, 1963, p. 120, pl. X, figs. 17–23.)

Material.—30 pedicle valves.

Occurrence.—AMNH Loc. 3153.

Meristina? sp.

Plate 5, figures 32–34; Plate 6, figures 1–2

Description.—Valves assigned to genus based on size (AMNH 44237, L = 26.9 mm [est.], W = 29.4 mm; AMNH 44238, L = 30.5 mm, W = 29.0 mm [est.]) and morphology. Shells deeply concave, with small, round pedicle foramen and small triangular delthyrium; one specimen has faint sulcus; two specimens have numerous concentric growth lines; critical morphological structures such as muscle scars, dental lamellae and jugum not preserved; pedicle beaks not as prominent as in *Meristina nasuta*.

Material.—Four pedicle valves.

Occurrence.—AMNH Loc. 3154.

Genus **CHARIONOIDES**
Boucot, Johnson and Staton, 1964

Type species.—*Meristella doris* Hall, 1860, p. 84.

Charionoides doris (Hall, 1860)

Plate 6, figures 3–6

Meristella doris Hall, 1860, p. 84.

Charionoides aff. *C. doris* Boucot, Johnson and Staton, 1964, p. 817, pl. 127, figs. 14–20.
Charionoides doris Boucot, 1973, p. 64, pl. 20, figs. 14–22; Feldman, 1985, p. 335, fig. 40.

Description.—Two specimens available for study: AMNH 44239 (L = 12.5 mm, W = 9.3 mm, T = 7.2 mm); AMNH 44240 (L = 10.5 mm, W = 8.7 mm, T = 5.0 mm). One shell biconvex and the other ventribiconvex; both pyriform to almost almond shaped in outline; maximum width attained approximately two-thirds distance from beak; beak region damaged and incomplete; palintrope poorly defined and slightly convex; neither fold nor sulcus present although in one specimen (AMNH 44239) anterior commissure slightly plicate; no growth lines evident.

Discussion.—These shells differ from *Charionoides doris* of the Onondaga Limestone in Williamsville, New York (NYSM 1546), only in their lack of growth lines, which may be due to exfoliation and weathering.

Material.—Two articulated shells.

Occurrence.—AMNH Loc. 3152.

Genus **PENTAGONIA** Cozzens, 1846

Type species.—*Atrypa unisulcata* Conrad, 1841, p. 56.

Pentagonia unisulcata (Conrad, 1841)
Plate 6, figures 7–13

Atrypa unisulcata Conrad, 1841, p. 56.
Atrypa uniangulata Hall, 1861, p. 101.
Meristella? *unisulcata* (Conrad) Hall, 1862, p. 158, pl. 2, figs. 17, 20–23 (not figs. 19, 24, 25).
Meristella (*Penatgonia*) *unisulcata* (Conrad) Hall, 1867, p. 309, pl. 50, figs. 18–29 (not figs. 30–35).
Non *Meristella unisulcata* (Conrad) Nettleroth, 1889, p. 99, pl. 15, figs. 9–16.
Non *Pentagonia unisulcata* (Conrad) Savage, 1930, pp. 47, 50, 53, 62; 1931, p. 242, pl. 30, figs. 17, 18.
Pentagonia unisulcata (Conrad) Stauffer, 1915, p. 104, 245 (not pp. 160, 171, 175, 234); Goldring, 1935, p. 148, figs. 53B–D; Butts, 1941, pl. 115, figs. 17–21, 35; Cooper, 1944, p. 333, pl. 127, fig. 37; Dutro, 1971, pp. 187–188, figs. 3, 5; Feldman, 1985, pp. 335–337, fig. 41.

Description.

Exterior.—Shells range from small to medium-sized (Table 17), nonstrophic, impunctate and pentagonal in outline with suberect beak; shells dorsibiconvex with greatest width attained about two-thirds to three-fourths shell length; raised, rounded fold bearing narrow median groove gives brachial valve cariniform appearance; groove originates at umbo and widens anteriorly, almost imperceptibly in one specimen, forming two subparallel ridges which end at anterior commissure; concave flanks drop steeply adaxially away from sulcate fold; pedicle valve bears broad sulcus that widens anteriorly; defining sulcus laterally are two ridges that extend from umbo across posterolateral margins of flanks to uniplicate anterolateral commissure; numerous, concentric growth lines evenly spaced on entire shell surface; on larger shells growth lines are coarser towards anterior third of the shell.

Pedicle valve interior.—Hinge teeth short, blunt and supported by strong dental lamellae at base of which is deposited secondary shell material; muscle field broad, flabelliform.

Discussion.—Due to lack of brachial interiors and relatively poor internal preservation, detailed comparisons must be deferred at this time. The Genesee Valley shells however, are identical to *Pentagonia unisulcata* recovered from the mid-Hudson Valley (Feldman, 1985, fig. 41). *P. unisulcata* from the Genesee Valley is smaller than *Pentagonia peersi* (Dutro, 1971, pl. 1, figs. 9–12; pl. 2, figs. 1–3, 5–12) and larger than the subovate *P. lenta* (Dutro, 1971, pl. 1, figs. 5–8; pl. 2, fig. 4).

Material.—Five articulated shells, two pedicle valves.

Occurrence.—AMNH Loc. 3152.

Family **NUCLEOSPIRIDAE** Davidson, 1881

Genus **NUCLEOSPIRA** Hall, 1859

Type species.—*Spirifer ventricosa* Hall, 1857, p. 57.

Nucleospira ventricosa (Hall, 1857)
Plate 6, figures 14–23

Spirifer ventricosa Hall, 1857, p. 57, not figs. 1, 2.
Nucleospira ventricosa Hall, 1859, pp. 220–221, pl. 14, figs. 1a–h, pl. 28B, figs. 2–9; Hall and Clarke, 1894, pl. 48, figs. 2–6, 18; Weller, 1903, p. 209, pl. 30, figs. 19–22; Schuchert, 1913, p. 430, pl. 73, figs. 10–12; Bowen, 1967, pp. 37–38, pl. 5, figs. 16–17.
Nucleospira sp. Boucot and Johnson, 1968, p. H14, pl. 5, figs. 1–11.
Nucleospira aff. *ventricosa* Feldman, 1985, pp. 337–339, fig. 42.

Description.

Exterior.—Biconvex shells small (Table 18) and transversely suboval in outline with curved hingeline; pedicle and brachial beaks erect with concave pseudodeltidium covering delthyrium in a few specimens; one large adult shell has short, extremely narrow and shallow pedicle sulcus, with corresponding brachial fold; all other shells lack sulcus and fold; although radial ornamentation lacking there are concentric growth lines present concentrated towards rectimarginate anterior commissure.

Pedicle valve interior.—Hinge teeth small, pointed dorsally, unsupported by dental lamellae; delthyrium enclosed by concave pseudodeltidium; very low, thin median septum, most prominent in posterior half of valve, extends almost entire valve length beginning in umbonal cavity; muscle scars not preserved.

Brachial valve interior.—Cardinal process relatively large with anterior margin corrugated such that it looks

Table 17.—Measurements (in mm) of *Pentagonia unisulcata* (Conrad, 1841). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	8.6	11.0	5.7	a.v.
3152	14.1	17.3	9.0	a.v.
3152	—	20.7	11.3 dh	a.v.
3152	14.7	20.9	9.8	a.v.

like an "M" in plan view; medial surface of cardinal process is scyphiform with lateral margins converging posteriorly such that apex of cardinal process is deeper than anterior region; sockets shallow but appear to be deep due to raised cardinal process; muscle impressions, poorly preserved in only one specimen, consists of two slightly diverging striae (about 25 degrees) bisected by low myophragm; anterior border of muscle field extends to about 30% of valve length.

Discussion.—These shells are identical to those collected from AMNH locs. 3137 and 3138A in the mid-Hudson Valley (Feldman, 1985, fig. 42). *Nucleospira ventricosa* from the Keyser Limestone (Bowen, 1967, p. 37, pl. 5, figs. 16–27) differs only in the shape of the cardinal process which may be due to intraspecific variation (see Feldman, 1985, p. 338 for further discussion).

Specimens of *Nucleospira ventricosa* from the New Scotland Formation and equivalents (Cooper, 1944, p. 331, pl. 127, figs. 8, 9) have a somewhat different cardinal process in that they are subovate in outline. *Nucleospira* sp. from the Bois Blanc Formation (Boucot and Johnson, 1968, p. B14, pl. 5, figs. 1–11) is morphologically identical to the Genesee Valley shells. Specimens of *Nucleospira* aff. *ventricosa* from the Moose River Synclinorium, Maine (Boucot, 1973, p. 64, pl. 20, figs. 23–27), are too poorly preserved to be certain that they are indeed *ventricosa*, mainly because the cardinal process is not well preserved (see fig. 25); in all other respects they are identical to the Onondaga shells.

Material.—80 articulated shells, 11 pedicle valves, three brachial valves.

Occurrence.—AMNH Locs. 3152, 3153, 3154.

Family **RETZIIDAE** Waagen, 1883

Genus **TREMATOSPIRA** Hall, 1859

Type species.—*Trematospira gibbosa* Hall, 1859, p. 272.

Trematospira gibbosa Hall, 1859
Plate 6, figures 24–33

Trematospira gibbosa Hall, 1859, p. 272, pl. 45, figs. 7–15; Shimer and Shrock, 1944, p. 361, pl. 141, figs. 21–24.

Table 18.—Measurements (in mm) of *Nucleospira ventricosa* (Hall, 1857). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	8.7	9.4	5.3	a.v.
3152	8.3	8.7	4.7	a.v.
3152	7.6	7.9	4.5	a.v.
3152	8.0	7.5	4.5	a.v.
3152	4.8	5.3	2.8	a.v.
3152	8.8	8.7	4.6	a.v.
3152	10.1	10.3	6.1	a.v.
3152	8.7	8.4	5.3	a.v.
3152	7.4	7.0	4.9	a.v.
3152	8.5	8.7	5.5	a.v.
3152	7.9	8.3	5.6	a.v.
3152	5.7	5.9	2.9	a.v.
3152	6.7	7.0	3.7	a.v.
3152	5.8	6.8	3.2	a.v.
3152	8.0	7.3	4.1	a.v.
3152	6.4	7.0	3.3	a.v.
3152	8.6	8.9	5.1	a.v.
3152	6.9	7.7	4.5	a.v.
3152	9.5	10.0	5.0	a.v.
3152	6.9	7.9	4.1	a.v.
3152	8.9	9.6	5.4	a.v.
3152	8.5	8.5	5.1	a.v.
3152	8.2	7.6	4.4	a.v.
3152	9.9	10.1	5.0	a.v.
3152	7.4	7.1	4.4	a.v.
3152	7.0	7.5	3.7	a.v.
3152	7.7	7.8	4.2	a.v.
3152	7.8	8.1	4.3	a.v.
3152	8.4	9.5	5.2	a.v.
3152	7.1	8.3	4.8	a.v.
3152	9.4	8.6	5.5	a.v.
3152	6.6	6.9	3.7	a.v.
3152	7.3	9.3	4.8	a.v.
3153	10.4	10.7	6.7	a.v.
3153	9.1	9.4	5.6	a.v.
3153	9.5	9.3	5.9	a.v.
3153	10.8	12.5	7.7	a.v.
3153	9.6	10.6	5.3	a.v.

Description.—Of four (articulated) specimens in the collection (three are silicified) one is biconvex, the second unequally biconvex with pedicle valve about twice as convex as brachial valve, the third crushed and the fourth with only a trace of the pedicle valve; shells transversely subelliptical in outline, rostrate, with suberect beak; pedicle foramen mesothyridid; deltidium, partially obscured by incurved brachial umbo, covers delthyrium; maximum width attained at approximately midlength; pedicle valve bears distinct sulcus which becomes more clearly defined anteriorly, while brachial valve has corresponding, though somewhat less defined, fold; ornamentation consists of strong, angular, chevron-like costae, usually nine on brachial

Table 19.—Measurements (in mm) of *Trematospira gibbosa* Hall, 1859 and *T. camura* (Hall, 1850). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	specimen type	(L) p.v.	(L) b.v.	(W)	(T)	number of plications			
						p.v.	b.v.	sulcus	fold
T. gibbosa									
3152	a.v.	9.4	8.2	11.0	5.9	10	9	2	3
3152	a.v.	10.4	8.9	10.5	7.1	10	9	2	3
3152	a.v.d	8.5	7.3	9.0	—	9	9	2	3
3153	a.v.d	—	10.1	11.9	—	—	9	—	3
T. camura									
NYSM E1890	a.v.	8.4	7.4	11.2	4.9	13	15	2	2
NYSM E1890	a.v.	7.4	6.9	8.7	5.6	11	10	2	2
NYSM E1890	a.v.	8.7	6.9	11.0	5.0	13	14	2	3
NYSM E1890	a.v.	6.1	5.9	8.2	4.2	10	10	2	3

valve and 10 on pedicle valve; pedicle sulcus bears two costae while three are found on fold; two costae in sulcus distinctly smaller than others on pedicle valve exterior, especially the two adjacent to the sulcus; anterior commissure uniplicate and crenulated by costae.

Discussion.—*Trematospira camura* from the Rochester Shale, Lockport, New York (NYSM E1890), is biconvex, less gibbous and has less prominent costae (Table 19). *Trematospira multistriata* from the New Scotland Limestone, Schoharie County, New York (NYSM E2786) is considerably larger (L = 20.8 mm, W = 26.4 mm [pedicle valve]), more finely costate and has a broader, shallower sulcus. *Trematospira multistriata* from the Oriskany Sandstone of Becraft Mountain, Hudson, New York (NYSM 12122), is more gibbous and robust than *Trematospira gibbosa*. Specimens of *Trematospira* sp. from the Glenerie Formation just south of Glenerie, New York are medium-sized (average of two pedicle valves: L = 14.7 mm, W = 19.5 mm; average of 2 brachial valves: L = 13.2 mm, W = 19.0 mm), and possess more costae (14–15 per pedicle valve; 16–17 per brachial valve); this gives the appearance of being more finely costate than *Trematospira gibbosa*. These shells however, lack a distinct sulcus and fold.

Johnson (1970, pp. 179–181, pl. 52, figs. 8–25) described *Trematospira perforata* from the Great Basin of Nevada and noted that *Trematospira multistriata* is a related species from the Helderberg Group of New York. The specimens of *Trematospira perforata* from Nevada range in shape from elongate suboval to pyriform in juveniles to transversely suboval in adults. The ornamentation differs from *Trematospira gibbosa* in that the costae are finer, more numerous (about 30 on USNM 157151 [brachial valve]) and display a greater degree of bifurcation (evident on *T. gibbosa* only at the lateral margins). One specimen of *Trematospira perforata* (NYSM E2862, L = 12.2 mm, W = 15.4 mm [brachial valve]) from the Port Ewen Limestone in Rondout, New York, has 20 costae on the brachial valve which also increase by bifurcation at the lateral margins of larger ones. Another specimen of *Trematospira perforata* from the New Scotland Formation of Becraft Mountain, Hudson, New York (NYSM 12125) is not as alate as *Trematospira gibbosa* and has six costae in the sulcus.

Material.—20 articulated shells.

Occurrence.—AMNH Loc. 3152.

Order **SPIRIFERIDA** Waagen, 1883

Superfamily **DELTHYRIDACEA** Phillips, 1841

Family **DELTHYRIDIDAE** Phillips, 1841

Subfamily **DELTHYRINAE** Phillips, 1841

Genus **ACROSPIRIFER**
Helmbrecht and Wedekind, 1923

Type species.—*Spirifer primaevus* Steininger, 1853, by subsequent designation of Wedekind, 1926, p. 202.

Acrospirifer duodenaria (Hall, 1843)
Plate 7, figures 1–4

Delthyris duodenaria Hall, 1843, p. 171, fig. 5.
Spirifer duodenaria Hall, 1867, p. 189, pls. 27, 28; Landes, Ehlers and Stanley, 1945, pl. 12, fig. 4.
Hysterolites (*Acrospirifer*) *worthenanus*? Amsden *in* Amsden and Ventress, 1963, p. 182, pl. 16, figs. 1–4, 6–8, 11–16, 5?, 9?, 10?
Acrospirifer duodenaria Boucot and Johnson, 1968, pp. B14–15, pl. 5, figs. 12–39; Feldman, 1985, pp. 341–342, fig. 46.

Description.

Exterior.—Four fairly well preserved but incomplete silicified specimens are available for study and serve as the basis for the following description. Shells transversely subelliptical in outline with straight hingeline at which point maximum width attained; pedicle interarea low, narrow, apsacline and bears open delthyrium; brachial interarea apsacline and very narrow;

triangular, smooth sulcus originates in umbonal area on pedicle valve; corresponding flattened fold found on brachial valve; four rounded plications with U-shaped interspaces found on each pedicle valve flank while brachial valve bears five plications on each flank; one faint growth line evident on brachial valve exterior; no fine radial ornamentation preserved.

Pedicle valve interior.—Hinge teeth short, blunt and unsupported by dental lamellae; area just below and posterior to teeth somewhat thickened; valve floor crenulated due to impress of plications.

Brachial valve interior.—Notothyrial cavity chipped and incompletely preserved in all three brachial valves in the collection; no evidence of cardinal process, nor muscle scars; sockets short, deeply excavated, almost tear drop shaped and laterally directed; short, stubby crural bases which join inner margins of sockets evident in one specimen; valve floor crenulated due to impress of plications.

Discussion.—The Genesee Valley shells are identical to those collected from the mid-Hudson Valley (Feldman, 1985, pp. 341–342, fig. 46) but are not quite as well preserved. The occurrence of *Acrospirifer duodenaria* in western New York supports Hall's (1867, pp. 189–190) claim that the species is known throughout "all the extent of the formation within the state."

Acrospirifer murchisoni described by Boucot (1973, pp. 41–46, pl. 16, figs. 19–25) from the Moose River Synclinorium, Maine, differs in its larger size and wider pedicle interarea. *Acrospirifer atlanticus*, also described by Boucot (1973, pp. 46–47, pl. 17, figs. 1–9), is larger and more alate.

Boucot *et al.* (1970, p. 14, pl. 4, figs. 22–26) illustrated a form of *Acrospirifer*? sp. from the Green Pond Outlier that is considerably less transverse in outline. Johnson (1970, pp. 189–190, pl. 56, figs. 5–13; pl. 57, figs. 1–6) described *Acrospirifer* aff. *murchisoni* from the Great Basin, Nevada, that is less alate, more transversely suboval and commonly has six plications on the pedicle flank.

Material.—One pedicle valve, three brachial valves.

Occurrence.—AMNH Loc. 3152.

Family **MUCROSPIRIFERIDAE** Pitrat, 1965

Subfamily **MUCROSPIRIFERINAE** Boucot, 1959

Genus **MUCROSPIRIFER** Grabau, 1931

Type species.—*Delthyris mucronatus* Conrad, 1841, p. 54.

Mucrospirifer? sp.
Plate 7, figures 5–6

Description.—A single silicified brachial valve is assigned to *Mucrospirifer* sp. based on the following description. Shell large (L = 22 mm [est.]; W = 57 mm [est.]), strongly mucronate (although missing lateral extremities) with prominent, low fold with slight concavity evident originating in umbonal region and widening and deepening anteriorly; 21–23 rounded costae crossed by two prominent growth lines; finer, numerous growth lines visible under low (10×) magnification, particularly on fold; sockets fairly long, U-shaped, widely divergent; cardinal process represented by low concavity to the sides of which extend narrow, concave (anacline) interarea; muscle field narrowly triangular, widening anteriorly and bisected by low, rounded myophragm which merges imperceptibly with valve floor at about midlength; interior of valve floor crenulated due to impress of costae.

Table 20.—Measurements (in mm) of *Alatiformia*? sp. See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	*(L)*	*(W)*	*(T)*	*specimen type*
3152	8.8	9.1	6.1	a.v.
3152	10.7	18.6 d	5.5	a.v.
3152	8.1	15.2 dh	4.1	a.v.

Material.—One brachial valve.

Occurrence.—AMNH Loc. 3152.

Genus **ALATIFORMIA** Struve, 1963

Type species.—*Spirifer alatiformis* Drevermann, 1907, p. 126.

Alatiformia? sp.
Plate 7, figures 7–9

Description.—Shells small (Table 20), alate, transverse in outline, with flat striated interareas that were moderately high before compaction; delthyrium covered by chert, hence no deltidial plates evident; pedicle valve bears well-defined deep sulcus while brachial valve bears corresponding sharp, flat-topped fold; there are seven to eight costae covering each flank, crossed by numerous growth lamellae, clearly evident in sulcus and on fold; ornamentation identical to that of *Alatiformia varicosus* (Hall) (USNM 51202) from the "Onondaga" Limestone in Clarke County, Indiana. Morphology conforms to genus as described by Struve (1964, pp. 326–328).

Material.—Three articulated shells.

Occurrence.—AMNH Loc. 3152.

Genus **MEDIOSPIRIFER** Bublichenko, 1956

Type species.—*Delthyris medialis* Hall, 1843, p. 208.

Mediospirifer sp. A
Plate 7, figures 10–15

Description.

Exterior.—Shells incomplete anteriorly, but defi-

nitely transverse; largest pedicle valve very long making outline almost semicircular; pedicle valve has characteristic high, very slightly concave interarea covered with lateral striae; delthyrium triangular with adjacent ridge indicating presence of delthyrial plates; well-developed shallow sulcus with about 20 fine costae, separated by narrow U-shaped interspaces, covering pedicle flank; corresponding low fold on brachial exterior; occasional growth lamellae cross costae.

Pedicle valve interior.—No hinge teeth evident but two distinct, strong dental lamellae present which diverge at angle of about 55 degrees; muscle field, defined by base of dental plates, teardrop shaped; valve floor crenulated by impress of costae.

Brachial valve interior.—Sockets shallow, widely divergent; no distinct cardinal process evident; valve floor crenulated by impress of costae.

Discussion.—The shells more closely resemble *Mediospirifer fornaculus* (Hall) from Watson Station, Indiana (USNM 232452) than do typical *Mediospirifer audaculus* from the Hamilton Group of New York, studied in Hall's collection (AMNH), which have more widely divergent dental lamellae. The presence of dental lamellae supporting the hinge teeth rules out assignment to *Mucrospirifer*, which lacks dental plates.

Material.—Three pedicle valves, three brachial valves.

Occurrence.—AMNH 3152.

Mediospirifer? sp. B
Plate 7, figures 16–20

Description.—Fine external ornamentation not well-preserved due to etching in acid; 13 rounded costae on each pedicle flank and 14 on each brachial flank; costae separated by shallow, almost V-shaped interspaces and crossed by numerous growth lines evident only adjacent to pedicle sulcus; brachial valve bears corresponding flat-topped fold; both sulcus and fold originate in beak region; shell transverse, almost semicircular in outline and ventribiconvex in lateral profile; pedicle interarea flat (with some indications of lateral striae) except near beak where it becomes concave, and strongly apsacline; brachial interarea ribbon-like and appears to be anacline; delthyrium triangular and encloses angle of approximately 40 degrees; narrow ridge along one delthyrial margin indicating existence of plate.

Discussion.—Specimens of *Mediospirifer audaculus* (Conrad) (USNM 275323) from the Wanakah Formation and *M. fornaculus* (Hall) (USNM 232542) from Watson Station, Indiana, have higher, flatter interareas, are more finely costate (17–25 costae per flank) and more robust than the Onondaga shell.

The Onondaga shell resembles *Spinocyrtia "eurysteines"* from the Middle Devonian Silica Formation (UMMP 61090A, B, C) but differs in its smaller size, more mucronate alae and greater length.

Material.—One articulated shell.

Occurrence.—AMNH Loc. 3153.

Subfamily **KOZLOWSKIELLININAE** Boucot, 1957

Genus **KOZLOWSKIELLINA** Boucot, 1958

Type species.—*Kozlowskiella strawi* Boucot, 1957, p. 318.

(= **KOZLOWSKIELLA** Boucot, 1957)

Subgenus **MEGAKOZLOWSKIELLA** Boucot, 1957

Type species.—*Spirifer perlamellosus* Hall, 1857, p. 57.

Megakozlowskiella raricosta (Conrad, 1842)
Plate 7, figures 21–26

Spirifer perlamellosus Hall, 1857, p. 57.
Delthyris raricosta Conrad, 1842, p. 262, pl. 14, fig. 18.
Spirifer raricosta Hall, 1867, p. 192, pl. 27, figs. 30–34; pl. 30, figs. 1–9.
Kozlowskiella (Megakozlowskiella) raricosta Boucot, 1957, pl. 3, figs. 18, 19.
Megakozlowskiella cf. *raricosta* Johnson, 1970, p. 204, pl. 70, figs. 26–28.
Megakozlowskiella raricosta Boucot and Johnson, 1968, p. B16, pl. 6, figs. 7–15; Feldman, 1985, pp. 345–349, figs. 51, 52.

Description.—Shells medium-sized (Table 21), subtransverse in outline, strophic and ventribiconvex; hingeline straight with maximum width usually reached at or just anterior to hingeline, but in some shells maximum width occurs at midlength; pedicle interarea exposed on articulated shells very narrow and apsacline, but on free pedicle valves wide and concave; narrow brachial interarea concealed by overhanging pedicle umbo; pedicle valve bears strong U-shaped sulcus while brachial valve bears corresponding, somewhat flattened fold; both sulcus and fold originate in umbonal area; commonly three plications on flanks of both valves that become narrower laterally; between plications are U-shaped interspaces; delthyrium, including an angle of about 60 degrees, open on all specimens, but on two shells there are ridges on sides of delthyrium which may be indicative of plates; anterior commissure uniplicate; strong, concentric growth lines possess anterior frills (numbering five to 13 per 5 mm) in well-preserved specimens; three juveniles have unusually large number of plications (eight pedicle valve, nine brachial valve) which leads me to suspect that as ontogeny progresses some lateral plications lost; adults, as a rule, have a maximum of six plications.

Pedicle valve interior.—Small, pointed hinge teeth supported by thin dental lamellae that diverge medially

from their point of attachment adjacent to median septum, in posterior portion of valve; thin median septum incomplete but appears to have been fairly high, extending half the length of valve; no muscle scars preserved; crenulations of plicae impressed on valve floor.

Brachial valve interior.—Cardinal process bilobed and longitudinally striated; deeply excavated dental sockets are U-shaped, widening out anteriorly; outer socket ridges smooth and diverge at angle of about 30 degrees; crural plates small and somewhat concave, extending anteroventrally short distance from notothyrial platform; no muscle scars preserved; interior of valve strongly corrugated reflecting impress of plications.

Discussion.—The shells are identical with those collected in the mid-Hudson Valley (Feldman, 1985, figs. 51, 52) but not as well preserved. *Megakozlowskiella magnapluera* from the Great Basin, Nevada (Johnson, 1970, p. 202, pl. 71, figs. 1–19) is more subquadrate in outline and has fewer plications. *Megakozlowskiella raricosta* was described by Hall (1867, p. 192, pl. 27, figs. 30–34; pl. 30, figs. 1–9) from the Schoharie Grit (Helderberg Mountains and Schoharie, New York) and the Onondaga Limestone at Stafford, Caledonia and Williamsville (western New York). He also reported occurrences at Columbus, Ohio, Falls of the Ohio, and Canada West.

Material.—26 articulated shells, 34 pedicle valves, 16 brachial valves.

Occurrence.—AMNH Locs. 3152, 3153.

Table 21.—Measurements (in mm) of *Megakozlowskiella raricosta* (Conrad, 1842). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	(L)	(W)	(T)	plications pv	plications bv	frills No. 5 mm	specimen type
3152	19.0 d	30.0	12.3	6	—	9	a.v.
3152	17.5	21.4	18.2	4	5	5	a.v.
3152	19.0	25.0 dh	11.9	4	5	9	a.v.
3152	7.2	14.0 dh	5.0	8	9	9	a.v.
3152	14.8 d	24.7	—	6	—	8	a.v.
3152	25.8	26.5 dh	16.2	6	5	13	a.v.
3152	—	28.2	10.9	—	—	12	a.v.
3152	15.3	17.3	8.0	5	4	8	a.v.
3152	21.2	21.5	13.8	—	6	—	a.v.
3152	8.7	16.2 dh	6.0	8	9	9 t	a.v.
3153	9.6	22.8 dh	7.2	20	21	13	a.v.

Subfamily **PARASPIRIFERINAE** Pitrat, 1965

Genus **PARASPIRIFER** Wedekind, 1926

Type species.—*Spirifer cultrijugatus* Roemer, 1844, p. 70.

Paraspirifer? sp.
Plate 7, figure 27

Description.—A large, robust spiriferid, suggestive of *Paraspirifer*, is embedded in a block of chert with one flank projecting out of the matrix. One-half of high fold evident and there is assumed to be corresponding deep sulcus. Shell silicified with 10 coarse radial costae on one flank of brachial valve and 3 on fold; the 4 costae closest to fold bifurcate; bifurcations more pronounced anteriorly but faint due to shell erosion; costae with U-shaped interspaces; shell closely resembles *P. acuminatus* from the Hamilton Group collected near Fultonham, Schoharie County, New York (AMNH 5171), but is smaller. *P. acuminatus* figured by Godefroid and Fagerstrom (1983) is almost identical to the shell illustrated here in terms of morphology and size. There are vague indications of concentric lamellae, but no granules are evident in this specimen.

Material.—One articulated (?) shell.

Occurrence.—AMNH Loc. 3153.

Family **RETICULARIIDAE** Waagen, 1883

Genus **ELYTHA** Frederiks, 1918

Type species.—*Delthyris fimbriatus* Conrad, 1842, p. 263.

Elytha fimbriata (Conrad, 1842)
Plate 7, figures 28–32; Plate 8, figures 1–3

Delthyris fimbriatus Conrad, 1842, p. 263.
Spirifer fimbriata Hall, 1867, p. 214, pl. 33, figs. 1–21.
Elytha sp. Boucot and Johnson, 1968, p. B18, pl. 7, figs. 1–5.
Elytha fimbriata Goldring, 1943, p. 236, fig. 43J; Cooper, 1944, p. 327, pl. 126, figs. 1–3; Feldman, 1985, pp. 349–350, fig. 54.

Description.

Exterior.—Shells medium-sized (Table 22), ventribiconvex with short hingeline; beak erect but short; maximum width attained at about midlength; pedicle interarea small, low and apsacline while brachial interarea represented by thin strip which appears to be apsacline; distinct shallow sulcus, originating in umbonal region, found on pedicle valve while brachial valve bears corresponding low, rounded fold; low plications, U-shaped in cross section, cover lateral slopes; more clearly developed on ephebic forms; plications separated by U-shaped interspaces; concentric growth lamellae cross plications becoming more numerous anteriorly; each lamella bears single row of medially grooved spines (11–12 per 5 mm), up to 2.7 mm in length, most of which are lost due to abrasion; in specimens still enclosed in limestone matrix however, spines are visible (see pl. 8, fig. 3); anterior commissure uniplicate.

Table 22.—Measurements (in mm) of *Elytha fimbriata* (Conrad, 1842). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	(L)	(W)	(T)	no. of plications per flank	specimen type
3152	19.4	28.5	13.3	5 t	a.v.
3152	21.5	30.6 dh	15.4	7	a.v.
3152	18.3	26.2	15.1	6	a.v.
3152	23.0	32.9	14.9	6 t	a.v.
3152	18.4	22.4	9.8	5 t	a.v.
3152	14.9	22.4 dh	—	6	a.v.
3152	15.6	18.6	7.3	6	a.v.
3152	17.8	27.0	11.5	—	a.v.
3152	18.4	24.3	11.2	—	a.v.
3152	14.0	20.8	—	—	a.v.
3152	15.6	18.6	7.3	—	a.v.
3152	17.0	25.2	10.2	—	a.v.
3152	14.8	18.1	6.9	—	a.v.
3152	12.0	15.9	—	—	a.v.

Pedicle valve interior.—Hinge teeth short, pointed, supported by dental lamellae which extend to valve floor and then anterolaterally; delthyrium open with no indication of modifying plates; low myophragm extends anteriorly from delthyrial cavity just under one-third valve length and passes through muscle field which is very faintly impressed by anteriorly directed striations; valve floor crenulated due to impress of plications.

Brachial valve interior.—Shallow sockets broaden and diverge anterolaterally; medially concave, broad crural plates partially adjoin valve floor but do not unite into a septalium; neither muscle field nor myophragm preserved, although in specimens collected from mid-Hudson Valley, adult forms possessed short, low myophragm; valve floor, especially anteriorly, crenulated by impress of plications.

Discussion.—*Elytha fimbriata* described by Feldman (1985, fig. 54) is identical to the Genesee Valley shells. Boucot and Johnson (1968, p. B18, pl. 7, figs. 1–5) described specimens of *Elytha* sp. from the Bois Blanc Formation; these were assigned by Feldman (1985, pp. 349–350) to *Elytha fimbriata* based on their oval shape, short hingeline, length of the myophragm and presence of dental lamellae. Hall reported the occurrence of *Elytha fimbriata* from the Oriskany Sandstone at Saugerties, New York, Knox in Albany County, in the Schoharie Grit in Albany and Schoharie counties, and in the Onondaga Limestone in Cherry Valley, as well as at numerous other localities across the state and into Ohio.

Material.—13 articulated shells, 30 pedicle valves, 18 brachial valves.

Occurrence.—AMNH Locs. 3152, 3153.

Family **AMBOCOELIIDAE** George, 1931

Ambocoeliid indet.
Plate 8, figures 4–6

Description.—Shell small (L = 6.4 mm; W = 7.3 mm; T = 4.3 mm), ventribiconvex, subcircular in outline; both valve exteriors smooth, nonspinose, with no growth lamellae evident; pedicle valve bears narrow, shallow sulcus that originates in umbonal region and extends to slightly uniplicate anterior commissure; greatest width attained at about midlength; beak and interarea poorly preserved.

Discussion.—The Onondaga shell is similar to *Emanuella* described by Goldman and Mitchell (1990, pp. 90–94) in its ventribiconvex shape and uniplicate anterior commissure, but differs in its lack of striations and large size. *Ambocoelia* (Goldman and Mitchell, 1990, p. 83) differs in that it is either planoconvex or concavoconvex and has a rectimarginate anterior commissure. *Crurispina*, also described by Goldman and Mitchell (1990, pp. 95–96) is similar in size and shape (ventribiconvex) but is covered externally with numerous short spines. It is possible that the Onondaga specimen is a weathered *Crurispina*, but this seems unlikely as Goldman and Mitchell (1990, p. 95) noted that the normally spinous shell is pitted when exfoliated. *Ambocoelia* sp. from the mid-Hudson Valley (Feldman, 1985, pp. 350–351, fig. 56) differs in its much higher pedicle valve.

Material.—One articulated shell.

Occurrence.—AMNH Loc. 3152.

Superfamily **CYRTINACEA** Frederiks, 1912

[*nom. trans.* Johnson, 1966, (*ex* Cyrtininae Frederiks, 1912)]

Family **CYRTINIDAE** Frederiks, 1912

Genus **CYRTINA** Davidson, 1858

Type species.—*Cyrtia hamiltonensis* Hall, 1857, p. 166.

Cyrtina hamiltonensis (Hall, 1857)
Plate 8, figures 7–10

Cyrtia hamiltonensis Hall, 1857, p. 166.

Cyrtina hamiltonensis Hall, 1867, p. 268, pl. 27, figs. 1–4; pl. 44, figs. 26–33, 38–52; Grabau and Shimer, 1909, figs. 393a–c; Prosser and Kindle, 1913, pp. 185–187, pl. 17, fig. 109; Clarke and Swartz, 1913, pp. 591–592, pl. 56, figs. 1–3; Branson and Williams, 1924, p 149, pl. 19, figs. 5–8; Stewart, 1927, p. 43, pl. 3, figs. 27, 28; Goldring, 1935, figs. 62c, d; Stumm, 1942, pl. 81, figs. 7, 8; Ehlers, 1963, pp. 198–199, pl. 1, figs. 1–12; Feldman, 1985, pp. 351–353, figs. 57A–E.

Cyrtina hamiltonensis var. *recta* Hall, 1867, p. 270, pl. 44, figs. 34–37; Hall and Clarke, 1895, pl. 28, figs. 21, 22.

Cyrtina hamiltoniae var. *recta* Hall, Nettleroth, 1889, p. 97, pl. 13, figs. 13–16.

Table 23.—Measurements (in mm) of *Cyrtina hamiltonensis* (Hall, 1857). See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	(L)	(W)	(T)	number of plications		specimen type
				dorsal	ventral	
3152	5.4	8.9	7.6	6	6	a.v.
3152	4.8	6.9	5.9	6	6	a.v.
3152	7.6	11.9	8.3	8	8	a.v.
3152	6.7	10.5	8.6	—	8	a.v.
3152	5.4	9.5	4.0	6	6	a.v.
3152	4.9	7.8	4.7	8	—	a.v.
3152	7.9	9.4	7.0	6	6	a.v.
3152	6.1	10.0	7.7	—	—	a.v.
3152	5.3	8.8 dh	—	—	6	a.v.

Description.

Exterior.—Shells small (Table 23), ventribiconvex, hemipyramidal in outline; many slightly deformed due to compaction; maximum width attained just anterior to straight hingeline; pedicle interarea high, smooth and apsacline; delthyrium obscured in shells studied but appears to be covered by convex pseudodeltidium; smooth, moderately deep sulcus originating deep in umbonal region found on pedicle valve, while brachial valve bears corresponding fold; in some specimens concentric growth lamellae found concentrated near uniplicate anterior commissure.

Brachial valve interior.—Sockets shallow, widely divergent; their outer boundary forms narrow interarea which overlaps socket posteriorly; cardinal process eroded posteriorly but appears to be bilobed, triangular in outline and supported by thickened secondary shell material rising from valve floor which is crenulated due to impress of plications; no muscle scars preserved.

Discussion.—*Cyrtina hamiltonensis* from the Genesee Valley differs from *Cyrtina hamiltonensis* from the Traverse Group of Michigan (Keyes and Pitrat, 1978, pl. 1, figs. 11–15) only in that the Michigan specimens are essentially catacline. *Cyrtina alpenensis alpenensis* (Keyes and Pitrat, 1978, pl. 1, figs. 1–5) differs in that it has a smooth umbonal area, a character which separates it from all other species of *Cyrtina* in the Traverse Group. The specimens of *Cyrtina hamiltonensis* recovered from the mid-Hudson Valley (Feldman, 1985, figs. 57A–E) are identical to those found in western New York. *Cyrtina umbonata* (Cooper, 1944, pl. 140, figs. 40–42) is smaller and has a more incurved umbo. *Cyrtina* cf. *varia* Clarke, 1900 illustrated by Johnson (1970, pl. 73, figs. 1–14) has a shallower sulcus, more acute cardinal angles and is less semi-circular in dorsal view.

Material.—10 articulated shells, three pedicle valves, two brachial valves.

Occurrence.—AMNH Loc. 3152.

Table 24.—Measurements (in mm) of *Cryptonella*? sp. See *Systematic Paleontology: Introduction: Measurement Abbreviations and Subscripts* for explanations.

AMNH loc.	(L)	(W)	(T)	specimen type
3152	15.9	11.5	4.6	a.v.
3152	15.8	12.3	6.6	a.v.
3152	14.4	10.4	6.0	a.v.
3152	10.8	6.8 dh	3.9	a.v.
3152	11.8	—	5.1	a.v.
3152	—	13.6	12.4	a.v.

Cyrtina sp. A
Plate 8, figure 11

Description.—A single highly compacted shell, much larger than *Cyrtina hamiltonensis* (L [brachial valve] = 10.3 mm, L [pedicle valve] = 18.6 mm, W = 16.4 mm) with 12 dorsal and 12 ventral plications, is assigned to *Cyrtina* sp. A until more material becomes available for study.

Material.—One articulated specimen.

Occurrence.—AMNH Loc. 3152.

Order **TEREBRATULIDA** Waagen, 1883

Suborder **TEREBRATELLIDINA** Muir-Wood, 1955

Superfamily **CRYPTONELLACEA** Thomson, 1926

[*nom. trans.* Stehli, 1965,
ex Cryptonellinae Thomson, 1926, p. 529]

Family **CRYPTONELLIDAE** Thomson, 1926

Genus **CRYPTONELLA** Hall, 1861

Type species.—*Terebratula rectirostra* Hall, 1860, p. 88.

Cryptonella? sp.
Plate 8, figures 12–17

Description.—Shells small (Table 24), smooth, elongate subpyriform to slightly subpentagonal in outline, biconvex to ventribiconvex and lenticular in profile; greatest width attained at about two-thirds valve length; anterior commissure ranges from rectimarginate to sulcate; lateral margins rectimarginate but, in one specimen, sinuate posteriorly; pedicle foramen permesothyridid; beak suberect to erect; delthyrium covered by conjunct deltidial plates, observable in only one specimen; no growth lamellae noticeable.

Discussion.—The shells resemble *Cryptonella reimanni* (Cloud, 1942, pp. 130–131, pl. 23, figs. 9–18) more than any other species, but differ in lack of growth lamellae, which may be due to exposure and exfoliation. Specific designation must be deferred until better material becomes available for study.

Material.—Six articulated shells.
Occurrence.—AMNH Loc. 3152.

Suborder **TEREBRATULIDINA** Waagen, 1883

Superfamily **DIELASMATACEA** Schuchert, 1913

Family **CRANAENIDAE** Cloud, 1942

Subfamily **CRANAENINAE** Cloud, 1942

Genus **CRANAENA** Hall and Clarke, 1893

Type species.—*Terebratula romingeri* Hall, 1863, p. 48.

Cranaena? sp.
Plate 8, figures 18–19

Description.—Shell small (L = 13.4 mm; W = 9.0 mm; T = 5.6 mm), smooth, covered by occasional faint growth lamellae and ventribiconvex; pedicle valve bears shallow sulcus which originates at about midlength, while brachial valve bears corresponding fold which seems to be present throughout its entire length, although right side of the brachial valve (when viewed dorsally) is compressed making differentiation of fold somewhat questionable; anterior commissure sulcate and lateral commissures sinuate posteriorly; beak suberect and foramen mesothyridid; delthyrium covered by dorsal umbo; deltidial plates not visible.

Discussion.—*Cranaena romingeri* (Cloud, 1942, pp. 138–139, pl. 24, figs. 2–12) is smaller, more gibbous and subcircular to subovate in outline and has a rectimarginate lateral commissure. The Genesee Valley shell more closely resembles *Cranaena schucherti* (Cloud, 1942, pp. 139–140, pl. 23, figs. 24–31; pl. 24, fig. 1) in its lenticular appearance and size.

Material.—One articulated shell.
Occurrence.—AMNH Loc. 3152.

APPENDIX

Localities Cited in this Report

AMNH Locality 3152. Extensive bedding plane exposure in eastern portion of abandoned quarry, immediately west of Perry Road, 1.2 km (0.7 miles) north of B & O Railroad tracks, 3.2 km (2.0 miles) northeast of bridge in Le Roy, Genesee County, New York; USGS Le Roy quadrangle, 7.5 minute series [topographic], N4/4 Caledonia 15′ quadrangle; Lower Moorehouse Member.

AMNH Locality 3153. Small bedding plane exposures along southeastern portion of active General Crushed Stone Co. quarry, immediately south of Honeoye Falls Road, 5.5 km (3.4 miles) east of intersection with U.S. Route 15, 5.5 km (3.4 miles) WSW of Honeoye Falls, Monroe County, New York; USGS Rush quadrangle, 7.5 minute series [topographic], NW/4 Honeoye 15′ quadrangle; Upper Moorehouse Member.

AMNH Locality 3154. Scattered exposures at southwest corner of active quarry operated by Penfield Dolomite Company, immediately south of Gulf Road, 2.1 km (1.3 miles) east of Perry Road, Le Roy, Genesee County, New York; USGS Le Roy quadrangle (see above); Lower Moorehouse Member.

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PLATES

EXPLANATION OF PLATE 1

Figure — Page

1–4. *Levenea* cf. *subcarinata* (Hall, 1857). Pedicle exterior, interior, posterior, anterior, AMNH 44150, ×1.5, AMNH Loc. 3152. ... 9

5–12. *Dalejina* cf. *alsa* (Hall, 1863). ... 9

5–6. Brachial exterior, interior, AMNH 44151, ×3.5.

7. Pedicle exterior, AMNH 44152, ×2.

8–11. Pedicle, brachial exterior, anterior, posterior, AMNH 44153, ×1.5.

12. Detail of ornament AMNH 44154, ×2 (all specimens from AMNH Loc. 3152).

13–15. *Discomyorthis*? sp. ... 10

13–14. Brachial valve exterior, pedicle valve exterior, AMNH 44155, ×1.5.

15. Pedicle interior with large flabellate(?) muscle field, AMNH 44156, ×2 (both from AMNH Loc. 3152).

16–25. *Schizophoria* cf. *multistriata* (Hall, 1859–1861). ... 10

16–18. Pedicle, brachial exterior, posterior, AMNH 44157, ×1.75, AMNH Loc. 3152.

19–22. Pedicle, brachial exterior, anterior, posterior, AMNH 44158, ×3, AMNH Loc. 3152.

23. Pedicle interior, AMNH 44159, ×2.5, AMNH Loc. 3152.

24. Pedicle interior, AMNH 44160, ×2.5, AMNH Loc. 3153.

25. Brachial interior, AMNH 44161, ×4.5, AMNH Loc. 3152.

26–29. *Pentamerella arata* (Conrad, 1841). ... 12

26–29. Pedicle, brachial exterior, posterior, anterior, AMNH 44162, ×2, AMNH Loc. 3152.


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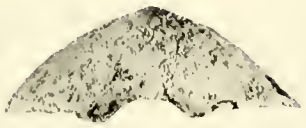
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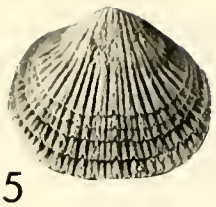
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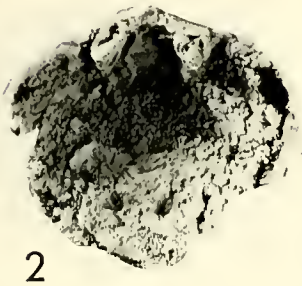
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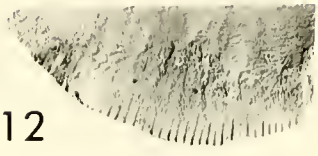
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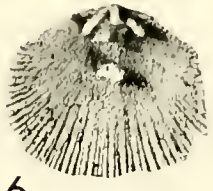
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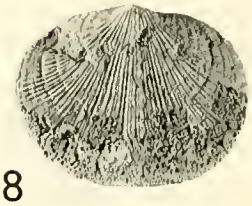
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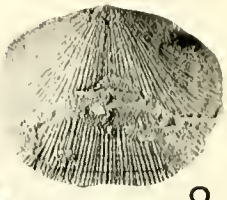
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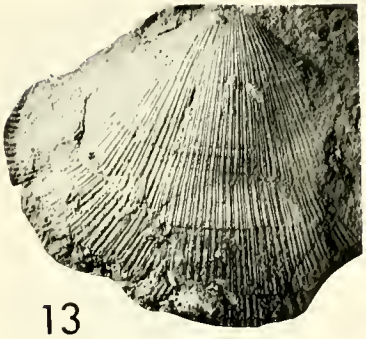
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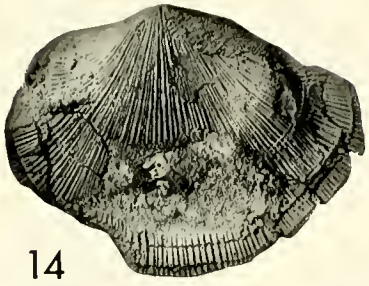
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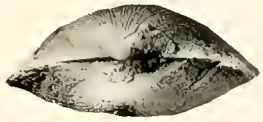
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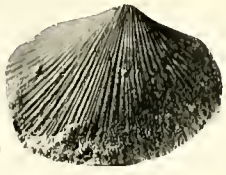
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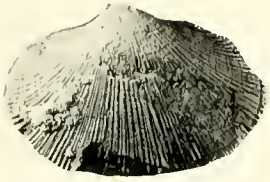
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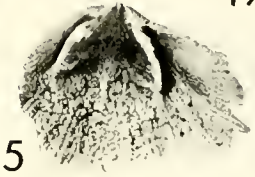
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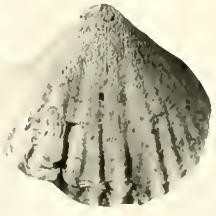
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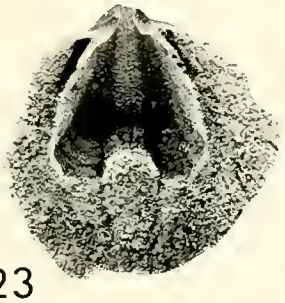
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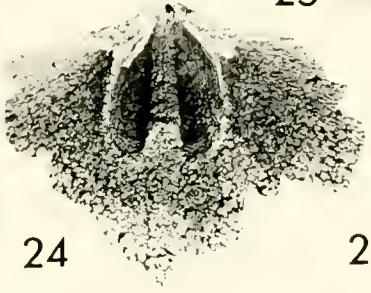
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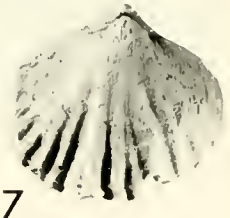
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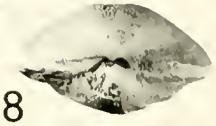
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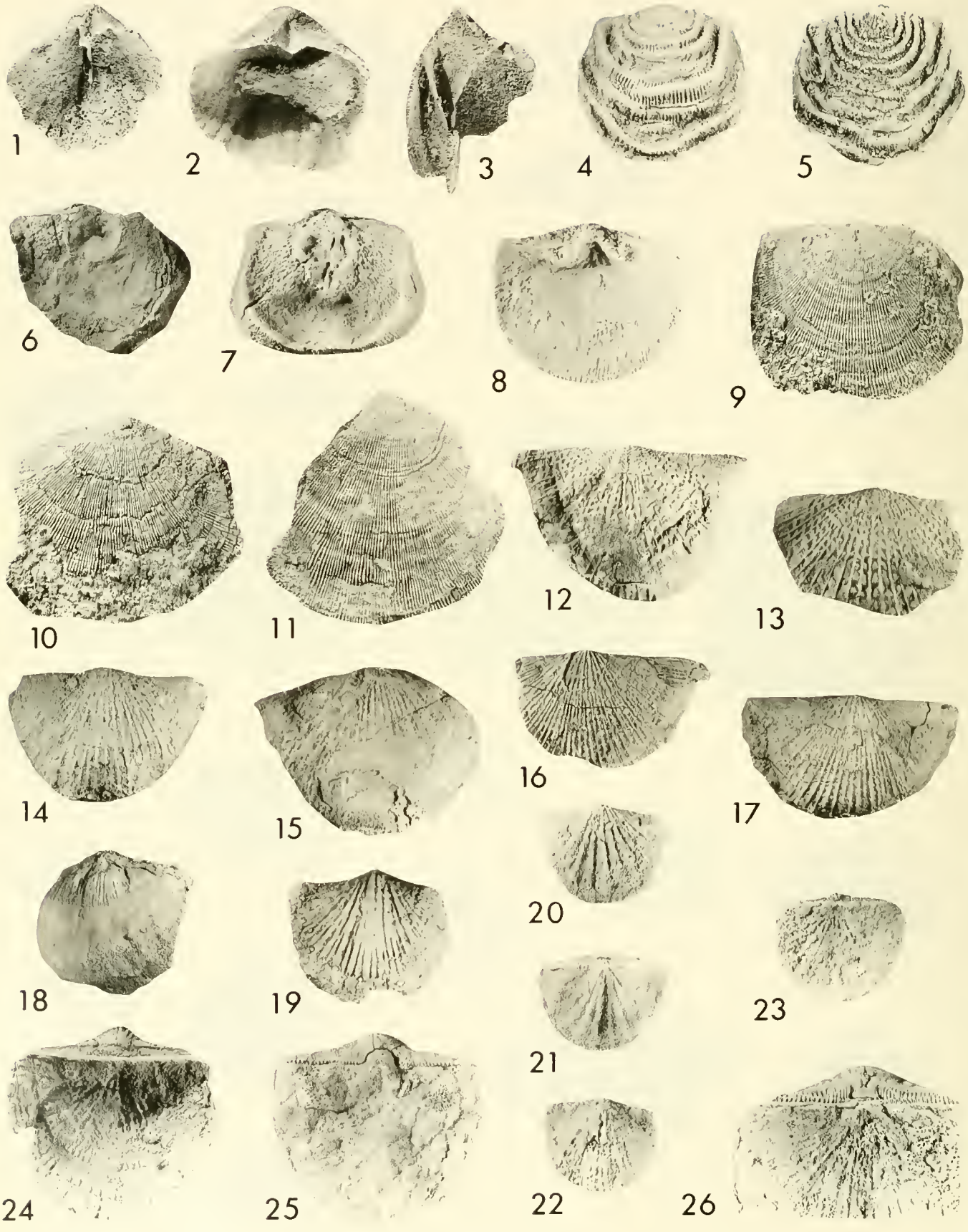
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EXPLANATION OF PLATE 2

EXPLANATION OF PLATE 3


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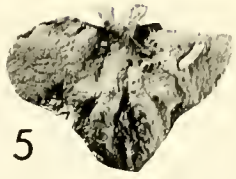
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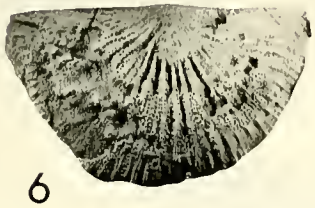
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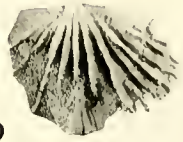
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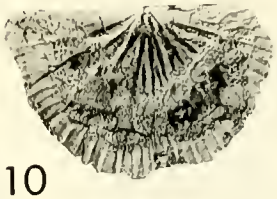
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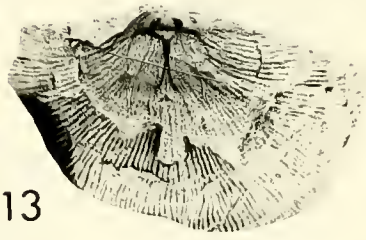
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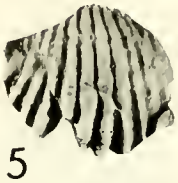
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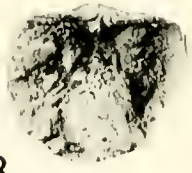
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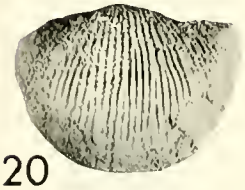
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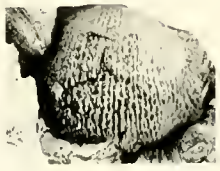
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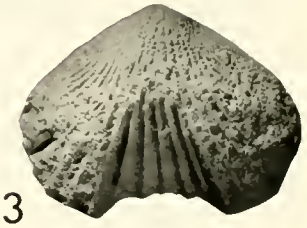
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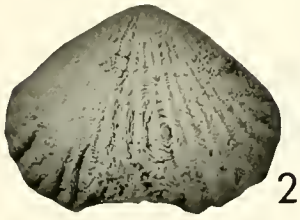
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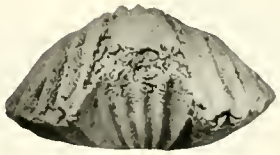
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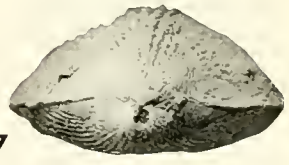
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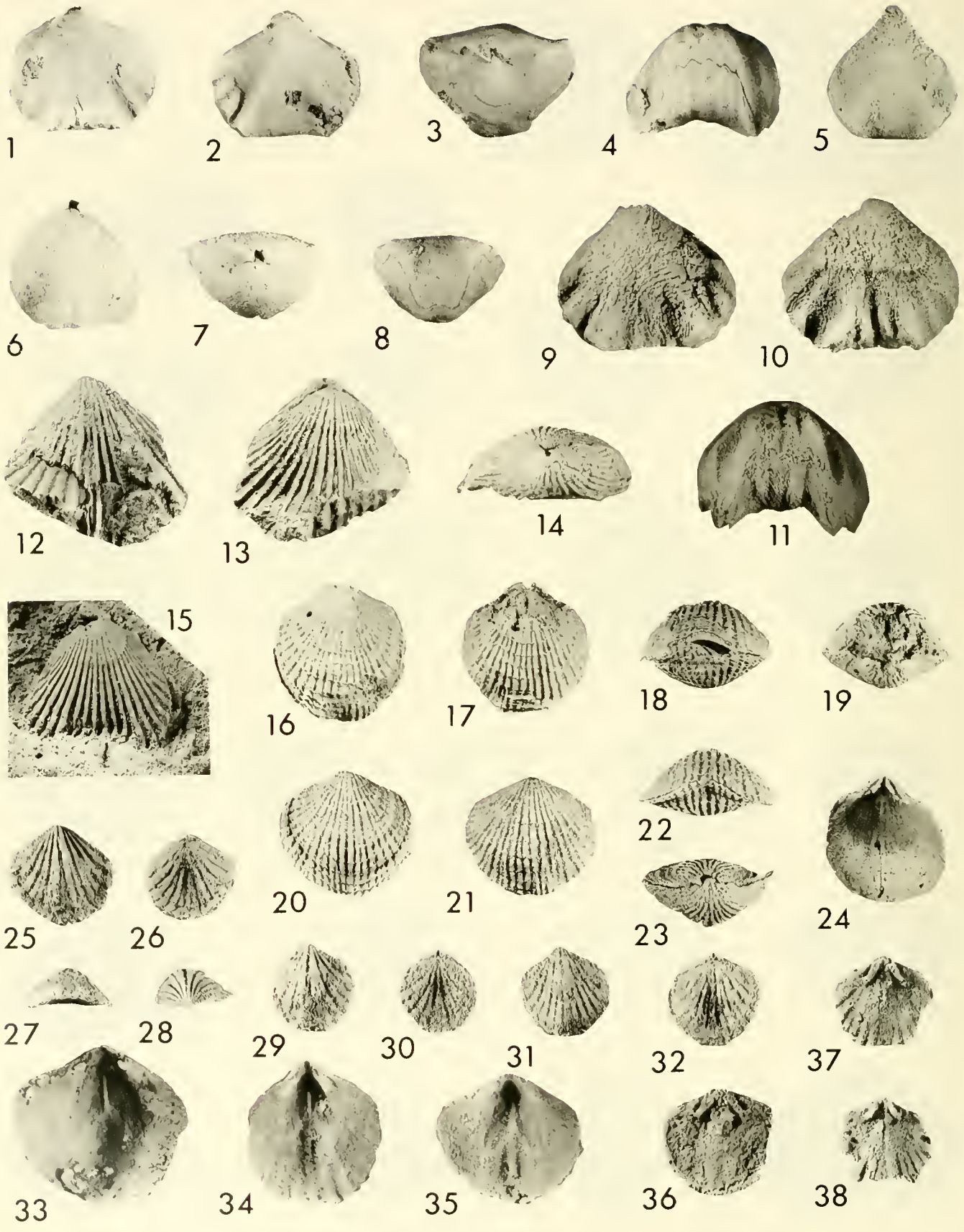
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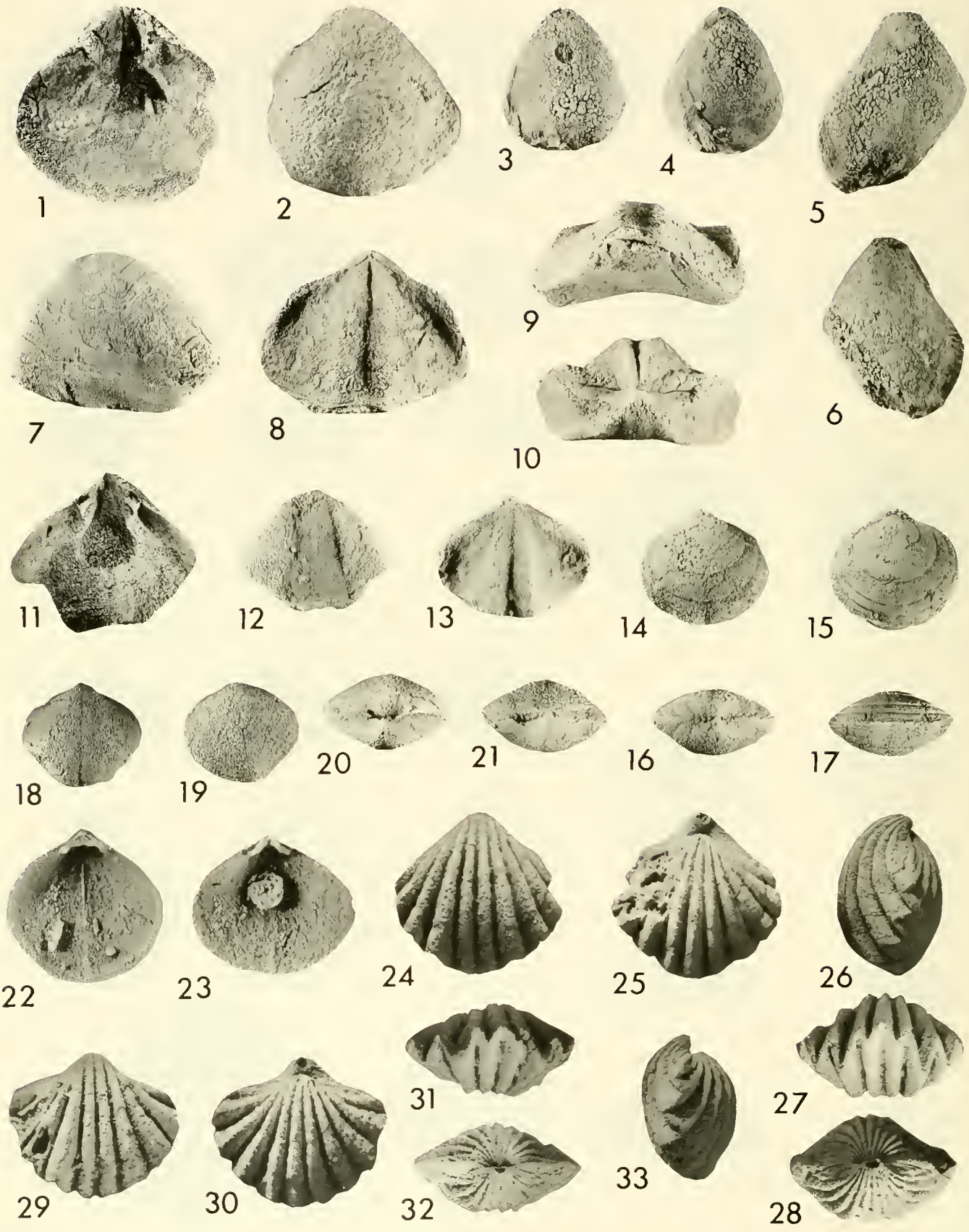
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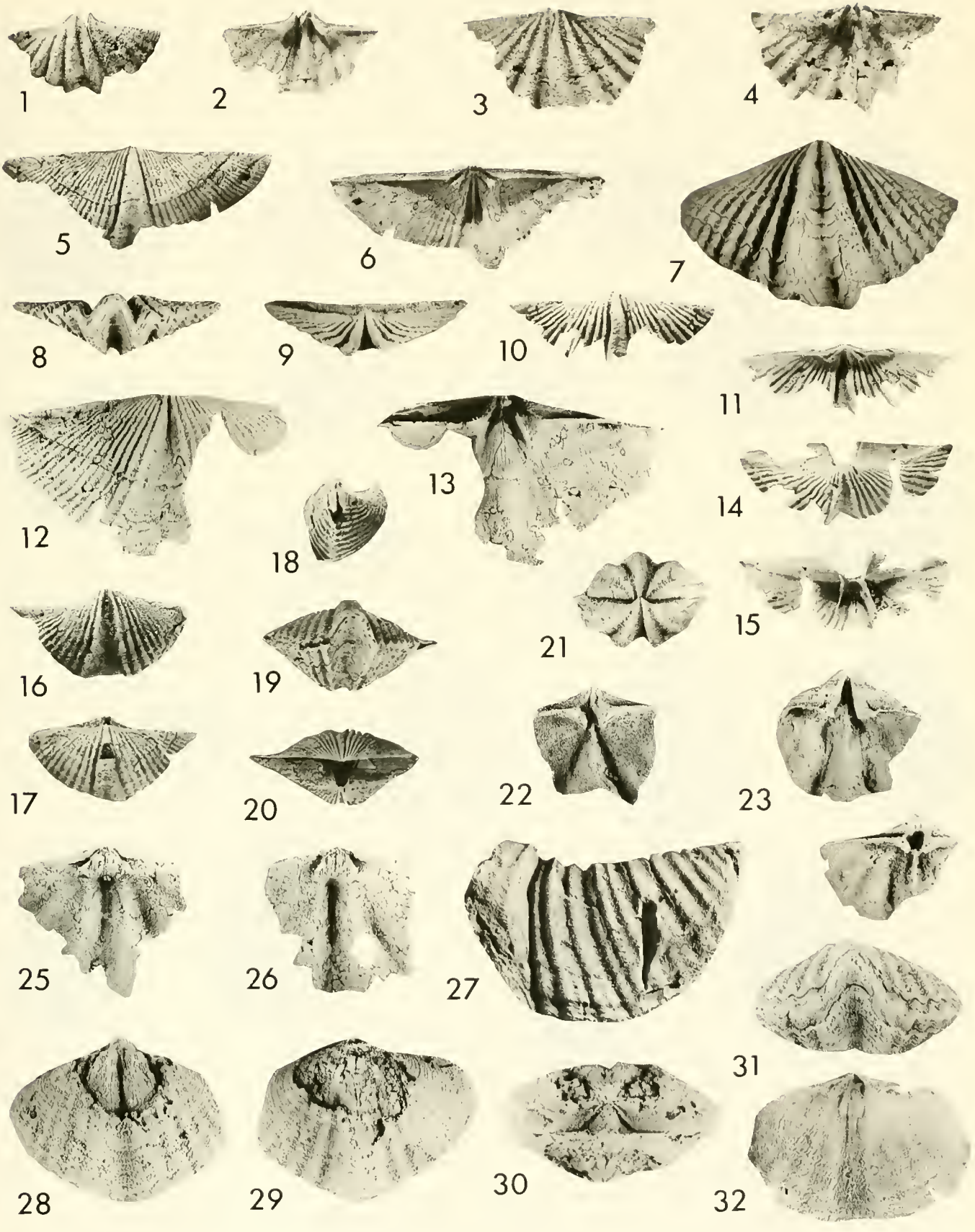
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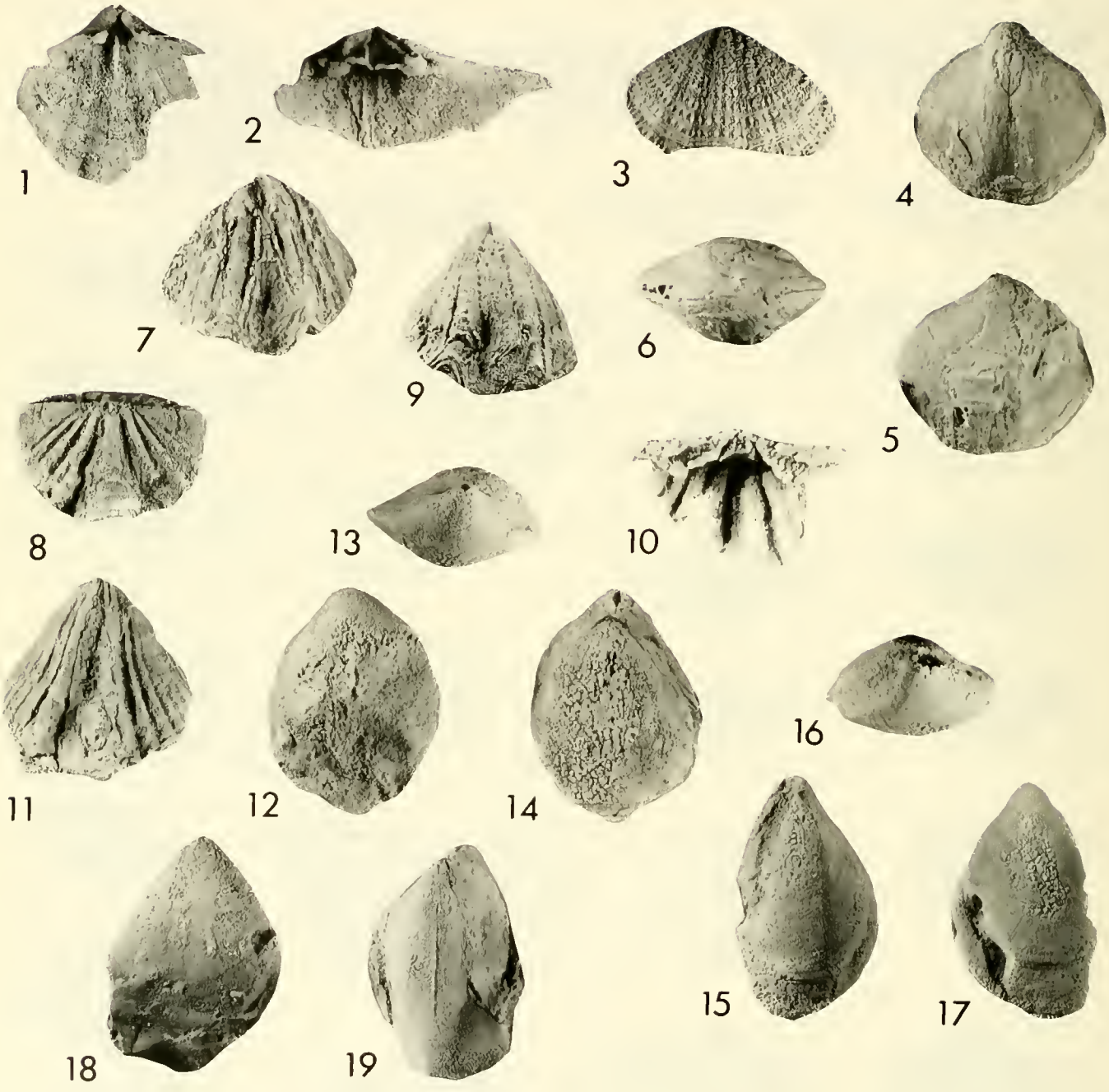
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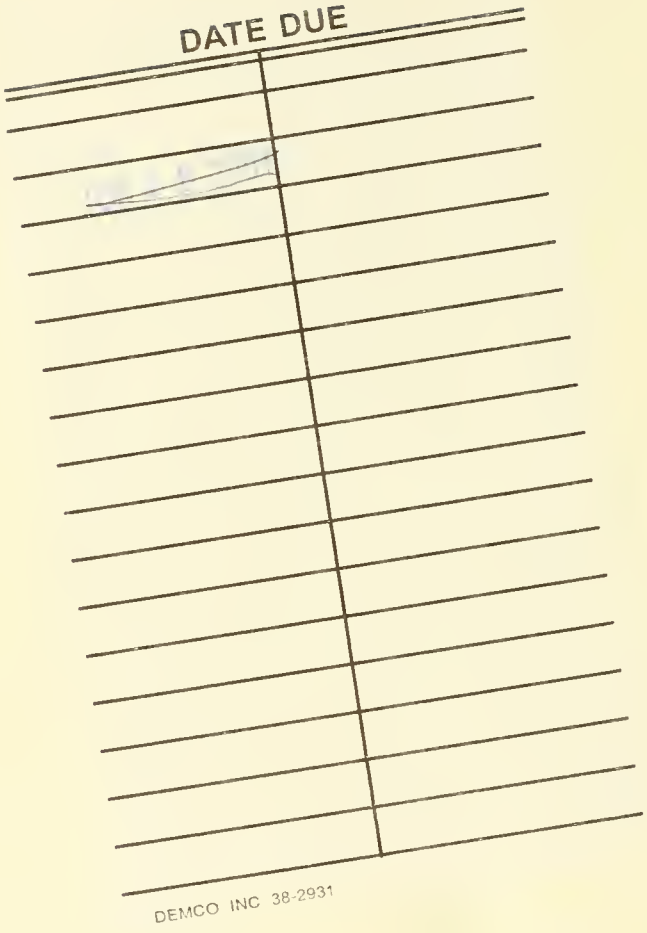
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