

THE UNIVERSITY OF KANSAS
PALEONTOLOGICAL CONTRIBUTIONS

March 15, 2000

Number 12

TYPE SPECIMENS OF ATHYRIDID BRACHIOPODS
FROM THE JAMES HALL COLLECTION

Fernando Alvarez and Covadonga Brime

Departamento de Geología, Universidad de Oviedo, Oviedo 33005, Spain, fernando@asturias.geol.uniovi.es and
brime@asturias.geol.uniovi.es

Abstract.—Type specimens of 14 Lower Paleozoic athyridid species from the James Hall collection are selected or recognized, photographically illustrated, and briefly described and discussed. These include the lectotypes of the type species for the genera *Charionella* Billings, 1861 (*Atrypa scitula* Hall, 1843); *Charionoides* Boucot, Johnson, and Staton, 1964 (*Meristella doris* Hall, 1860); *Meristina* Hall, 1867 (*Meristella maria* Hall, 1863a); *Whitfieldella* Hall and Clarke, 1893 (*Atrypa nitida* Hall, 1843); *Camarium* Hall, 1859a (*C. typum* Hall, 1859a); *Camarospira* Hall and Clarke, 1893 (*Camarophoria eucharis* Hall, 1867); *Nucleospira* Hall in Davidson, 1858 (*Spirifer ventricosus* Hall, 1857a); *Rhynchospirina* Schuchert and LeVene, 1929 (*Waldheimia formosa* Hall, 1857a); *Homoospira* Hall and Clarke, 1893 (*Rhynchospirina evax* Hall, 1863a); *Leptospira* Boucot, Johnson, and Staton, 1964 (*Trematospira costata* Hall, 1859a); *Trematospira* Hall, 1859a (*Spirifer multistriatus* Hall, 1857a); and *Parazyga* Hall and Clarke, 1893 (*Atrypa hirsuta* Hall, 1857a) and the neotypes of the type species for the genera *Meristella* Hall, 1859a (*Atrypa laevis* Vanuxem, 1842) and *Hyattidina* Schuchert, 1913 (*Atrypa congesta* Conrad, 1842). Synonymies and emended diagnoses are also suggested for these type species.

INTRODUCTION

In the process of reviewing athyridid brachiopod genera and their contained species for the forthcoming revision of the 1965 brachiopod *Treatise on Invertebrate Paleontology* (Moore, ed., 1965), we encountered the problem that for many of the type species there was no evidence of type designation (see, e.g., Alvarez, 1976, 1990; Brunton, 1980, 1984; Modzalevskaia, 1994; Alvarez, Brunton, and Struve, 1996). To eliminate ambiguities and prevent future uncertainties, we tracked down many individual specimens and collections that were previously missing or presumed to be irretrievably lost, including material in private collections (e.g., Alvarez, Brunton, and Struve, 1996). As a result of our soliciting information from many institutions while revising the athyridids, a number of students and curators kindly commented on the status and availability of unpublished draft catalogues or on work in progress in

identifying type, figured, and cited specimens, which help is here warmly acknowledged.

James Hall, director of the New York State Museum from 1866 until his death at 86 in 1898, was one of the most productive paleontologists of the 19th century. He is acknowledged as the father of American paleontology, leaving the *Palaeontology of New York* as his monument. As Fakundiny and Yochelson wrote (1987, p. 2), "he—James Hall—would do almost anything to obtain fossils and the priority of authorship in naming forms new to science," although financial problems forced Hall to negotiate with the Museum of Comparative Zoology and with the American Museum of Natural History to sell part of his own fossil collection (see, e.g., Merrill, 1920; Clarke, 1921; Fisher, 1978; Aldrich and Leviton, 1987; Batten, 1987; Yochelson, 1987). Perhaps due to this early splitting of Hall's collections and the scarce information available on the repositories, few of the type species described here have been

refigured since their original publication (see Blum, 1987; Linsley, 1994). The new figures herein are in most instances the first photographic illustrations to be presented. This is very important as James Hall's illustrations passed through the hands of an illustrator, who frequently tried to provide an artistic, bilaterally symmetrical drawing of the specimen, sometimes indulging in a little cosmetic reconstruction or in careful assembly of broken parts, and either an engraver or a lithographer before it reached the scientific audience that would test and judge it (see full discussion by Blum, 1987; Linsley, 1994). As Linsley (1994, p. 7) wrote, "a drawing is an interpretation, however, and if incorrectly done can be misleading." We hope this selection and illustration of the types, together with the discussions and emended diagnoses provided, will facilitate subsequent recognition of the name-bearing types and avoid ambiguities when referring to such widely used names as *Meristina*, *Meristella*, and *Nucleospira* or when proposing new taxa.

SYSTEMATIC PALEONTOLOGY

Herein we follow the Alvarez, Rong, and Boucot (1998) subdivision for the order Athyridida into suborders, superfamilies, families, and subfamilies. Illustrated material is housed in the Paleontological Collections of the New York State Geological Survey, Albany, with specimen numbers prefixed I, and in the American Museum of Natural History, New York, with specimen numbers prefixed AMNH.

Order ATHYRIDIDA Boucot, Johnson, and Staton, 1964

Suborder ATHYRIDIDINA

Boucot, Johnson, and Staton, 1964

Superfamily MERISTELLOIDEA Waagen, 1883

Family MERISTELLIDAE Waagen, 1883

Subfamily MERISTELLINAE Waagen, 1883

Genus MERISTELLA Hall, 1859

Type species.—*Atrypa laevis* Vanuxem, 1842, p. 120; SD Miller, 1889, p. 354.

Diagnosis.—Meristellinae commonly large, with subequally biconvex shells; short, obsolescent dental plates; ventral muscle field deeply impressed, longitudinally striated; broad and shallow supported septalium; septum extending anteriorly to about midvalve length; acute jugal arch projecting as long stem, moderately inclined posteriorly, bifurcating into accessory jugal lamellae reuniting with stem.

Occurrence.—*Meristella* is a cosmopolitan genus in Devonian rocks (Lochkovian–Eifelian).

Discussion.—The name *Meristella* was first used by Hall (1859a) in a footnote on page 78 in the *12th Annual Report of the Regents of the University of the State of New York*. *Atrypa naviformis* Hall, 1843 was the only species named with reference to *Meristella* and was therefore its type species by monotypy. Although Davidson (1882) listed *M.*

arcuata as type species of *Meristella* (see also Schuchert, 1897), most authors (e.g., Hall and Clarke, 1893; Havlíček, 1956; Boucot, Johnson, and Staton, 1965; Savage, 1971; Nikiforova, Modzalevskaia, and Bassett, 1985) followed Miller (1889) who, ignoring Davidson's paper, gave *Atrypa laevis* Vanuxem, 1842 as the type species of *Meristella*. To maintain the widely accepted concept of *Meristella*, Alvarez (1996a) proposed and the Commission accepted (ICZN, 1998a, p. 131) the designation of *Atrypa laevis* Vanuxem, 1842 (p. 120) as the type of the nominal genus *Meristella* Hall, 1859a by subsequent designation by Miller (1889, p. 354).

MERISTELLA LAEVIS (Vanuxem, 1842)

Figure 1.1–1.5

Atrypa laevis Vanuxem, 1842, p. 120, fig. 26.2.

Merista laevis (Vanuxem, 1842); Hall, 1857a, p. 94, fig. 3–4 and unnumbered; Hall, 1859b, p. 247; Hall, 1861, pl. 39.

Meristella princeps (Hall, 1857a); Hall, 1860, p. 93, fig. 7; Hall, 1862, p. 180, fig. 7.

Meristella laevis (Vanuxem, 1842); Miller, 1889, p. 354; Hall and Clarke, 1893, pl. 43, 3–6; Linsley, 1994, pl. 38.

Diagnosis.—Large, strongly convex shells, dorsal valve equally or less convex than ventral, longer than wide; ventral beak strongly incurved at maturity, frequently concealing foramen, with delthyrium commonly obscured by beak of dorsal valve; deltidial plates sometimes exposed in early growth stages; with or without dorsal fold and ventral sulcus that may affect only anterior commissure; ventral muscle field flaring widely anterolaterally; bulbous pedicle callist with short constriction anteriorly commonly present.

Neotype.—*Atrypa laevis*, as Hall (1859b, p. 247) wrote, "was founded by Mr. Vanuxem upon specimens from the compact portion of the shaly limestone of Herkimer County, which usually have a more gibbous form than those of the Helderberg mountains." The first illustration of *Atrypa laevis* is that of Vanuxem (1842, p. 120, fig. 26.2). This specimen came from the Catskill Shaly Limestone. Vanuxem (1842, p. 121) specified that "No. 2. the Smooth atrypa, (*A. laevis*), is in great abundance, especially in Herkimer County; and it appears to be numerous at Oriskany falls, just under the Oriskany sandstone, which covers that part of the rock containing them. . . . The Smooth atrypa, throughout the range of the Oriskany sandstone, was seen only in a loose mass in Otsego County." Unfortunately, and perhaps due to having only drawings and not photographs as reference, none of the Vanuxem specimens inherited by Hall can be recognized as the one figured by Vanuxem. The well-preserved adult specimen figured by Hall (1861, pl. 39, 3.1–n; see also, Hall, 1857a, p. 94, fig. 3–4 and unnumbered; 1857b, p. 54, p. 94, fig. 3–4 and unnumbered; 1860, p. 93, fig. 7; 1862, p. 180, fig. 7; Hall and Clarke, 1893, pl. 43, 3–6) from the Lower Helderberg group (shaly limestone), Albany County, New York, which is almost identical in dimensions and very



Figure 1.1–5, *Meristella laevis* (Vanuxem, 1842); dorsal, ventral, lateral, anterior, and posterior views of neotype, Albany County, New York, AMNH 33581, $\times 1.5$; 6–10, *Charionella scitula* (Hall, 1843); dorsal, ventral, lateral, anterior, and posterior views of lectotype, Williamsville, Erie County, New York, I1215, $\times 1.5$; 11–15, *Charionoides doris* (Hall, 1860); dorsal, ventral, lateral, anterior, and posterior views of lectotype, Williamsville, Erie County, New York, AMNH 3071B, $\times 1.5$; 16–20, *Meristina maria* (Hall, 1863a), dorsal, ventral, lateral, anterior, and posterior views of lectotype, Waldron, Indiana, AMNH 36616, $\times 1.5$ (new).

similar in external morphology to that of Vanuxem, is here selected as neotype (see Art. 75 of the ICZN, 1999) of *Atrypa laevis* Vanuxem, 1842 and figured for the first time photographically in Figure 1.1–1.5 (AMNH 33581). Recently, Linsley (1994, pl. 38, 1–31) used the same drawings

of Hall (1861) and Hall and Clarke (1893) to illustrate different specimens of *Meristella laevis* and indicated a stratigraphic range for the species in the Devonian of New York, from Coeymans-Deansboro to Alsen-Port Ewen stratigraphic units, Helderberg Group (Lower Devonian).

Genus CHARIONELLA Billings, 1861

Type species.—*Atrypa scitula* Hall, 1843, p. 171.

Diagnosis.—Externally and internally similar to *Meristella*, but having a sessile septalium.

Occurrence.—Linsley (1994) indicated a stratigraphic range for *Charionella scitula* in the Devonian of New York, from Edgecliff to Nedrow-Morehouse stratigraphic units, Onondaga Formation, Middle Devonian, although he considered the possibility of extending its range into the Lower Devonian. *Charionella* was recorded from the Lower Devonian (lower Emsian) to Upper Devonian (lower Frasnian) in eastern North America.

CHARIONELLA SCITULA (Hall, 1843)

Figure 1.6–1.10

Atrypa scitula Hall, 1843, p. 171, fig. 67.1, and table 35, 1. *Meristella scitula* (Hall, 1843); Hall, 1867, p. 302, pl. 47, 34–38.

Charionella scitula (Hall, 1843); Hall and Clarke, 1893, p. 79, pl. 42, 19; Boucot, Johnson, and Staton, 1965, p. 656, and fig. 533, 3c; Linsley, 1994, pl. 91, 18–19.

Diagnosis.—As for the genus.

Lectotype.—The first illustration of *Charionella scitula* was that of Hall (1843, p. 171, fig. 67.1, and table 35, 1, as *Atrypa scitula*). He illustrated the dorsal and lateral views of a small meristelloid specimen, from Williamsville, Erie County, of elongate oval outline, fine concentric ornamentation, imperceptible fold and sulcus, and rather prominent dorsal beak. In 1867 Hall published more distinctive drawings of a medium-sized specimen of *Charionella scitula* (pl. 47, 34–35, as *Meristella scitula*; see also, Linsley, 1994, pl. 91, 18–19). Hall (1867, p. 303) affirmed that this species occurs in the “Corniferous limestone at Williamsville and Clarence-hollow, Erie County, N.Y.” This specimen, housed in the New York State Geological Survey, Albany, is here recognized as lectotype and photographically illustrated in Figure 1.6–1.10 (I1215).

Genus CHARIONOIDES

Boucot, Johnson, and Staton, 1964

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

Diagnosis.—Meristelline similar to *Meristella* but with ventral beak only slightly incurved; internally ventral valve with short dental plates, and muscle field less strongly impressed than in *Meristella*; in dorsal valve septalium longer than in the related genus *Charionella*, being sessile posteriorly but elevated on a short median septum anteriorly; spiralium and jugum unknown.

Occurrence.—Linsley (1994) indicated a stratigraphic range for *Charionoides doris*, in the Devonian of New York, from Schoharie (Tristates Group, Lower Devonian) to Seneca Member of Onondaga Formation, Middle Devonian (considering the possibility of extending farther down into the Lower Devonian). In the literature, *Charionoides* is said

to range from Lower Devonian (Emsian) to Middle Devonian (Eifelian) rocks of eastern North America.

CHARIONOIDES DORIS (Hall, 1860)

Figure 1.11–1.15

Meristella doris Hall, 1860, p. 84; Hall, 1867, p. 302, and pl. 50, 1–12.

Merista doris (Hall, 1860); Hall, 1862, p. 189.

Charionoides doris (Hall, 1860); Boucot, Johnson, and Staton, 1965, p. 656; Linsley, 1994, pl. 91, 1–9.

Diagnosis.—As for genus.

Lectotype.—Hall (1860, p. 84) described but did not illustrate a new meristelloid species under the name *Meristella doris*. In 1862 (p. 189–190) Hall gave the same description, now under the name “*Merista doris* (n. s.),” but, again, without providing any illustration. It was not until 1867 that Hall provided the first illustrations of *Charionoides doris* (as *Meristella doris*; 1867, pl. 50, 1–12). Of the specimens figured by Hall (see also Linsley, 1994), only one small specimen came from the Schoharie Grit in Schoharie County (1867, pl. 50, 1) and is figured only in dorsal view. All others came from “some loose masses of the upper part of the Corniferous limestone near Williamsville (south of Young’s farm), Erie County” (Hall, 1860, p. 85; 1867, p. 304, and text for pl. 50). One of these, the specimen “of medium size and perfect form” figured by Hall (1867, text for pl. 50, 5–6) is here selected as lectotype of *Charionoides doris* and photographically illustrated in Figure 1.11–1.15 (AMNH 3071B). It also fits well with the description of the species provided by Hall (1867, p. 303–304): “This shell is usually readily distinguished from the other species of the Upper Helderberg and Hamilton groups by its elongate form, which is compressed and laterally expanded towards the front; by the remarkable arcuation of the ventral valve, and the strong angular lateral ridge which extends from a little above the middle to the apex, nearly in the same curve as the junction of the valves in their anterior half.”

Genus MERISTINA Hall, 1867

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

Diagnosis.—External and internally similar to *Meristella* but commonly with well-developed dental plates extending anteriorly as ridges, subparallel or slightly divergent, bounding a narrow, deep, and longitudinally striate muscle field; narrow and deep supported septalium, and jugal stem bifurcating into two short arms at its posteroventral end.

Occurrence.—*Meristina* is a widespread genus, typical of the Silurian of Eurasia and North America.

Discussion.—Designation of type species is usually credited to Hall (1867) by original designation. When *Meristina* was established by Hall (1867, p. 299), however, no nominal species was explicitly designated as type species, and as there are two species, *M. maria* and *M. nitida*, included within the genus, there is no type by indication (type by

monotypy, ICZN, 1999, Art. 68.3). According to Article 69.1, it is Dall (1877, p. 49) who should be given the credit for the subsequent designation of *M. maria* as type species for *Meristina*.

MERISTINA MARIA (Hall, 1863)

Figure 1.16–1.20

Meristella maria Hall, 1863a, p. 212 (and booklet, p. 18).

Meristina maria (Hall, 1863a); Hall, 1879, p. 159 and pl. 25, 9–10, 12; Hall, 1882, p. 299 and pl. 25, 9–10; Hall and Clarke, 1893, pl. 41, 2–3; Hall and Clarke, 1894, pl. 33, 1–2; Boucot, Johnson, and Staton, 1965, fig. 533, 4a–c; Alvarez, Rong, and Boucot, 1998, p. 830, fig. 1.3.

Whitfieldia maria (Hall, 1863a); Beecher and Clarke, 1889, p. 73, and pl. 7, 3, 3a.

Diagnosis.—Large, strongly convex shells, dorsal and ventral valve equally convex, subpentagonal, longer than wide; delthyrium obscured by beak of dorsal valve; dorsal fold and ventral sulcus more clearly developed anteriorly; few, but strong growth lines; ventral muscle field laterally bounded by long dental plates.

Lectotype.—When Hall erected and described *M. maria* as a new species of the genus *Meristella*, he did not illustrate the species (Hall, 1863a, p. 212; see also booklet, p. 18). Subsequently, at the time that this author established the genus *Meristina*, he illustrated only the brachio-jugal system of *Meristina maria* but not the exterior of the shell (Hall, 1867, p. 299). The first illustrations of the species appeared in the *28th Annual Report* (Hall, 1879). On plate 25, Hall illustrated the dorsal view of a young specimen (fig. 8); the anterior view of a specimen with the median fold poorly developed (fig. 11); and the dorsal, anterior, and lateral views of a large mature specimen (fig. 9–10, 12, respectively). Hall and Clarke (1893, pl. 41, 2–3; 1894, pl. 33, 1–2) and Boucot, Johnson, and Staton (1965, fig. 533, 4a, b) used figures of this last specimen, prepared by G. B. Simpson (Philip Ast lithograph), to illustrate *M. maria*. This specimen, from the upper Silurian of Waldron (Indiana), which fits well with Hall's description (e.g., Hall, 1863a; Hall and Clarke, 1893), is here selected as lectotype for *Meristina maria* (Hall, 1863a) and is photographically figured for the first time in Figure 1.16–1.20 (AMNH 36616).

Subfamily WHITFIELDELLINAE

Alvarez, Rong, and Boucot, 1998

Genus WHITFIELDELLA Hall and Clarke, 1893

Type species.—*Atrypa nitida* Hall, 1843, p. 11, table 14, fig. 5 (note that the figure on page 12 is erroneously numbered as 13 when it should be 14; see Hall figure explanations).

Diagnosis.—Small to medium meristellid, with dental plates short and dorsally convergent; ventral muscle field weakly impressed, lacking longitudinal striations; septalium shallow, short, partially covered, supported by high, short

median septum; lateral branches of jugum originate at approximately midlength of dorsal valve, vertical or projecting backward at high angle; jugal stem possibly thick and spiny.

Occurrence.—*Whitfieldella* is cited as occurring in the Upper Ordovician (Ashgill) in south-central USA and Asia (Tadzhikistan; southwestern China, Guizhou) and from the Silurian of North America, Europe, and Siberia.

WHITFIELDELLA NITIDA (Hall, 1843)

Figure 2.1–2.8

Atrypa nitida Hall, 1843, table 14, fig. 5; Hall, 1852, p. 268, and pl. 55, 1.

Meristina nitida (Hall, 1843); Hall, 1879, p. 160, and pl. 25, 1–7; Hall, 1882, p. 300, and pl. 25, 1–7; Beecher and Clarke, 1889, p. 70, and pl. 7, 6–10.

Whitfieldella nitida (Hall, 1843); Hall and Clarke, 1893, pl. 40, 4–13; Hall and Clarke, 1894, pl. 32, 1–5.

Diagnosis.—Biconvex, elongate trigonal to subpentagonal shells, longer than wide; ventral umbo moderately curved; with or without faint sulcus on both valves.

Lectotype.—Hall, when erecting *A. nitida* as a new species of *Atrypa*, showed the ventral, lateral, and dorsal views of a small specimen from Lockport, the type locality, but no type was specified (Hall, 1843, table 14, fig. 5 [Note that the figure on page 12 is erroneously numbered as 13 when it should be 14; see Hall figure explanations]). This figured specimen (see also Hall, 1852, pl. 55, 1e–g) cannot be considered as the holotype (ICZN, 1999, Art. 73.1.2) since the type series includes at least another 51 specimens (see, for example, Hall, 1852, pl. 55, 1a–c, 1h–o), all of which are now housed in the AMNH. This specimen is here selected as the lectotype for *Whitfieldella nitida* (Hall, 1843) and photographically illustrated in Figure 2.1–2.5 (AMNH 31290). All the specimens from the type locality are small and have an elongate, subtriangular outline and an almost straight anterior margin. In contrast, the specimens from Waldron, Indiana, are much larger and have outlines that vary from narrow ovate and ventribiconvex to almost rhomboidal, ovate, and with anterior margin strongly emarginate (e.g., Hall, 1879, p. 160; 1882, p. 300, pl. 25, 1–7). To show this variation in size and shape, besides the lectotype (Fig. 2.1–2.5), an adult specimen from Waldron is also illustrated (Fig. 2.6–2.8). Drawings of this specimen (AMNH 40799) were used by Hall in his articles (Hall, 1879, pl. 25, 3–5; Hall, 1882, pl. 25, 3–5; Hall and Clarke, 1893, pl. 40, 8–9; Hall and Clarke, 1894, pl. 32, 2–3).

Family MERISTIDAE Hall and Clarke, 1893

Subfamily MERISTINAE Hall and Clarke, 1893

Genus CAMARIUM Hall, 1859

Type species.—*Camarium typum* Hall, 1859a, p. 43.

Diagnosis.—Meristine lacking mystrochial plates; accessory jugal lamellae reuniting with lateral branches of jugum.

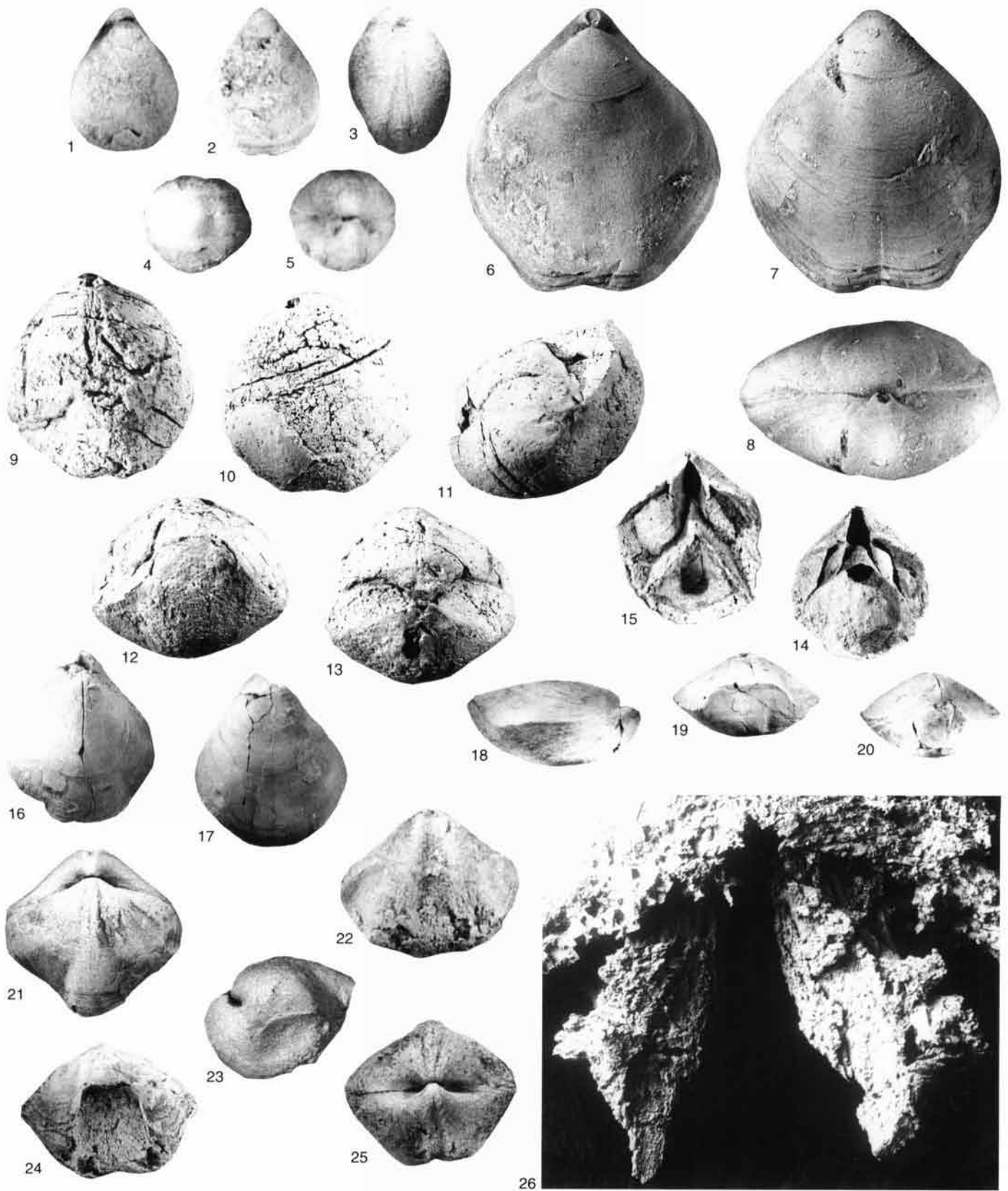


Figure 2.1-8, *Whitfieldella nitida* (Hall, 1843): 1-5, dorsal, ventral, lateral, anterior, and posterior views of lectotype, Lockport, Niagara County, New York, AMNH 31290, $\times 3$; 6-8, dorsal, ventral, and posterior views of specimen, Waldron, Indiana, AMNH 40799, $\times 2$; 9-15, *Camarium typum* Hall, 1859a; 9-13, dorsal, ventral, lateral, anterior, and posterior views of lectotype, Cumberland, Maryland, AMNH 34713, $\times 1.5$; 14-15, interior of two ventral valves with well-developed ventral shoe-lifter, Cumberland, Maryland, I1540 and (Continued on facing page.)

Occurrence.—*C. typum* and closely similar species occur in the Devonian of North America (Maryland, New York), Europe (Germany, Bohemia), and Asia (Gorny Altai) and in the Carboniferous of Australia (NSW; Tournaisian), USA (Texas; lower Mississippian) and the Canadian Arctic Archipelago (Ellesmere Island; late Bashkirian or early Moscovian).

Discussion.—The name *Camarium* was published by Hall (1859a) without designation of a type species, but as one of the originally included new nominal species (ICZN, 1999, Art. 67.2.1) was given the name *C. typum*; that species must be considered as the type species by original designation (ICZN, 1999, Art. 68.2.2; by indication according to 3rd edition, 1985). Soon thereafter, Hall (1860, 1862) admitted that this genus is identical with *Merista* (subjective synonym; see also Boucot, Johnson, and Staton, 1965, p. 658). Later, Amsden (1968) endorsed *Camarium* Hall after discovering that it lacks the mystrochial plates present in *Merista* Sues 1851.

CAMARIUM TYPUM Hall, 1859

Figure 2.9–2.15

Camarium typum Hall, 1859a, p. 43 and fig. 1–6; Hall, 1859b, p. 487; Alvarez, Rong, and Boucot, 1998, fig. 5.

Merista typum (*Camarium typum*) (Hall, 1859a); Hall, 1860, p. 93, fig. 10–13.

Merista (*Camarium*) *typum* (Hall, 1859a); Hall, 1861, pl. 95A, 2–3, 5–6.

Merista typha (Hall, 1843); Hall and Clarke, 1893, p. 72 and pl. 42, 7–12.

Diagnosis.—Biconvex, elongate, or transverse shells of rounded subpentagonal outline, with dorsal fold and ventral sulcus commonly developed anteriorly; dental plates commonly short; shoe-lifter process with form of posteriorly plunging, roof-shaped plate; small septalium supported by high and thin median septum.

Lectotype.—Among the specimens illustrated in the original publication none was specified as type. The “perfect specimen” illustrated by Hall (1859a, p. 43, fig. 5–6; 1860, p. 93, fig. 10–11; 1861, pl. 95A, 2a,b; Hall and Clarke, 1893, pl. 42, 8, 10), from the Lower Helderberg Group at Cumberland (Maryland) is here selected as lectotype (Fig. 2.9–2.13, AMNH 34713). To show the characteristic ventral shoe-lifter we also illustrate the interior of two ventral valves from the same locality (Fig. 2.14–2.15, I1540–I1541) and illustrated by Hall and Clarke in 1893 (pl. 42, 9, 12).

Subfamily CAMAROPHORELLINAE Schuchert, 1929

Genus CAMAROSPIRA Hall and Clarke, 1893

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

Diagnosis.—Moderate-sized, biconvex, elongate shells of rounded subpentagonal outline, with dorsal fold and ventral sulcus commonly developed anteriorly; well-developed dental plates converging to form spondylium duplex that rises slightly on long, low median septum, septalium deeply concave, supported by long, high median septum; jugum unknown.

Occurrence.—Middle Devonian of North America.

Discussion.—The genus *Camarospira* was established with only one species originally included, *Camarospira eucharis*, which must be taken as its type species by monotypy (ICZN, 1999, Art. 68.3).

CAMAROSPIRA EUCHARIS (Hall, 1867)

Figure 2.16–2.20

Camorphoria eucharis Hall, 1867, p. 368 and pl. 57, 40–45.

Camarospira eucharis (Hall, 1867); Hall and Clarke, 1893, p. 82, pl. 50, 46–52 (erroneously numbered as pl. 52 on p. 82); Hall and Clarke, 1894, pl. 33, 20–24; Cooper, 1944, pl. 127, 28–31; Boucot, Johnson, and Staton, 1965, p. 658, and fig. 535, 2a–d; Linsley, 1994, pl. 91, 23–27.

Diagnosis.—As for the genus.

Lectotype.—Hall (1867, pl. 57, 40–44) showed the dorsal, ventral, posterior, and anterior views of a characteristic specimen (see also Hall and Clarke, 1893, pl. 50, 49 [erroneously numbered as pl. 52 on p. 82]; Hall and Clarke, 1894, pl. 33, 21; Cooper, 1944, pl. 127, 28–29, 31; Linsley, 1994, pl. 91, 23–27), from the Corniferous limestone of Canada (Onondaga Formation, Cayuga, Ontario, Canada; Middle Devonian), here selected as lectotype (Fig. 2.16–2.20, I1174).

Superfamily ATHYRIDOIDEA Davidson, 1881

Family HYATTIDINIDAE Sheehan, 1977

Genus HYATTIDINA Schuchert, 1913

Type species.—*Atrypa congesta* Conrad, 1842, p. 265.

Diagnosis.—Moderately to strongly convex and rostrate shell; commonly with ventral sulcus and dorsal fold; numerous, weak growth lines; dental plates thin and short; pedicle supports absent; ventral muscle field impressed, lacking longitudinal striations; cardinal plate thin, flat, triangular, with inner hinge plates separated by narrow fissure; no cardinal process; no dorsal median septum or myophragm; lateral branches of jugum originate before valve midlength, projecting backward and joining in narrow jugal arch; jugal saddle and stem absent.

Occurrence.—*Hyattidina* is found in the Upper Ordovician (?Caradoc, Ashgill) of Europe and in the Silurian of North America and Eurasia.

Figure 2 (Continued from facing page).

I1541 respectively, $\times 3$; 16–20, *Camarospira eucharis* (Hall, 1867), dorsal, ventral, lateral, anterior, and posterior views of lectotype, Cayuga, Ontario, Canada, I1174, $\times 1.5$; 21–26, *Hyattidina congesta* (Conrad, 1842); 21–25, dorsal, ventral, lateral, anterior, and posterior views of neotype, Reynales, Niagara County, New York, AMNH 31132, $\times 2$; 26, SEM photograph of characteristic cardinalia with inner hinge plates separated by fissure, Lockport, Niagara County, New York, I1420, $\times 34$ (new).

HYATTIDINA CONGESTA (Conrad, 1842)

Figure 2.21–2.26

Atrypa congesta Conrad, 1842, p. 265, and pl. 16, 18; Hall, 1843, p. 71, fig. 16, 2, and table 6, fig. 2; Hall, 1852, p. 67, and pl. 23, 1a–n.

Hyattella congesta (Conrad, 1842); Hall and Clarke, 1893, p. 61, and pl. 40, 23–28; Hall and Clarke, 1894, p. 961 [p. 767, and pl. 32, 10–17].

Hyattidina congesta (Conrad, 1842); Cooper, 1944, pl. 127, 1–4; Boucot, Johnson, and Staton, 1965, fig. 535, 1a–d.

Diagnosis.—Shells of pentagonal outline; ventral sulcus and dorsal fold accentuated by bounding furrows; slightly divergent diductor scars enclose linear adductors.

Neotype.—When erecting *Atrypa congesta*, Conrad showed three schematic drawings of the dorsal, lateral, and ventral views of a Silurian specimen from the Clinton Group from Medina, New York (Conrad, 1842, p. 265 and pl. 16, 18). Soon afterward, Hall (1843, p. 71, fig. 16, 2, and table 6, fig. 2) provided two similar drawings of a specimen of *Atrypa congesta* and confirmed that this species was “exceedingly abundant at Medina, and near Reynold’s basin” (Hall, 1843, p. 71). In 1852, Hall provided new and better illustrations of this species (pl. 23, 1a–n), being the specimen figured in plate 23, 1f, g, i, figured again by Hall and Clarke in 1894 (pl. 32, 10–12). Because none of Conrad’s specimens inherited by Hall can be recognized convincingly as the one figured by Conrad, this well-preserved adult specimen, figured by Hall (1852) and Hall and Clarke (1894), which was considered as an average example by Hall himself and is very similar in dimensions and in external morphology to that of Conrad, is here considered as neotype (ICZN, 1999, Art. 75) for *Atrypa congesta* Conrad, 1842, and figured for the first time photographically in Figure 2.21–2.25 (AMNH 31132). Typically, *Hyattidina congesta* has a triangular hinge plate and is divided medially by a deep cleft as was shown by Hall and Clarke (1893, pl. 40, 27–28; 1894, pl. 32, 16–17; see also Cooper, 1944, pl. 127, 4; Boucot, Johnson, and Staton, 1965, fig. 535, 1d). This specimen, from the Clinton Group (early Silurian) at Lockport, New York, is here illustrated (Fig. 2.26, I1420) with a photograph taken with a scanning-electron microscope equipped with an environmental chamber.

Superfamily NUCLEOSPIROIDEA Davidson, 1881**Family NUCLEOSPIRIDAE Davidson, 1881****Genus NUCLEOSPIRA Hall in Davidson, 1858**

Type species.—*Spirifer ventricosus* Hall, 1857a, p. 57.

Diagnosis.—Athyrididines with irregularly and commonly anteriorly concentrated lamellose growth lines and concentrically arranged fine solid spines covering entire shell, which project radially at different angles from valve surface; delthyrium commonly completely covered apically by concave plate; dental plates absent but delthyrial margins commonly thickened; low, long median ridge present in

both valves; strongly developed cardinal flange extending posteroventrally into ventral umbo; simple, acute jugum posteriorly situated, lacking jugal saddle, with long stem, accessory jugal lamellae absent.

Occurrence.—*Nucleospira* is a cosmopolitan genus that ranges from Silurian (Llandovery) to Lower Permian (Sakmarian).

Discussion.—Authorship of the genus *Nucleospira* is usually credited to Hall (1859a, p. 24); however, the first to publish the name was Davidson (1858), who included *Nucleospira* Hall with an existing species, *N. ventricosa* Hall. This is adequate to make the generic name *Nucleospira* available with *N. ventricosa* as type species by monotypy and so under Article 50.1 of the ICZN (1999) authorship of *Nucleospira* is Hall in Davidson, 1858.

NUCLEOSPIRA VENTRICOSA (Hall, 1857)

Figure 3.1–3.5

Spirifer ventricosus Hall, 1857a, p. 57 (text but not figures 1–2; see below); Hall, 1857b, p. 17 (text but not figures 1–2; see below).

Nucleospira ventricosa (Hall, 1857a); Hall, 1859b, p. 220; Hall, 1861, pl. 14, 1a–h; pl. 28B, 2–9; Boucot, Johnson, and Staton, 1965, p. 666, and fig. 541; Linsley, 1994, pl. 41, 1–19.

Diagnosis.—Small, biconvex, subcircular, globose shells; ventral valve with shallow median sulcus forming weakly uniplicate anterior commissure, dorsal valve possibly with poorly developed medial interspace; ventral cardinal area apsacline, obscured by small incurved ventral beak; ventral diductor scars feebly impressed, enclosing elongate adductor scars, restricted to umbonal cavity.

Lectotype.—When erecting *Spirifer ventricosus*, Hall (1857a, p. 57; see also 1857b, p. 17; 1859b, p. 220) described it as having a “globose shell, very small area, concave and surface marked by concentric lines of growth” but showed a posterior and dorsal view of a ribbed spiriferid (1857a, p. 57, fig. 1–2; see also 1857b, p. 17, fig. 1–2) completely different from the specimens illustrated by the same author in the plates for the 3rd volume of the *Palaeontology of New York* (Hall, 1861, pl. 14, 1a–h; pl. 28B, 2–9; see also Linsley, 1994, pl. 41, 1–19). A well-preserved specimen, figured by Hall (1861, pl. 28B, 3c–d) and described by him as “an individual preserving the remains of the fine hair-like spines which cover the surface of perfect specimens” (Hall, 1859b, p. 221; see also Hall, 1861, text of pl. 28B, 3c) is here selected as lectotype of *Nucleospira ventricosa* (Hall, 1857a). This specimen (Fig. 3.1–3.5, AMNH 33416) came from the Lower Helderberg Group of New York (Clarksville, Albany County), the area from which Hall described his species, and agrees with what Hall wrote in his descriptions. Linsley (1994, p. 98) indicated a stratigraphic range for *Nucleospira ventricosa* in the Devonian of New York, from Kalkberg-New Scotland (Lower Helderberg) to Alsen-Port Ewen (Upper Helderberg), Lower Devonian.

Suborder RETZIIDINA**Boucot, Johnson, and Staton, 1964****Superfamily RHYNCHOSPIRINOIDEA Schuchert, 1929****Family RHYNCHOSPIRINIDAE Schuchert, 1929****Genus RHYNCHOSPIRINA****Schuchert and LeVene, 1929***Type species.*—*Waldheimia formosa* Hall, 1857a, p. 88.

Diagnosis.—Subequally biconvex, elongate oval to subpentagonal costate shells, with or without poorly defined fold and sulcus, or shells may be faintly bisulcate; median costae narrower than costae on flanks; deltidial plates conjunct and foramen in meso- to permesothyridid position; short dental plates possibly present; incipient pedicle collar variably developed or absent; cardinal plate trapezoidal, flat cardinal flanges, projecting posterovertrally; hinge plate short, in comparison with long flat outer hinge plates, thick, extending as transverse process between cardinal flanges and supported by short median septum extending anteriorly as low ridge; jugum projecting backward as broad, short, roof-shaped process, lateral branches of jugum vertical.

Occurrence.—Silurian (Wenlock) to Middle Devonian of America and Eurasia where it is also cited in the Upper Devonian of Gorno Altai of Siberia.

RHYNCHOSPIRINA FORMOSA (Hall, 1857)

Figure 3.6–3.11

Waldheimia formosa Hall, 1857a, p. 88; Hall, 1857b, p. 48.*Trematospira formosa* (Hall, 1857a); Hall, 1859b, p. 215; Hall, 1861, pl. 36, 2a–t.*Rhynchospira formosa* (Hall, 1857a); Hall, 1859a, p. 30, fig. 1–6; Hall, 1859b, p. 485; Hall, 1861, pl. 95A, 7–11; Hall, 1863b, p. 58, fig. 12–17; Hall, 1867, p. 278, fig. 1–6; Hall and Clarke, 1893, pl. 50, 21–25; Hall and Clarke, 1894, pl. 36, 8–12.*Rhynchospirina formosa* (Hall, 1857a); Linsley, 1994, pl. 35, 20–39; Alvarez, Rong, and Boucot, 1998, fig. 1.6, 2.6.*Diagnosis.*—Elongate oval costate shells, with poorly defined fold and sulcus; prominent ventral umbo, moderately to strongly curved; growth lines fine, closely spaced.

Lectotype.—“*Waldheimia formosa*,” erected by Hall in 1857a (p. 88), was first figured as “*Trematospira formosa* (n.s.)” (Hall, 1959b, p. 215) by the same author in 1861 (pl. 36, 2a–t) with specimens found in “the shaly limestone of the Lower Helderberg group: Helderberg mountains, Albany County” (Hall, 1859b, p. 216). Of these specimens, the well-preserved adult specimen of “large size and very symmetrical form” (Hall, 1859b, p. 216) illustrated by Hall (1861, pl. 36, 2l–o), which was the only complete specimen illustrated by this author when erecting the genus *Rhynchospira* (Hall, 1859a, p. 30, fig. 1; see also 1863b, p. 58, fig. 12; 1867, p. 278, fig. 1), is here selected as lectotype and photographically illustrated (Fig. 3.6–3.10, AMNH 33399). A disarticulated dorsal valve, housed in Albany

(11859), is also illustrated to show the morphology of the cardinalia, an important character in the classification of the retziidines and of the whole athyridid order. This photograph (Fig. 3.11) was taken with a scanning-electron microscope equipped with an environmental chamber. The cardinal plate (see also Hall and Clarke, 1893, pl. 50, 24; Hall and Clarke, 1894, pl. 36, 11) is trapezoidal, with flat cardinal flanges projecting posterovertrally; the hinge plate is short and thick, in comparison with the long, flat outer hinge plates, extending as a transverse process between the cardinal flanges and supported by a short median septum that extends anteriorly as a low ridge. Linsley (1994) indicated the stratigraphic range for *Rhynchospirina formosa* as Lower Devonian from Manlius to Alsen-Port Ewen Formations (Helderberg Group).

Genus HOMOEOSPIRA Hall and Clarke, 1893*Type species.*—*Rhynchospira evax* Hall, 1863a, p. 213; SD Hall and Clarke, 1894, p. 986.

Diagnosis.—Externally like *Rhynchospirina* but delthyrium may be open or restricted by disjunct or conjunct deltidial plates, showing in this instance a median fold; foramen in submeso- to permesothyridid position; dental plates absent; cardinal flanges poorly developed or absent, hinge plate extremely short, supported by stout median septum extending anteriorly as ridge; long, flat, anteriorly divergent outer hinge plates; acute and simple process extending horizontally backward from jugum; lateral branches of jugum vertical.

Occurrence.—Silurian (Wenlock–Ludlow) of America and Europe where it is also cited in the Lower Devonian (Lochkovian).

Discussion.—Designation of *Rhynchospira evax* as the type species of the genus *Homoeospira* is usually credited to Schuchert (1897, p. 231), although the first unequivocal designation of the type species seems to be that of Hall and Clarke (1894, p. 986).

HOMOEOSPIRA EVAX (Hall, 1863)

Figure 3.12–3.16

Rhynchospira evax Hall, 1863a, p. 213 (and abstract, p. 19).*Retzia evax* (Hall, 1863a); Hall, 1879, p. 160 and pl. 25, 13–21; Hall, 1882, p. 302, pl. 25, 13–21; Beecher and Clarke, 1889, p. 55, and pl. 5, 2, 2a, 3, 3a, 5–8; pl. 8.*Homoeospira evax* (Hall, 1863a); Hall and Clarke, 1893, pl. 50, 15–20; Hall and Clarke, 1894, pl. 36, 13–16; Boucot, Johnson, and Staton, 1965, fig. 532, 3a, b.

Diagnosis.—Subequally biconvex, elongate oval to subpentagonal costate shells with poorly defined fold and sulcus, commonly faintly bisulcate causing an emargination anteriorly; ventral umbo moderately to strongly curved.

Lectotype.—*Rhynchospira evax* was erected by Hall in 1863a (p. 213) and first figured, as *Retzia evax*, in the 28th Annual

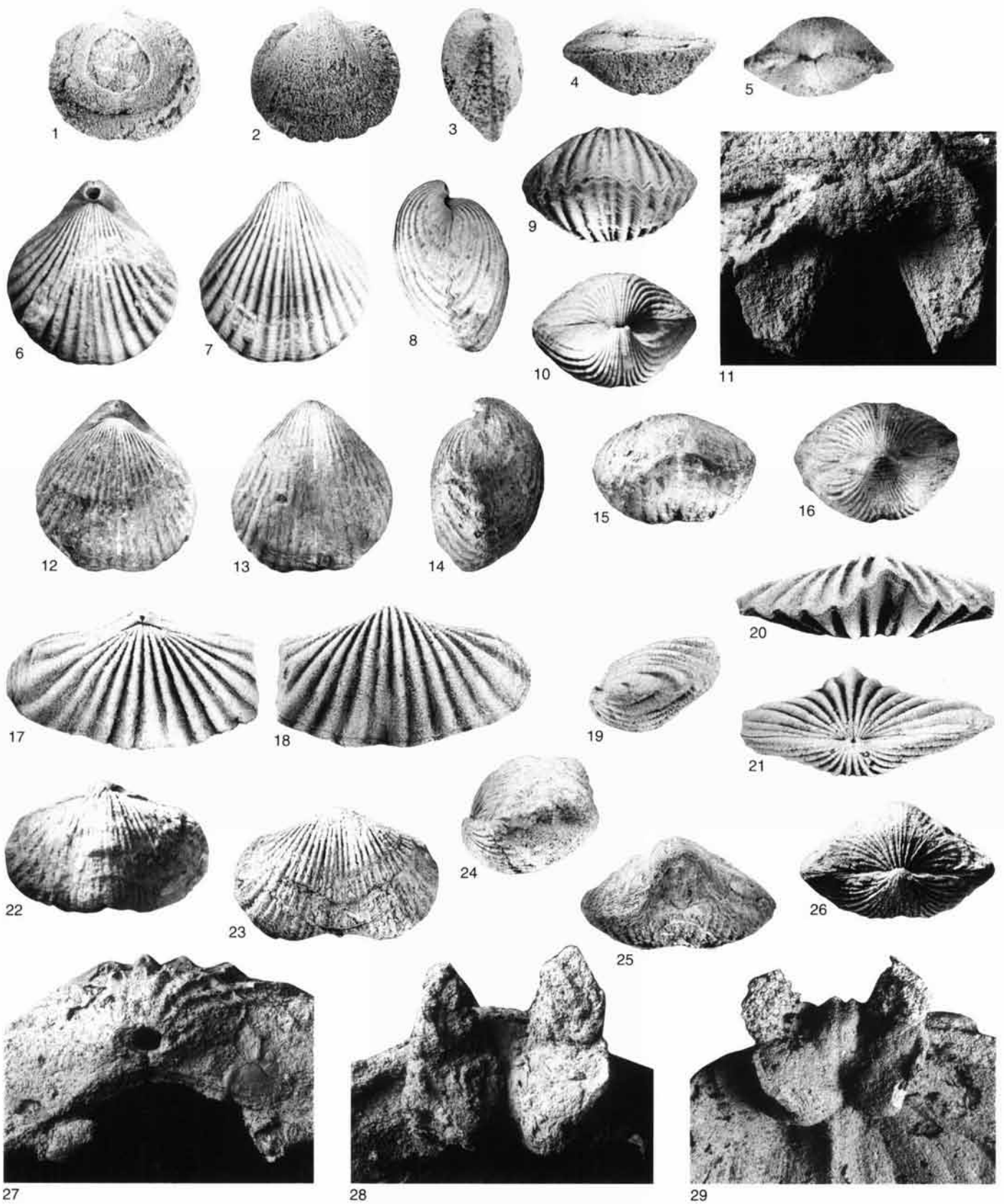


Figure 3. 1-5, *Nucleospira ventricosa* (Hall, 1857a); dorsal, ventral, lateral, anterior, and posterior views of lectotype, Clarksville, Albany County, New York, AMNH 33416, $\times 2.5$; 6-11, *Rhynchospirina formosa* (Hall, 1857a); 6-10, dorsal, ventral, lateral, anterior, and posterior views of lectotype, Clarksville, Albany County, New York, AMNH 33399, $\times 2$; 11, SEM photograph of characteristic (Continued on facing page.)

Report of the New York State Cabinet (Hall, 1879, pl. 25, 13–21). The “full-grown specimen; showing the adult characters of the exterior” (Hall and Clarke, 1893, text of pl. 50, 16–17) for which Hall provided more than one view (Hall, 1879, pl. 25, 14, 18, 20) and which was subsequently repeatedly illustrated as *Retzia evax* (Hall, 1882, pl. 25, 14, 18–20) or *Homoeospira evax* (Hall and Clarke, 1893, pl. 50, 16–17; Hall and Clarke, 1894, pl. 36, 13–14; see also Boucot, Johnson, and Staton, 1965, fig. 532, 3a,b), coming from the Silurian (Niagara Group) at Waldron (Indiana), is here selected as lectotype and photographically illustrated (Fig. 3.12–3.16, AMNH 36619).

Genus LEPTOSPIRA Boucot, Johnson, and Staton, 1964

Type species.—*Trematospira costata* Hall, 1859a, p. 27.

Diagnosis.—Large, subequally biconvex, transverse oval, pauciplicate shells, commonly with dorsal fold and ventral sulcus; costae subangular, approximately of same width in medial regions as on flanks; deltidial plates conjunct; foramen in mesothyridid position; cardinalia like *Rhynchospirina*; spiralia and jugum unknown.

Occurrence.—Lower Devonian (Lochkovian) to Upper Devonian (lower Frasnian) of North America (central and northeastern USA).

Discussion.—*T. costata* was the third of five species and one variety included by Hall (1859a) in his genus *Trematospira*. Although later the species was described as *Trematospira costata* (n.s.) in the third volume of the *Palaeontology of New York* (Hall, 1859b, p. 210), the name *T. costata* was already available when published in the *Twelfth Annual Report of the New York State Cabinet* (Hall, 1859a), because it satisfied the ICZN (1999) requirements of availability for every new scientific name published before 1930; that is, it satisfied the provisions of Article 11 and was accompanied by an indication (Art. 12), an illustration of the taxon being named (Hall, 1859a, p. 28, fig. 1).

LEPTOSPIRA COSTATA (Hall, 1859)

Figure 3.17–3.21

Trematospira costata Hall, 1859a, p. 27–28, fig. 1; Hall, 1859b, p. 210; Hall, 1861, pl. 28A, 4a–e; Hall, 1867, p. 276, fig. 5–6; Hall and Clarke, 1893, pl. 49, 19–20; Cooper, 1944, pl. 141, 29–30.

Leptospira costata (Hall, 1859a); Boucot, Johnson, and Staton, 1965, fig. 531, 5a,b; Linsley, 1994, pl. 35, 43–48.

Diagnosis.—Dorsibiconvex, transversely elliptical, length less than one-half width; plicate; broad, scarcely defined

dorsal fold and better defined, at least anteriorly, ventral sulcus.

Lectotype.—This specimen, with dorsal and anterior views, was figured by Hall (1859a, p. 28, fig. 1; see also 1861, pl. 28A, 4a–d; 1867, p. 276, fig. 5–6), from Clarksville, Albany County, New York, and is here selected as lectotype and photographically illustrated (Fig. 3.17–3.21, AMNH 2461). Linsley (1994, pl. 35, 43–48) used Hall's drawings (1859a, 1861, 1867) and those of Hall and Clarke (1893) to illustrate two different specimens of *Leptospira costata* (see also Boucot, Johnson, and Staton, 1965, fig. 531, 5a,b), and indicated a stratigraphic range for the species in the Devonian of New York, from Kalkberg to New Scotland Formations, Lower Helderberg Group (Lower Devonian).

Genus TREMATOSPIRA Hall, 1859

Type species.—Recently, Alvarez (1996b) proposed and the Commission accepted (ICZN, 1998b, p. 133–134) the designation of *Spirifer multistriatus* Hall, 1857a (p. 59; SD Hall and Clarke, 1893, p. 126) as the type of the genus *Trematospira* Hall, 1859a.

Diagnosis.—Externally resembling *Leptospira* but with more numerous costae, bifurcating anteriorly; short dental plates possibly present; greatly elevated cardinal plate deeply divided by median longitudinal groove, thick cardinal flanges projecting into pedicle cavity; small bilobate process possibly developed between cardinal flanges, supported by short median septum, extending anteriorly as low ridge, frequently obsolete; short, acute, and simple process extending horizontally backward from jugum.

Occurrence.—Lower Devonian (upper Lochkovian–lower Pragian) of North America.

TREMATOSPIRA MULTISTRIATA (Hall, 1857)

Figure 3.22–3.29

Spirifer multistriatus Hall, 1857a, p. 59, fig. 1–6.

Trematospira multistriata (Hall, 1857a); Hall, 1859b, p. 209; Hall, 1861, pl. 24, 3; pl. 28A, 5a–f; Hall and Clarke, 1893, pl. 49, 9–14; Hall and Clarke, 1894, pl. 38, 3–8; Cooper, 1944, pl. 141, 29–30; Boucot, Johnson, and Staton, 1965, fig. 531, 7a–d; Linsley, 1994, pl. 36, 1–24.

Diagnosis.—Dorsibiconvex, transversely elliptical to subpentagonal, shells with numerous fine costae, with dorsal fold and ventral sulcus; growth lines weak, closely spaced, few growth lamellae may be present anteriorly.

Lectotype.—When erecting *Spirifer multistriatus*, Hall (1857a, p. 59, fig. 1–6) illustrated different schematic views

Figure 3 (Continued from facing page).

cardinalia, Clarksville, Albany County, New York, I1859, X20; 12–16, *Homoeospira evax* (Hall, 1863a); dorsal, ventral, lateral, anterior, and posterior views of lectotype, Waldron, Indiana, AMNH 36619, X1; 17–21, *Leptospira costata* (Hall, 1859a); dorsal, ventral, lateral, anterior, and posterior views of lectotype, Clarksville, Albany County, New York, AMNH 2461, X1; 22–29, *Trematospira multistriata* (Hall, 1857a); 22–26, dorsal, ventral, lateral, anterior, and posterior views of lectotype, AMNH 33375, X1; 27, dorsal view of posterior part of ventral valve showing pedicle opening, coalesced concave deltidial plates, and teeth, SEM photograph, I2118, X8; 28–29, ventral views of two differently developed cardinalia, SEM photographs, Clarksville, Albany County, New York, I2119 and I2120 respectively, X12, X9 (new).

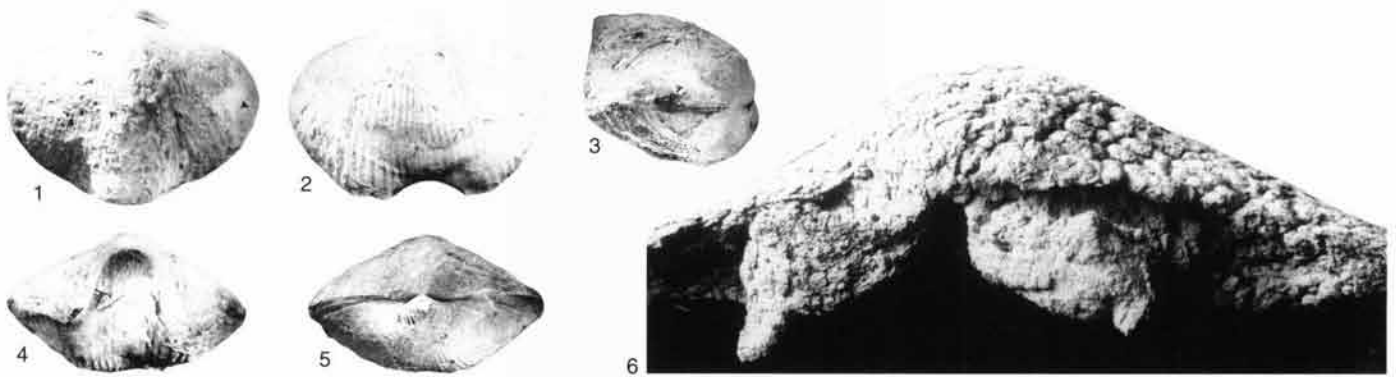


Figure 4.1-6. *Parazyga hirsuta* (Hall, 1857a); 1-5, dorsal, ventral, lateral, anterior, and posterior views of lectotype, Eighteen Mile Creek, Erie County, New York, I1714, $\times 1$; 6, SEM photograph of characteristic cardinalia, Canandaigua Lake, New York, I1716, $\times 12$ (new).

of several specimens coming from the "shaly limestone of the Lower Helderberg, Albany and Schoharie counties" (Hall, 1857a, p. 60). The adult specimen figured by Hall in the *Tenth Report* (1857a, p. 59, fig. 1-2; see also Hall, 1861, pl. 24, 3i, k, m) from Clarksville, Albany County, New York, is here selected as lectotype (Fig. 3.22-3.26, AMNH 33375). Three disarticulated valves from the same locality and also illustrated by Hall and Clarke (1893, pl. 49, 12-14; 1894, pl. 38, 6-8) are here illustrated with photographs taken with a scanning-electron microscope equipped with an environmental chamber to show its characteristic posterior features (Fig. 3.27-3.29, I2118-I2120). Linsley (1994, pl. 36, 1-2f) utilized the same Hall drawings to illustrate different specimens of *Trematospira multistriata* (see also Boucot, Johnson, and Staton, 1965, fig. 531, 7a-d), and indicated a stratigraphic range for *Trematospira multistriata* of Lower Devonian from Kalkberg-New Scotland (Lower Helderberg Group) to Glenerie-Oriskany Formations (Tristates Group).

Family PARAZYGIDAE Alvarez, Rong, and Boucot, 1998
Genus PARAZYGA Hall and Clarke, 1893

Type species.—*Atrypa hirsuta* Hall, 1857a, p. 168; SD Hall and Clarke, 1894, p. 995. Designation of type species is usually credited to Schuchert (1897, p. 301), but the first unequivocal designation of the type species is that of Hall and Clarke (1894, p. 995).

Diagnosis.—Moderate sized, subequally biconvex, transversely oval, subcircular or elongate shells with sparse lamellose growth lines and numerous, long, hollow spines anteriorly or anterolaterally directed; dorsal fold and ventral sulcus commonly present; costae simple, numerous, fine, rounded, of the same width across shell; conjunct deltidial plates present or absent; foramen in permesothyridd position; dental plates stout, pedicle collar more or less complete; triangular outer hinge plates well developed, projecting posteriorly as thin, flat cardinal flanges; crural bases strongly divergent, inner hinge plates absent; dorsal myophragm present; jugum as in *Trematospira* but with lateral branches slightly inclined anteriorly.

Occurrence.—Middle Devonian (Givetian) of North America.

PARAZYGA HIRSUTA (Hall, 1857)

Figure 4.1-4.6

Atrypa hirsuta Hall, 1857a, p. 168; Hall, 1857b, p. 128.

Trematospira hirsuta (Hall, 1857a); Hall, 1862, pl. 2, 9-16; Hall, 1867, p. 274-275, fig. 7-10, pl. 45, 16-32.

Parazyga hirsuta (Hall, 1857a); Hall and Clarke, 1893, pl. 49, 28-39; Hall and Clarke, 1894, pl. 38, 13-16; Boucot, Johnson, and Staton, 1965, fig. 531, 3a-d; Linsley, 1994, pl. 88, 16-32; Alvarez, Rong, and Boucot, 1998, fig. 12; Alvarez, 1999, fig. 1d, 2a-d.

Diagnosis.—As for the genus.

Lectotype.—*Atrypa hirsuta*, the type species of *Parazyga*, was erected, but not illustrated, by Hall (1857a, p. 168; see also Hall, 1857b, p. 128). The same author provided the first illustrations of this species (Hall, 1862, pl. 2, 9-16) when he included it in his genus *Trematospira*. Hall in this article showed different views of several valves, but for one specimen he presented the dorsal, anterior, and lateral views (Hall, 1862, pl. 2, 12-14). This specimen is repeatedly used by Hall to present new and better illustrations (see, e.g., Hall, 1867, pl. 45, 16-32; Hall and Clarke, 1893, pl. 49, 28-32; Hall and Clarke, 1894, pl. 38, 13, included already in their new genus *Parazyga*) of what he considered to be a good example of a full-grown individual. This specimen from the shales of the Hamilton Group (Eighteen Mile Creek, Erie County, New York) is here designated as lectotype and photographically illustrated (Fig. 4.1-4.5, I1714). A disarticulated dorsal valve from Canandaigua Lake, New York, housed in Albany (I1716), is also illustrated (Fig. 4.6) to show the morphology of the cardinalia (similar if not the same as the one illustrated by Hall, 1867, pl. 45, 28-29; Hall and Clarke, 1893, pl. 49, 35, 37). Well-developed, triangular, outer hinge plates project posteriorly as thin, flat cardinal flanges, the crural bases strongly diverge, and the inner hinge plates did not develop. Linsley (1994) indicated a stratigraphic range for

Parazyga hirsuta in the Devonian of New York, from Marcellus to Ludlowville-Moscow Formations (Hamilton Group; Middle Devonian).

ACKNOWLEDGMENTS

We are most grateful to E. Landing (New York State Geological Survey, Albany) and N. H. Landman and H. R. Feldman (American Museum of Natural History, New York) for providing access to collections in their care, specimen data, material on loan, and space and other facilities for conducting the research. E. Landing also gave us timely access to the New York State Library collection of Hall papers, and R. Doescher (Washington) searched for some obscure references cited herein; J. D. D. Smith (Internation-

Commission-Trust on Zoological Nomenclature, London) kindly offered advice on nomenclatorial matters. We thank A. J. Boucot (Corvallis, Oregon), J. L. Carter (Pittsburgh), and A. F. Budd and T. Hazen (Iowa) for valuable suggestions; C. H. C. and E. Brunton and S. Long (the Natural History Museum, London) for help while working in the Department and in the Library; C. G. Jones and the technical staff of the Natural History Museum, London, for helping in the SEM examinations and for processing SEM film from which prints used herein were selected; C. Blanco-Abarrio for photographic assistance; J. Hardesty and two anonymous referees for kindly reviewing the manuscript. Financial support from the Alvarez-Brime Foundation is also warmly acknowledged.

REFERENCES

- Aldrich, M. L., and A. E. Leviton. 1987. James Hall and the New York Survey. *Earth Sciences History* 6(1):24–33.
- Alvarez, Fernando. 1976. El sistema yugal de los Athyrididae McCoy (Brachiopoda) del Devónico Cantábrico. Tesis de Licenciatura. Universidad de Oviedo. Oviedo. 53 p., 9 pl.
- . 1990. Devonian athyrid brachiopods from the Cantabrian Zone (NW Spain). *Biostratigraphie du Paléozoïque* 11:1–311.
- . 1996a. *Meristella* Hall, 1859 (Brachiopoda): Proposed designation of *Atrypa laevis* Vanuxem, 1842 as the type species. *Bulletin of Zoological Nomenclature* 53:182–183.
- . 1996b. *Trematospira* Hall, 1859 (Brachiopoda): Proposed designation of *Spirifer multistriatus* Hall, 1857 as the type species. *Bulletin of Zoological Nomenclature* 53:264–266.
- . 1999. Ornamentación desarrollada por algunos braquiopodos del orden Athyridida. *Trabajos de Geología* 21:12–16.
- Alvarez, Fernando, C. H. C. Brunton, and Wolfgang Struve. 1996. On *Athyris* (Brachiopoda) and its type species “*Terebratulula concentrica* von Buch. *Senckenbergiana lethaea* 76(1/2):65–105.
- Alvarez, Fernando, Rong Jia-yu, and A. J. Boucot. 1998. The classification of athyridid brachiopods. *Journal of Paleontology* 72:827–855.
- Amsden, T. W. 1968. Articulate brachiopods of the St. Clair Limestone (Silurian), Arkansas, and the Clarita Formation (Silurian), Oklahoma. *Journal of Paleontology* 43(3, supplement):1–117, 83 fig., 20 pl.
- Batten, R. L. 1987. Robert Parr Whitfield: Hall's assistant who stayed too long. *Earth Sciences History* 6(1):61–71.
- Beecher, C. E., and J. M. Clarke. 1889. The development of some Silurian Brachiopoda. *Memoirs of the New York State Museum* 1(1):95 p., 8 pl.
- Billings, Elkanah. 1861. Note on a new genus of Paleozoic Brachiopoda. *Canadian Journal of Industry, Science and Art* 6:148.
- Blum, A. S. 1987. “A better style of art:” the illustrations of the paleontology of New York. *Earth Sciences History* 6(1):72–85.
- Boucot, A. J., J. G. Johnson, and R. D. Staton. 1964. On some atrypoid, retzioid and athyridoid Brachiopoda. *Journal of Paleontology* 38:805–822.
- . 1965. Suborder Athyrididina. In R. C. Moore, ed., *Treatise on Invertebrate Paleontology*. Part H, Brachiopoda, Volume 2. Geological Society of America and University of Kansas Press. New York and Lawrence. p. 654–667.
- Brunton, C. H. C. 1980. Type specimens of some Upper Palaeozoic athyridid brachiopods. *Bulletin of the British Museum (Natural History)*, *Geology Series* 34(4):219–234.
- . 1984. Silicified brachiopods from the Viséan of County Fermanagh, Ireland (III). Rhynchonellids, Spiriferids and Terebratulids. *Bulletin of the British Museum (Natural History)*, *Geology Series* 38(2):27–130.
- Clarke, J. M. 1921. James Hall of Albany, *Geologist and Palaeontologist*, 1811–1898. Albany. 565 p.
- Conrad, T. A. 1842. Observations on the Silurian and Devonian Systems of the U.S. with descriptions of the new organic remains. *Proceedings of the Academy of Natural Sciences, Philadelphia* 8:228–280.
- Cooper, G. A. 1944. Phylum Brachiopoda. In H. W. Shimer and R. R. Shrock, eds., *Index fossils of North America*. M.I.T. Press. Cambridge, Massachusetts. p. 277–365.
- Dall, W. H. 1877. Index to the names which have been applied to the subdivisions of the class Brachiopoda, excluding the Rudistes previous to the year 1877. *United States National Museum, Bulletin* 8:1–88.
- Davidson, Thomas. 1858. *Palaeontological Notes on the Brachiopoda*. No. I. On the genera and sub-genera of Brachiopoda that are provided with spiral appendages for the support of the oral arms, and species so constructed, which have been discovered in British Carboniferous strata. *Geologist* 1:409–416.
- . 1881. On genera and species of spiral-bearing Brachiopoda, from specimens developed by the Rev. Norman Glass. *Geological Magazine* 8:1–13.
- . 1882. A Monograph of the British fossil Brachiopoda. Devonian and Silurian Supplements. *Palaeontographical Society* 5:1–134.
- Fakundiny, R. H., and E. L. Yochelson. 1987. James Hall and the products of his factory: in commemoration of the sesquicentennial of the New York State Geological Survey. *Earth Sciences History* 6(1):1–2.
- Fisher, D. W. 1978. James Hall—Patriarch of American Paleontology, Geological Organizations and State Geological Surveys. *Journal of Geological Education* 26:145–152.
- Hall, James. 1843. *Geology of New York, Part IV, comprising the Survey of the Fourth Geological District*. *Natural History of New York*, vol. 4. Carroll and Cook Printers. Albany. 683 p.
- . 1852. *Palaeontology of New York, Volume II, containing descriptions of the organic remains of the Lower Middle division of the New-York System (equivalent in part to the middle Silurian rocks of Europe)*. Charles van Benthuyzen. Albany. 362 p., 104 pl.
- . 1857a. Descriptions of Palaeozoic fossils, chiefly from those constituting the third volume of the *Palaeontology of New York* with others from the fourth volume, etc. etc. Appendix C of the 10th Annual report. *New York State Cabinet of Natural History* 10:39–186.
- . 1857b. Descriptions of Palaeozoic fossils from the Lower Helderberg, Oriskany Sandstone, Upper Helderberg, Hamilton and Chemung Group. Extracted from the Report of the Regents of the University for 1856. Charles van Benthuyzen. Albany. 146 p.
- . 1859a. Contributions to the Palaeontology of New York; being some of the results of investigations made during the years 1855, '56, '57 and '58. *New York State Cabinet of Natural History Annual Report* 12:7–110.
- . 1859b. *Palaeontology of New York, Volume 3, Part 1 (text)*, containing descriptions and figures of the organic remains of the Lower Helderberg Group and Oriskany Sandstone. *New York Geological Survey, Natural History of New York*. Charles van Benthuyzen. Albany. 532 p.
- . 1860. Contributions to the Palaeontology of New York; descriptions of new species of fossils from the Hamilton group of Western New York, with notices of others from the same

- horizon in Iowa and Indiana. New York State Cabinet of Natural History, Annual Report 13:53–125.
- . 1861. Palaeontology of New York, Volume 3, Part 2 (plates), containing descriptions and figures of the organic remains of the Lower Helderberg Group and Oriskany Sandstone. New York Geological Survey, Natural History of New York. Charles van Benthuyzen. Albany. 120 pl.
- . 1862. Contributions to palaeontology comprising descriptions of new species of fossils from the Upper Helderberg and Chemung Groups. New York State Cabinet of Natural History Annual Report 15:27–197.
- . 1863a. Art. XII. Notice of some new species of fossils from a locality of the Niagara Group, in Indiana; with a list of identified species from the same place. Albany Institute Transactions 4:195–228.
- Also published as an independent booklet, paginated 1–34.
- . 1863b. Contributions to palaeontology; principally from investigations made during the years 1861 and 1862. 2. Observations upon some of the Brachiopoda, with reference to the characters of the genera *Cryptonella*, *Centronella*, *Meristella*, *Trematospira*, *Rhynchospira*, *Retzia*, *Leptocoelia* and allied forms. New York State Cabinet of Natural History Annual Report 16:38–61.
- . 1867. Palaeontology of New York, Volume 4, Part 1, containing descriptions and figures of the fossil Brachiopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. New York State Geological Survey. Albany. 428 p., 63 pl.
- . 1879. The fauna of the Niagara Group, in central Indiana. New York State Cabinet of Natural History Annual Report 28:99–199, pl. 1–37.
- . 1882. Descriptions of the species of fossils found in the Niagara Group at Waldron, Indiana. Geological Survey of Indiana, Annual Report 11:217–401, 55 pl.
- Hall, James, and J. M. Clarke. 1893. An introduction to the study of the genera of Palaeozoic Brachiopoda. II. Brachiopoda Articulata (continued). New York Geological Survey, Palaeontology 8(2):1–317, pl. 21–84.
- . 1894. The evolution of the genera of the Palaeozoic Brachiopoda. New York State Museum Annual Report 47:803–851, 943–1137.
- Also published in Annual Report of the New York State Geologist 13:609–657, 749–943; extracted from Palaeontology of New York, Volume 8, Part 2, p. 319–370.
- Havlíček, Vladimír. 1956. The brachiopods of the Branik and Hlubočepý Limestones in the immediate vicinity of Prague. Sborník Ústředního ústavu geologického 22:535–665.
- In Czech.
- International Commission on Zoological Nomenclature. 1985. International Code of Zoological Nomenclature, 3rd edition. International Trust for Zoological Nomenclature. London. 338 p.
- . 1998a. Opinion 1899: *Meristella* Hall, 1859 (Brachiopoda): *Atrypa larvis* Vanuxem, 1842 designated as the type species. Bulletin of Zoological Nomenclature 55:131–132.
- . 1998b. Opinion 1900: *Trematospira* Hall, 1859 (Brachiopoda): *Spirifer multistriatus* Hall, 1859 designated as the type species. Bulletin of Zoological Nomenclature 55:133–134.
- . 1999. International Code of Zoological Nomenclature, 4th edition. International Trust for Zoological Nomenclature. London. 306 p.
- Linsley, D. M. 1994. Devonian Paleontology of New York. Paleontological Research Institution, Special Publication 21:1–472.
- Merrill, G. P. 1920. Contributions to a history of American state geological and natural history surveys. United States National Museum Bulletin 109:345–361.
- Miller, S. A. 1889. North American geology and paleontology for the use of amateurs, students and scientists. Western Methodist Book Concern, Cincinnati, Ohio. 718 p., 1,194 fig.
- Modzalevskaia, T. L. 1994. The lectotype of *Collarothyris canaliculata* (Wenjukow). Journal of Paleontology 68:685.
- Moore, R. C., ed. 1965. Treatise on Invertebrate Paleontology. Part H, Brachiopoda. Geological Society of America and University of Kansas Press. New York and Lawrence. 927 p.
- Nikiforova, O. I., T. L. Modzalevskaia, and M. G. Bassett. 1985. Review of the upper Silurian and Lower Devonian articulate brachiopods of Podolia. Palaeontology, Special Papers 34:1–66.
- Savage, N. M. 1971. Brachiopods from the Lower Devonian Mandagery Park Formation, New South Wales. Palaeontology 14:387–422.
- Schuchert, Charles. 1897. A synopsis of American fossil Brachiopoda, including bibliography and synonymy. United States Geological Survey Bulletin 87:1–464.
- . 1913. Class 2. Brachiopoda. In K. A. von Zittel, edited by C. R. Eastman, Text-book of Palaeontology, 2nd ed., Volume 1. MacMillan & Co., Ltd. London. p. 335–420.
- . 1929. Classification of brachiopod genera, fossils and recent. In Charles Schuchert and C. M. LeVene, Brachiopoda (Generum et Genotyporum Index et Bibliographia). Fossilium Catalogus, I: Animalia, Part 42. W. Junk. Berlin. p. 10–25.
- Schuchert, Charles, and C. M. LeVene. 1929. Index and bibliography of brachiopod genera and their genotypes. In Charles Schuchert and C. M. LeVene, Brachiopoda (Generum et Genotyporum Index et Bibliographia). Fossilium Catalogus, I: Animalia, Part 42. W. Junk. Berlin. p. 26–131.
- Sheehan, P. M. 1977. Late Ordovician and earliest Silurian meristellid brachiopods in Scandinavia. Journal of Paleontology 51:23–43.
- Suess, Eduard. 1851. Ueber ein neues Brachiopoden-Geschlecht Merista. Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt 2(4):150.
- Vanuxem, Lardner. 1842. Geology of New York, part 3, comprising the survey of the third geological district. Natural History of New York. 306 p., 80 fig.
- Waagen, W. H. 1883. Salt Range fossils. *Productus*-Limestone fossils: Brachiopoda. Geological Survey of India, Memoir, Palaeontologia Indica (series 13) 4:391–546.
- Yochelson, E. L. 1987. Walcott in Albany, New York: James Hall's "special assistant." Earth Sciences History 6(1):86–94.