

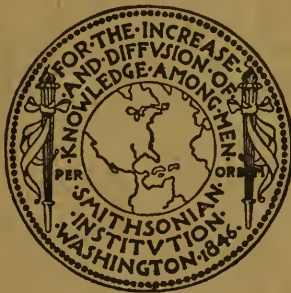
SMITHSONIAN MISCELLANEOUS COLLECTIONS  
VOLUME 97, NUMBER 10

FOURTH CONTRIBUTION  
TO NOMENCLATURE OF CAMBRIAN  
FOSSILS

BY

CHARLES ELMER RESSER

Curator, Division of Invertebrate Paleontology,  
U. S. National Museum



(PUBLICATION 3487)

CITY OF WASHINGTON  
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This is the fourth paper in a series dealing with nomenclatural changes necessary for Cambrian fossil species.<sup>1</sup> In this paper non-trilobitic and non-American species are included. It was hoped all necessary changes in sight could go in this fourth contribution, but that proved to be impossible. Several descriptive papers now in press or nearing completion involve previously described species, and thus make additional nomenclatural changes. Moreover, it is the practice to withhold references of species to new genera where undescribed species are in hand which will make better genotypes. Needed changes are also withheld in instances where someone is known to be at work on the faunas which contain improperly named species.

The nontrilobitic species are discussed first, grouped according to classes. The trilobites are again placed in alphabetical order according to genera.

### BRACHIOPODA

PATERINIDAE Schuchert

**MICROMITRA** Meek, 1873

**Micromitra minutissima (Hall and Whitfield)**

*Kutorgina minutissima* HALL and WHITFIELD, U. S. Geol. Expl. 40th Par., vol. 4, pt. 2, p. 207, pl. 1, figs. 11, 12, 1877.

*Kutorgina sculptilis* WALCOTT (part), U. S. Geol. Surv. Mon. 8, p. 20, pl. 1, fig. 7b; pl. 9, fig. 7, 1884.

*Micromitra sculptilis* WALCOTT (part), idem, 51, p. 341, pl. 3, figs. 5b, c, 1912.

The Nevada form is distinct from *M. sculptilis* of Montana in having coarser ribs. For this reason the old species name is restored.

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<sup>1</sup> Resser, Charles Elmer, Nomenclature of some Cambrian trilobites, Smithsonian Misc. Coll., vol. 93, no. 5, Feb. 14, 1935; Second contribution to nomenclature of Cambrian trilobites, idem, vol. 95, no. 4, Apr. 1, 1936; Third contribution to nomenclature of Cambrian trilobites, idem, vol. 95, no. 22, Apr. 5, 1937.

Middle Cambrian, Eldorado; (loc. 58) east side New York and Secret Canyons, Eureka District, Nevada.

*Cotypes*.—U.S.N.M. no. 24551a, b.

**Micromitra burgessensis, n. sp.**

*Micromitra (Iphidella) pannula* WALCOTT, Smithsonian Misc. Coll., vol. 67, no. 9, p. 481, pl. 106, fig. 16, 1924.

This species conforms in every respect to the characteristics of *Micromitra* even though only one valve has been found. The growth lines are pronounced and are wavy and close together. Ribbing is well developed, and the ribs have the usual irregularities. Because of the crinkly growth lines and particularly because of the preservation of long slender spines which extend far beyond the margin, this shell was regarded as the same as *I. pulchra*. However, a glance at the illustrations shows that the two forms are quite different and that *pulchra* is a true *Iphidella*.

Middle Cambrian, Burgess; (loc. 35k) Burgess Pass, near Field, British Columbia.

*Holotype*.—U.S.N.M. no. 69646.

**PATERINA Beecher, 1891**

**Paterina troyensis, n. sp.**

*Scenella retusa* WALCOTT (part), U. S. Geol. Surv. Bull. 30, p. 126, pl. 12, fig. 3a, 1886 (not fig. 3 = *Stenothecoides*).

The specimen doubtfully referred to *Scenella retusa* by Walcott is a brachiopod belonging to *Paterina*. It is a small form only 1.5 mm long and 1 mm high. About halfway back a depression follows the position of an ordinary growth line, but this is regarded as an accidental feature. The shell appears to be nearly smooth, but this may be due to imperfect preservation.

Lower Cambrian, Schodack; (loc. 27) Troy, New York.

*Holotype*.—U.S.N.M. no. 15369.

**Paterina zenobia (Walcott)**

*Micromitra (Paterina) stissingensis?* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 353, pl. 3, fig. 1e, 1912.

*Micromitra (Paterina) stissingensis ora* WALCOTT, idem, p. 354, 1912.

*Micromitra zenobia* WALCOTT, idem, p. 342, text fig. 23, 1912; Smithsonian Misc. Coll., vol. 67, no. 9, p. 481, pl. 106, figs. 1-7, 1924.

Middle Cambrian, Burgess; (loc. 35k) Burgess Pass, (locs. 61j, 35k') West slope Mount Field; (loc. 14s) Mount Stephen near Field, British Columbia.

*Holotype*.—U.S.N.M. no. 58311; plesiotypes, nos. 56907, 51483, 69631-7.

## IPHIDELLA Walcott, 1905

**Iphidella fieldensis**, n. sp.

*Micromitra (Iphidella) pannula* WALCOTT (part), Canadian Alpine Journ., vol. 1, no. 2, pl. 1, fig. 1, 1908; U. S. Geol. Surv. Mon. 51, p. 361, pl. 14, fig. 11, 1912.

This species was confused with *I. pannula* but there is little resemblance. *I. fieldensis* is characterized by a fairly well developed diamond pattern on the older part of the shell, which is more and more obscured toward the margins by increase in prominence of the wavy growth lines.

Middle Cambrian, Stephen; (loc. 14s) Mount Stephen; (loc. 35k) Burgess Pass, near Field, British Columbia.

*Holotype*.—Walker Mus., Toronto.

**Iphidella pulchra**, n. sp.

*Micromitra (Iphidella) pannula* WALCOTT, Research in China, vol. 3, Carnegie Inst. Publ. 54, pl. 1, fig. 13, 1913; Smithsonian Misc. Coll., vol. 67, no. 9, p. 482, pl. 106, fig. 17, 1924.

This is a very beautiful brachiopod. Well-preserved specimens show "spines" extending far beyond the margins of the shells. *I. pulchra* carries the diamond pattern to its extreme development. Very large specimens show the pattern interrupted somewhat in the outer part of the shell by rather heavy growth lines.

Middle Cambrian, Burgess; (loc. 35k) Burgess Pass; (loc. 14s) Mount Stephen, near Field, British Columbia.

*Holotype*.—U.S.N.M. no. 59801.

## OBOLIDAE King

## LINGULELLA Salter, 1866

The family Obolidae includes many brachiopod genera, chief of which in Cambrian strata are *Obolus* and *Lingulella*. Each contains many species, and to both genera are assigned a number of subgenera. Discrimination of oboloid brachiopods is an inexact procedure at present because no one has yet determined what the characteristics essential for classification may be. Relative size and shape, and sometimes shell ornamentation, are the only usable criteria.

Proper generic names are not available for many Cambrian species. It is evident that most, if not all, of the subgenera in *Obolus* and *Lingulella* are valid genera, but these two names themselves are in question. One thing is certain, namely, that *Obolus* must be confined to post-Cambrian species. *Lingulella* is founded on *L. davisi* McCoy,

also a post-Cambrian brachiopod. Unfortunately the specimens of *L. davisii* are poorly preserved; consequently it is difficult to determine whether Cambrian forms are congeneric.

Distinctions of generic rank between the Cambrian species referred to *Obolus* and those placed in *Lingulella* seem to be wanting. In fact the assignment of species to these genera has been on the basis of shape alone, the wide forms being called *Obolus*. Pending revision of these brachiopods, Cambrian species which formerly would have been placed partly in *Obolus* and partly in *Lingulella* are preferably referred to *Lingulella*.

***Lingulella bridgei*, n. sp.**

*Lingulepis acutangula* BRIDGE (part), U. S. Geol. Surv. Prof. Paper 186-M, p. 244, pl. 68, figs. 4, 5, 1937.

The stratigraphic position of the sandstone containing this species has not yet been determined with certainty.

This is a large form for which reason Bridge confused it with *Lingulepis acutangula*. However, it lacks the necessary restriction of the ventral valve at the apical end, tapering too slowly and evenly to be referred to *Lingulepis*.

The ventral valve figured by Bridge is broken away on the sides toward the apex, thus causing it to approach the form of *Lingulepis*. A smaller, more perfect ventral valve shows the true proportions of the shell, and while the valve comes to a rather sharp point, the margins approach the apex as slightly convex lines. The dorsal valve figured by Bridge is fairly complete but evidently somewhat flattened.

*L. bridgei* has the usual shell composition. A ventral valve about 15 mm long is 10 mm wide.

Upper Cambrian, Lion Mountain ?;  $\frac{1}{4}$  mile east of Sandy, Blanco County, Texas.

*Cotypes*.—U.S.N.M. no. 93009.

***Lingulella burnetensis*, n. sp.**

*Obolus matinalis* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 400, pl. 8, figs. 1a, b, 1912; BRIDGE (part), in Sellards, Adkins, and Plummer, Univ. Texas Bull. 3232, pl. 2, fig. 14, 1932.

This is a rather wide form, which is perhaps the reason for its reference to *O. matinalis* in spite of its larger size. There is some question as to the specific identity of the specimens from the two localities. Since the holotype is in sandstone it may come from the Lion Mountain sandstone member. The other specimens (loc. 67) are clearly in the *Aphelaspis* zone.



This species is characterized by its broad shape. The ventral valve has a sharp apex but widens rapidly, so that the holotype is about 14 mm long and 12 mm wide.

Upper Cambrian, Cap Mountain; (locs. 67, 67c) near the top of Potatotop, 7 miles northwest of Burnet, Texas.

*Holotype*.—U.S.N.M. no. 52420; paratype, no. 52419.

***Lingulella alia*, n. sp.**

*Obolus matinalis* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 400, pl. 8, fig. 1k, 1912; BRIDGE (part), in Sellards, Adkins, and Plummer, Univ. Texas Bull. 3232, pl. 2, fig. 15, 1932.

This is a smaller brachiopod than the Cap Mountain species, *L. burnetensis*. Both valves are very wide, the holotype dorsal valve being about 9 mm long and 9 mm wide. Even though the ventral valve appears to be less wide, measurements show but little difference between length and width.

Upper Cambrian, Wilberns; (loc. 71) Cold Creek Canyon, San Saba County, and (loc. 14c) Baldwin's Ranch, Cold Creek, Llano County, Texas.

*Holotype*.—U.S.N.M. no. 51566.

***Lingulella monticola*, n. sp.**

*Lingulella perattenuata* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 523, pl. 21, fig. 1e, 1912.

This small, neat form was referred by Walcott to *L. perattenuata*. The ventral valve is about 6 mm long and 3.5 mm wide, and the rate of taper is nearly rapid enough to warrant reference to *Lingulepis*. Otherwise the species conforms to the norm for the genus. This form is more slender than the older species, *L. longula*.

Upper Cambrian, Cap Mountain (Lion Mountain member?); (loc. 67c) Potatotop, 7 miles northwest of Burnet, Texas.

*Holotype*.—U.S.N.M. no. 27424.

***Lingulella longula*, n. sp.**

*Lingulella perattenuata* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 523, pl. 21, figs. 1f, g, 1912.

*L. perattenuata* is thus far confined to the Black Hills and the name must be restricted to Whitfield's specimens. Unfortunately they do not warrant the precise drawings Walcott presents. The form from the Middle Cambrian of the Grand Canyon is an undescribed species. The specimens in sandstone from locality 70 also represent a new species, but since most of the material from that

locality belongs to the Wilberns formation, the horizon of the sandstone is in question.

*L. longula* is associated with *Obolus sinoc*, from which its elongate shape readily distinguishes it. Compared to *L. perattenuata*, *L. longula* averages much smaller in size and is more slender. Only dorsal valves are figured by Walcott but ventral valves are present in the collection. The shell has the usual growth lines well marked. The smaller type specimen is about 5 mm long and 3 mm wide.

Upper Cambrian, Hickory; (loc. 68y) Packsaddle Mountain, 11 miles southeast of Llano, Texas.

*Cotypes*.—U.S.N.M. no. 27422.

***Lingulella hilli*, n. sp.**

*Obolus (Lingulella) acutangulus* WALCOTT, Proc. U. S. Nat. Mus., vol. 21, p. 392, pl. 27, fig. 6; pl. 28, figs. 1, 2, 1898.

*Lingulella acutangula* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 474, pl. 17, figs. 1a, b, c, f, h, j, 1912.

*Lingulella arguta* BRIDGE, U. S. Geol. Surv. Prof. Paper 186-M, p. 245, 1937.

Bridge recently pointed out that Walcott's *L. acutangula* is not related to *Lingulepis acutangula* of Roemer with which it was identified, and further suggested that this brachiopod is *L. arguta*. However, Bridge failed to note that several species from different horizons were included by Walcott in *L. arguta*.

Walcott's original identification of Roemer's species was based on the Hickory sandstone specimens described here as *L. hilli*. Subsequently (1912) Walcott added Wilberns specimens which belong to a much larger species. The matrix of *L. hilli* is a black rock, consisting mainly of hematite in which there are scattered poorly rounded grains of clear quartz. The brachiopods are not compressed and many specimens retain a limy shell. This material was collected by R. T. Hill about 1885 from an undetermined locality in Llano County. When the shell is dissolved, many specimens show the internal features, which explains Walcott's choice of them to illustrate the species even though the locality is unknown.

*L. hilli* varies in size, averaging about 7 mm long and 4.5 mm wide for the ventral valve, with the dorsal relatively shorter. The other features are those usually characterizing *Lingulella* species.

*L. hilli* is larger and wider than *L. arguta* from Nevada.

Upper Cambrian, Hickory; Llano County, Texas.

*Cotypes*.—U.S.N.M. no. 35240.

**Lingulella texana Walcott**

*Obolus sinoc* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 415, pl. 26, figs. 2-2d, 1912.

*Lingulella texana* WALCOTT, Smithsonian Misc. Coll., vol. 53, no. 3, p. 71, pl. 8, fig. 5, 1908; U. S. Geol. Surv. Mon. 51, p. 535, pl. 49, figs. 3, 3a.

Walcott's description stresses the radiating striae on the "outer surface" of the shell as the diagnostic feature. When it is remembered that the ribbing of a *Lingulella* shell is exposed only by exfoliation of one or more layers, this species loses its distinctive feature. This explains why specimens which retained the outer shell layers were referred to *Obolus sinoc*.

Upper Cambrian, Wilberns; (loc. 70) Baldy Mountain, 8 miles northwest of Burnet, and (loc. 69) Honey Creek, 8 miles southeast of Llano, Texas.

*Holotype*.—U.S.N.M. no. 51806; paratype, no. 51805; plesiotypes, no. 51627.

**Lingulella lochmanae, n. sp.**

*Obolus (Lingulella) acutangulus* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 474, pl. 17, figs. 1, d, e, g, i, k, m-o, 1912.

*Lingulella arguta* LOCHMAN, Journ. Pal., vol. 12, no. 1, p. 85, pl. 18, figs. 17-19, 1938.

*Lingulella acutangula* BRIDGE (part), in Sellards, Adkins, and Plummer, Univ. Texas Bull. 3232, pl. 2, fig. 8, 1932.

This is a medium-sized species which falls between such species as *L. alia*, *L. burnetensis* and *L. bridgei*, on the one hand, and the small species like *L. texana*, *L. longula*, and *L. hilli* on the other. There is naturally variation in size. A large ventral valve is about 13 mm long and 8 mm wide.

The specimens from locality 68 are doubtfully referred to the species. In fact, it is not certain that all the others belong to one species.

Upper Cambrian, Cap Mountain; South Fork Morgan Creek, 4 miles northwest of Highway 29; Lion Mountain sandstone?; (loc. 68) near top of Packsaddle Mountain, 12 miles southeast of Llano; Wilberns; (loc. 69) Packsaddle Mountain, and (loc. 69) Honey Creek, 8 miles southeast of Llano, all in Texas.

*Holotype*.—U.S.N.M. no. 95017; paratypes, nos. 27410, 27412, 51644.

**Lingulella nina (Walcott)**

*Obolus tetonensis nina* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 418, pl. 11, figs. 1-1g, 1912.

This species characterizes Honey Creek limestone of Oklahoma. The Texas form, from the slightly older Lion Mountain sandstone, formerly referred to *L. nina*, is a larger brachiopod.

Upper Cambrian, Honey Creek; (loc. 9r) 15 miles northwest of Fort Sill, and other localities in Oklahoma.

*Holotype and paratypes*.—U.S.N.M. no. 51643.

***Lingulella turneri*, n. sp.**

*Lingulella (Lingulepis) acuminata* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 545, pl. 34, figs. 3a-d, 1912.

This form was apparently placed in *Lingulepis acuminata* because *L. nevadensis* was included with it.

*L. turneri* is characterized by an average size for the ventral valve, about 9 mm long and 6 mm wide. There is a tendency toward flattening of the front marginal outline.

Upper Cambrian, Emigrant; (locs. 7x, 7z) 2½ miles southeast of Benders Pass, Silver Peak Range, Nevada.

*Cotypes*.—U.S.N.M. nos. 56967, 51884.

**LINGULEPIS Hall, 1863**

***Lingulepis burnetensis*, n. sp.**

*Lingulella (Lingulepis) acuminata* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 545, pl. 42, figs. 1k-n, 1912.

This species is smaller than either *Lingulella bridgei* or *Lingulepis llanoensis*. Compared with the latter *L. burnetensis* has about the same width, but the shell is shorter and the ventral valve tapers less evenly. One specimen 9 mm long is 6 mm wide.

Upper Cambrian, Wilberns; (loc. 70) Baldy Mountain, Morgans Creek, 8 miles northwest of Burnet, Texas.

*Cotypes*.—U.S.N.M. no. 51891.

***Lingulepis llanoensis*, n. sp.**

*Lingulella (Lingulepis) acuminata* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 545, pl. 42, fig. 1, o, 1912.

Walcott figured only the interior of the dorsal valve, but a very fine example of the ventral valve lies against it. This species is slender, a ventral valve 12 mm long being only about 6 mm wide. The ventral valve tapers at a nearly even rate to the apex.

Upper Cambrian, Wilberns; (loc. 14b) Cold Creek, 2 miles south of the San Saba county line, Llano County, Texas.

*Holotype and paratypes*.—U.S.N.M. no. 51892.

**Lingulepis nevadensis, n. sp.**

*Lingulella (Lingulepis) acuminata* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 545, pl. 34, figs. 3, 3e, 1912.

This brachiopod is associated with *Lingulella turneri* and evidently formed the basis on which Walcott referred both species to *L. acuminata*.

*L. nevadensis* is characterized by its relatively small size. Both figures of Walcott represent ventral valves, which show the usual degree of variation. The shell is not restricted toward the apex to any great extent. The growth lines are wavy.

Upper Cambrian, Emigrant; (loc. 7z) about 2½ miles southeast of Benders Pass, Silver Peak Range, Nevada.

*Cotypes*.—U.S.N.M. no. 51884.

## ACROTRETIDAE Schuchert

## ACROTHELE Linnarsson, 1876

**Acrothele walcotti, n. sp.**

*Acrothele colleni* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 640, text fig. 55, 1912; Smithsonian Misc. Coll., vol. 67, no. 2, p. 25, pl. 4, figs. 5-5c, 1917.

This species is characterized by the coarseness of both the ribs and the growth lines. The outline of both valves is more transverse than in *A. colleni*, from which *A. walcotti* further differs in the coarseness of the surface markings.

Middle Cambrian, Ross Lake shale; (loc. 35c) 1 mile east of Hector, Mount Bosworth; and (loc. 63j) Popes Peak, 1½ miles southwest of Stephen, British Columbia.

*Holotype and paratypes*.—U.S.N.M. no. 51410.

## ACROTRETA Kutorga, 1848

**Acrotreta aurumensis, n. sp.**

*Acrotreta microscopica* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 693, pl. 67, figs. 2-2d, 1912.

Walcott recognized the distinctness of the Nevada species from *A. microscopica* but argued that the different shape was due to pressure. Neither the Texas nor the Nevada specimens are compressed or distorted. *A. aurumensis* has a more elevated ventral valve and is larger than *A. microscopica*. There is not as much variation in shape as is shown in the illustrations. In fact figure 2a is erroneously drawn, for that shell has the same outline as fig. 2.

This species is characterized by the erectness of the ventral valve so that the false area is about at right angles to the base of the shell.

Upper Cambrian; (loc. 8 o) 2 miles north of Aurum, Schell Creek Range, Nevada.

*Cotypes*.—U.S.N.M. no. 52119.

BILLINGSELLIDAE Schuchert

WIMANELLA Walcott, 1908

*Wimanela walcotti*, n. sp.

*Wimanela simplex* WALCOTT (part), U. S. Geol. Surv. Mon. 51, p. 101, text fig. 64, 1912; Smithsonian Misc. Coll., vol. 67, no. 2, p. 26, pl. 4, figs. 7-7c, 1917.

This species is represented by many specimens in fine-grained, hard shale. Most of the ribbing and growth lines have been smoothed out by pressure. Fine ribs show in cross light and the growth lines must have been rather stronger than usual. The hinge line is straight and the undistorted valve forms a little more than a semicircle.

Middle Cambrian, Ross Lake; (loc. 63j) Popes Peak, 1½ miles south of Stephen; and 1 mile east of Hector, Mount Bosworth, British Columbia.

*Cotypes*.—U.S.N.M. nos. 63713-5, 51407.

*Wimanela rossensis*, n. sp.

*Wimanela simplex* WALCOTT (part), Smithsonian Misc. Coll., vol. 67, no. 2, p. 26, pl. 4, figs. 8-8c, 1917.

Limestone nodules in the Ross Lake shale contain an abundant fauna among which is a species of *Wimanela* different from *W. walcotti* in the enclosing shale. Preservation in granular limestone in contrast to partial flattening in shale, accounts for some of the differences at first apparent. However, not all can thus be accounted for. *W. rossensis* is much higher in the ventral valve, thus creating a larger area. Growth lines are heavy, but vary more in size than in *W. walcotti*.

Middle Cambrian, Ross Lake; (loc. 63j) Popes Peak, 1½ miles south of Stephen; and 1 mile east of Hector, Mount Bosworth, British Columbia.

*Cotypes*.—U.S.N.M. nos. 64716-9.



## China

- Helcionella* ? *churius* (Walcott) (Poorly preserved)  
 “ *rugosa chinensis* (Walcott) = *H. chinensis*  
*Helcionella rugosa orientalis* (Walcott) =  $\left\{ \begin{array}{l} H. orientalis \\ H. shantungensis \end{array} \right.$   
 “ ? *simplex* Walcott  
 “ *acuticosta pacifica* Saito = *H. pacifica*

***Helcionella rugosa* (Hall)**

- Metoptoma* ? *rugosa* HALL, Pal. New York, vol. 1, p. 306, pl. 83, fig. 6, 1847.  
*Stenotheca rugosa* WALCOTT (part), U. S. Geol. Surv. Bull. 30, p. 128, pl. 12, figs. 1b, c, 1886 [not fig. 1 = *H. curticei*; 1a = *H. fordi*; 1d, e = *Stenothecoides troyensis*]; idem, 10th Ann. Rep., p. 617, pl. 74, figs. 1b, c, 1891 [not fig. 1 = *H. curticei*; 1a = *H. fordi*; 1d = *H. sp.*; 1e = *H. walcotti*; 1f, g = *H. halli*; 1h, i = *Stenothecoides troyensis*].  
*Helcionella rugosa* Grabau and Shimer (part), N. A. Index Foss., vol. 1, p. 607, fig. 810b, 1909.

Great confusion was introduced into this species by illustration of the New York forms in 1886 and 1891. After that other workers assumed these animals to be highly variable and referred many diverse forms to *H. rugosa*.

Available specimens were segregated according to kind and locality. Thereupon, several species appeared as clearly defined units and are here defined. *H. rugosa* occurs only in the Hudson valley; at all other localities throughout the world the name was misapplied.

After careful comparison the name *rugosa* was restricted to the form which agrees with Hall's original description and illustration. Possibly if the original type could be studied this choice might have to be altered.

Lower Cambrian, Schodack; (loc. 27) Troy, and other localities, New York.

*Holotype*.—A.M.N.H. no. 212; plesiotypes, U.S.N.M. no. 15365.

***Helcionella halli*, n. sp.**

- Stenotheca rugosa* WALCOTT (part), 10th Ann. Rep. U. S. Geol. Surv., p. 617, pl. 74, fig. 1g, 1891 [see *H. rugosa*].

This species has a more circular outline than any other from New York. It is also high and has its apex overturned parallel to the base of the shell.

Lower Cambrian, Schodack; (loc. 35) 1½ miles north of Bald Mountain, northwest of Greenwich, New York.

*Holotype*.—U.S.N.M. no. 96472.



**Helcionella walcotti, n. sp.**

*Stenotheca rugosa* WALCOTT (part), 10th Ann. Rep. U. S. Geol. Surv., p. 617, pl. 74, fig. 1c, 1891 [see *H. rugosa*].

This is the most common species in the Hudson valley. It has the coarsest ribs, and differs further in that the ribs are angular while in other species they are rounded in contour.

Lower Cambrian, Schodack; (loc. 33) North Greenwich, and many other localities in New York.

*Holotype*.—U.S.N.M. no. 17456.

**Helcionella curticei, n. sp.**

*Stenotheca rugosa* WALCOTT (part), U. S. Geol. Surv. Bull. 30, p. 128, pl. 12, fig. 1, 1886; idem, 10th Ann. Rep., p. 617, pl. 74, fig. 1, 1891 [see *H. rugosa*].

The holotype lies in the matrix, besides a good example of *H. rugosa*, so that it is easy to compare the two. *H. curticei*, which is named for the collector, is twice as high as *H. rugosa*, has a more rounded elliptical outline and coarser ribbing.

Lower Cambrian, Schodack; (loc. 27) Troy, New York.

*Holotype*.—U.S.N.M. no. 96473.

**Helcionella fordii, n. sp.**

*Stenotheca rugosa* WALCOTT (part), U. S. Geol. Surv. Bull. 30, p. 128, pl. 12, fig. 1a, 1886; idem, 10th Ann. Rep., p. 617, pl. 74, fig. 1a, 1891 [see *H. rugosa*].

*H. fordii* has a much rounder elliptical outline than *H. rugosa*. The rugosity is stronger than in *H. curticei*, from which *H. fordii* further differs in greater relative height.

Occurrence same as preceding.

*Holotype*.—U.S.N.M. no. 96474.

**Helcionella tatei, n. sp.**

*Stenotheca rugosa* Tate, Trans. Roy. Soc. South Australia, vol. 15, p. 183, pl. 2, fig. 4, 1892.

This species is characterized by its wide base. The sides slope evenly and the apex is overturned, but only near its tip. As shown in the figure the ribs are angular, but they are not pronounced. There are also vertical striations.

Lower Cambrian; Androssan, South Australia.

*Holotype*.—Australia; plastotypes, U.S.N.M. no. 96475.

**Helcionella sp.**

*Stenothecca rugosa* WALCOTT (part), 10th Ann. Rep. U. S. Geol. Surv., p. 617, pl. 74, fig. 1d, 1891 (see *H. rugosa*).

This Atlantic Province form referred to *H. rugosa* cannot be found in the collections as it evidently never was properly marked as a type. Until the specimen is located, its description cannot be written.

Lower Cambrian, Etcheminian; Conception Bay, Newfoundland.

**Helcionella kiaeri, n. sp.**

*Helcionella* cf. *rugosa* KIAER, Skft. Vid. Kristiania, 1916, Mat.-Natur. Kl., vol. 2, p. 19, pl. 2, fig. 3, 1917.

This is a rather stout, coarse-ribbed form but is not as large as some of the New York species. Its outline is evidently nearly circular.

Lower Cambrian, *Strenuella* limestone; Tømten, Ringsaker, Norway.

*Holotype*.—Pal. Mus. Oslo. no. 61b.

**Helcionella norvegica, n. sp.**

*Helcionella rugosa acuticosta* KIAER, Skft. Vid. Kristiania, 1916, Mat.-Natur. Kl., vol. 2, p. 20, pl. 2, figs. 4, 4a, 1917.

This is a small form characterized by strongly curved outlines front and back, with the apex turned beyond 90°. The ribs are sharply angled.

Occurrence same as preceding.

*Holotype*.—Pal. Mus. Oslo no. 15.

**Helcionella erecta (Walcott)**

*Stenothecca rugosa erecta* WALCOTT, 10th Ann. Rep. U. S. Geol. Surv., p. 617, pl. 74, fig. 4, 1891.

Lower Cambrian, Etcheminian; (loc. 41) Manuels Brook, Conception Bay, Newfoundland.

*Holotype*.—U.S.N.M. no. 18311.

**Helcionella acutacosta (Walcott)**

*Stenothecca ? rugosa acutacosta* WALCOTT, 10th Ann. Rep. U. S. Geol. Surv., p. 617, pl. 74, figs. 2-2b, 1891.

Occurrence same as preceding.

*Lectotype* (fig. 2) and *paratype*.—U.S.N.M. no. 18310.

**Helcionella curvirostra (Shaler and Foerste)**

*Stenothecca curvirostra* SHALER and FOERSTE, Mus. Comp. Zoöl., Bull. 16, p. 30, pl. 1, fig. 8, 1888; WALCOTT, 10th Ann. Rep. U. S. Geol. Surv., p. 618, pl. 74, fig. 10, 1891.

Lower Cambrian, Hoppin; North Attleboro, Massachusetts.  
*Holotype*.—U.S.N.M. no. 96476.

***Helcionella cobboldi*, n. sp.**

*Stenotheca abrupta* ? COBBOLD, Geol. Mag., dec. 6, vol. 4, p. 156, pl. 4, figs. 28, 29, 1919.

This species is similar to *H. abrupta*, but differs in being more slender and the ribs do not project so far beyond the marginal outline of the shell.

Lower Cambrian, Hartshill; Nuneaton, Warwickshire, England.  
*Cotypes*.—Sedgwick Mus.

***Helcionella abrupta* (Shaler and Foerste)**

*Stenotheca abrupta* SHALER and FOERSTE, Bull. Mus. Comp. Zoöl., vol. 16, p. 29, pl. 1, figs. 9a, b, 1888; WALCOTT, 10th Ann. Rep. U. S. Geol. Surv., p. 617, pl. 74, figs. 6, 6a, 1891.

Only the smaller of Foerste's specimens is to be found in the collections. These types were never marked and the material is rather fragile. The species must be restricted to the form first described.

Lower Cambrian, Hoppin; North Attleboro, Massachusetts.  
*Cotypes*.—U.S.N.M. no. 96477.

***Helcionella alia*, n. sp.**

*Stenotheca curvirostra* GRABAU, Occ. Papers Boston Soc. Nat. Hist., vol. 4, p. 638, pl. 31, fig. 13, 1900; GRABAU and SHIMER (not Shaler and Foerste), N. A. Index Foss., vol. 2, p. 373, fig. 1674d, 1910.

This species is stouter and longer than *H. curvirostra* and has more numerous ribs.

Lower Cambrian, Weymouth; Sandy Cove, Cohasset, Massachusetts.

*Holotype*.—Boston Soc. Nat. Hist. no. 11964.

***Helcionella grabau*, n. sp.**

*Stenotheca abrupta* GRABAU (not Shaler and Foerste), Occ. Papers Boston Soc. Nat. Hist., vol. 4, p. 637, pl. 31, figs. 12a-c, 1900; GRABAU and SHIMER, N. A. Index Foss., vol. 2, p. 373, figs. 1674a-c, 1910.

This is an erect species, but even then is more curved than *H. abrupta*. Grabau's original figures do not agree one with the other, but angle of view and the difference between mold of interior and exterior would account for this. This species is characterized by the large number of annulations, 10 being shown in the figure.

Lower Cambrian, Weymouth; Nahant, Massachusetts.

*Cotypes*.—Boston Soc. Nat. Hist. no. 11962.

**Helcionella pauper (Billings)**

*Stenotheca pauper* BILLINGS, Canadian Nat., new ser., vol. 6, p. 479, 1872.

*Stenotheca rugosa paupera* WALCOTT, 10th Ann. Rep. U. S. Geol. Surv., p. 617, pl. 74, fig. 7, 1891.

This species must be restricted to the form from Newfoundland. Billings's type was not figured, but Walcott states that he compared the type with the specimen he figured in 1891.

Lower Cambrian, Etcheminian; (loc. 41) Manuels Brook, Conception Bay, Newfoundland.

*Holotype*.—Nat. Mus. Canada; plesiotype, U.S.N.M. no. 18312.

**Helcionella foerstei, n. sp.**

*Stenotheca rugosa pauper* SIALER and FOERSTE, Bull. Mus. Comp. Zoöl., vol. 16, p. 29, pl. 1, fig. 7, 1888.

Compared with the specimen Walcott figured as *H. pauper*, the Massachusetts species is much more curved and has stronger ribs.

Lower Cambrian, Hoppin; North Attleboro, Massachusetts.

*Holotype*.—U.S.N.M. no. 96478.

**Helcionella terranovica, n. sp.**

*Stenotheca ? rugosa levis* WALCOTT (part), 10th Ann. Rep. U. S. Geol. Surv., p. 617, pl. 74, fig. 5, 1891 (see *H. levis*).

This is a much taller and stouter form than the other specimen Walcott referred to his variety *levis*. This species is stouter and more erect than *H. levis* and has fewer, much larger, annulations.

Lower Cambrian, Etcheminian; (loc. 41) Manuels, Conception Bay, Newfoundland.

*Holotype*.—U.S.N.M. no. 96479.

**Helcionella striata, n. sp.**

*Stenotheca levis* GRABAU (not Walcott), Occ. Paper Boston Soc. Nat. Hist., vol. 4, p. 641, pl. 31, fig. 15, 1900.

This form is shaped somewhat like *H. terranovica*, but the illustration shows pronounced longitudinal striations.

Lower Cambrian, Weymouth; Pleasant Beach, Cohasset, Massachusetts.

*Holotype*.—Boston Soc. Nat. Hist. no. 11961.

**Helcionella recurva, n. sp.**

*Stenotheca pauper* GRABAU (not Billings), Occ. Papers Boston Soc. Nat. Hist., vol. 4, p. 639, pl. 31, fig. 14, 1900; Grabau and Shimer, N. A. Index Foss., vol. 2, p. 374, fig. 1674c, 1910.

This species is much more curved than *H. foerstei* and besides has coarser ribs.

Lower Cambrian, Weymouth; Sandy Cove, Cohasset, Massachusetts.

*Holotype*.—Boston Soc. Nat. Hist. no. 11963.

**Helcionella levis (Walcott)**

*Stenotheca ? rugosa levis* WALCOTT (part), 10th Ann. Rep. U. S. Geol. Surv., p. 617, pl. 74, fig. 5a, 1891.

Walcott included two forms in his variety *levis*. The smoother one is chosen to represent the species and the other described as *H. terranovica*.

Lower Cambrian, Etcheminian; (loc. 41) Manuels, Conception Bay, Newfoundland.

*Holotype*.—U.S.N.M. no. 18313.

**Helcionella elevata (Cobbold)**

*Scenella elevata* COBBOLD, Quart. Journ. Geol. Soc. London, vol. 76, pt. 4, p. 364, pl. 24, fig. 36, 1921.

Cobbold pointed out that this species did not conform to the requirements of *Scenella* but because it lacked pronounced concentric rugosities reference to *Helcionella* was more difficult. Now that wide variation in this respect is known to exist in *Helcionella*, the shape of *H. elevata* may be relied on and the species referred to *Helcionella*.

Lower Cambrian, *Olenellus* limestone; Comley, Shropshire, England.

*Holotype*.—Geol. Surv. no. RR1211.

**Helcionella wheeleri (Walcott)**

*Stenotheca wheeleri* WALCOTT, Canadian Alpine Journ., vol. 1, no. 2, pl. 1, fig. 7, 1908.

Middle Cambrian, Stephen; (loc. 14s) Mount Stephen, near Field, British Columbia.

*Holotype*.—U.S.N.M. no. 96480.

**Helcionella belliana (Walcott)**

*Platyceras (?) bellianus* WALCOTT, Canadian Alpine Journ., vol. 1, no. 2, pl. 1, fig. 13, 1908.

Occurrence same as preceding.

*Holotype*.—U.S.N.M. no. 96481.

**Helcionella romingeri (Walcott)**

*Platyceras romingeri* WALCOTT, Proc. U. S. Nat. Mus., vol. 11, p. 442, 1888; Canadian Alpine Journ., vol. 1, no. 2, pl. 1, fig. 14, 1908.

Middle Cambrian, Stephen; (loc. 14s) Mount Stephen, near Field, British Columbia.

*Holotype*.—U.S.N.M. no. 96482.

***Helcionella orientalis* (Walcott)**

*Stenothecca rugosa orientalis* WALCOTT, Proc. U. S. Nat. Mus., vol. 29, p. 16, 1905.

*Helcionella rugosa orientalis* WALCOTT (part), Research in China, vol. 3, Carnegie Inst. Publ. 54, p. 91, pl. 5, fig. 15a, 1913 (not fig. 15 = *H. shantungensis*).

The species is restricted to the form at the first locality, which according to Dr. Walcott's practice is the type locality.

Middle Cambrian, Changhia; (loc. C21) Changhia, Shantung, China.

*Holotype*.—U.S.N.M. no. 57776.

***Helcionella shantungensis*, n. sp.**

*Helcionella rugosa orientalis* WALCOTT (part), Research in China, vol. 3, Carnegie Inst. Publ. 54, p. 91, pl. 5, fig. 15, 1913 (see *H. orientalis*).

This species is wider at the base than *H. orientalis* and the rugosities are not so coarse. The striations are also finer and weaker.

Middle Cambrian, Changhia; (loc. C18) east of Changhia, Shantung, China.

*Holotype*.—U.S.N.M. no. 57775.

***Helcionella triangularis* (Matthew)**

*Stenothecca triangularis* MATTHEW, Trans. Roy. Soc. Canada, vol. 3, sec. 4, p. 58, pl. 6, figs. 15, 15a, 1886.

Middle Cambrian, St. John; Hanford Brook. New Brunswick.

*Holotype and paratype*.—Walker Mus. (?).

***Helcionella manuelensis* (Matthew)**

*Plumulites manuelensis* MATTHEW, Trans. New York Acad. Sci., vol. 15, p. 145, fig. 1, 1896.

Middle Cambrian, Manuels; Manuels Brook, Conception Bay, Newfoundland.

*Holotype*.—Walker Mus. (?).

**SCENELLA Billings, 1872**

Diverse forms are referred to *Scenella*, particularly post-Cambrian species. A list of Cambrian species referred to the genus is given with cross references.

## Atlantic Province

- Scenella antiqua* Kiaer  
 “ *depressa* Kiaer  
 “ ? *discinoides* Schmidt (possibly two species)  
 “ *elevata* Cobbold = *Helcionella elevata*  
 “ *reticulata* Billings  
 “ ? *tuberculata* Schmidt

## North America

- Scenella conula* Walcott  
 “ *retusa* Ford = (part = *Paterina troyensis*)  
 “ *varians* Walcott = (part *S. amii*)  
 “ *amii* Matthew

## China

- Scenella clotho* Walcott = *Scenellopsis clotho*  
 “ “ Saito = *S. saitoi*  
 “ *dilatatus* Walcott = *S. dilatata*

**Scenella amii (Matthew)**

- Metoptoma amii* MATTHEW, Trans. Roy. Soc. Canada, 2nd ser., vol. 8, sec. 4, p. 111, pl. 1, fig. 12, 1902.  
*Scenella varians* WALCOTT, Canadian Alpine Journ., vol. 1, no. 2, pl. 1, fig. 6, 1908.  
 [Not *Scenella varians* WALCOTT, U. S. Geol. Surv. Bull. 30, p. 127, pl. 12, figs. 2, 2a, 1886.]

Middle Cambrian, Stephen; (loc. 14s) Mount Stephen, near Field, British Columbia.

*Holotype*.—Walker Mus. (?); plesiotype, U.S.N.M. no. 96483.

**Scenella columbiana (Walcott)**

- Crania ? columbiana* WALCOTT, Proc. U. S. Nat. Mus., vol. 11, p. 441, 1889.  
*Philhedra ? columbiana* VON HUENE, Verhandl. Russ.-kais. Min. Gesell. St. Petersburg, 2nd ser., vol. 36, pt. 2, pp. 216, 298, 1899.  
*Philhedra columbiana* WALCOTT, U. S. Geol. Surv. Mon. 51, p. 724, pl. 81, fig. 10, 1912.

Walcott reports the finding of two additional imperfect specimens in 1907. Examination of these specimens leads one to doubt their identity with the type. It is possible that they are merely the apical portions of *Nisusia*.

The type is a minute form not very well preserved. It certainly is not a brachiopod, so the best reference is to *Scenella*. This specimen may be merely a poorly or rather unusually preserved example of *Scenella amii*. However, since no other such example has been noted among the hundreds of *Scenella amii* specimens in the collection, this form may retain its specific rank.

Middle Cambrian; (loc. 14s) Mount Stephen, above Field, British Columbia.

*Holotype*.—U.S.N.M. no. 58307.

## SCENELLOPSIS, n. gen.

A peculiar form from China, referred with reservation to *Scenella*, seems to be a gastropod.

*Scenellopsis* is a small limpetlike shell with somewhat eccentric apex. Both growth and radiating lines are present but are preserved in two different specimens. Muscular impression, evidently branching, produces folds on the outer surface.

*Genotype*.—*Scenella clotho* Walcott.

**Scenellopsis dilatata (Walcott)**

*Scenella ? dilatatus* WALCOTT, Proc. U. S. Nat. Mus., vol. 30, p. 570, 1906; Research in China, vol. 3, Carnegie Inst. Publ. 54, p. 87, pl. 5, figs. 2, 2a, 1913.

Middle Cambrian, Changhia; (loc. C70) southeast of Tungyü, Shansi, China.

*Cotypes*.—U.S.N.M. nos. 57767, 8.

**Scenellopsis clotho (Walcott)**

*Scenella clotho* WALCOTT, Proc. U. S. Nat. Mus., vol. 29, p. 12, 1905; Research in China, vol. 3, Carnegie Inst. Publ. 54, p. 86, pl. 5, figs. 3, 3a, 1913.

Middle Cambrian, Changhia; (loc. C18) East of Changhia, Shantung, China.

*Holotype*.—U.S.N.M. no. 57769.

**Scenellopsis saitoi, n. sp.**

*Scenella clotho* SAITO (not Walcott), Journ. Faculty Sci. Imp. Univ. Tokyo, sec. 2, vol. 4, pt. 3, p. 359, pl. 3, figs. 18, 19, 1936.

This species resembles *S. clotho*, but, as pointed out by Saito, the apex is not as high and the apertural margin is less upturned. Saito's figures show that the marginal outline is also much more flattened at the broad end.

Lower Cambrian, Misaki; near Chungwa, northern Chosen.

*Holotype*.—Geol. Inst. Imp. Univ. Tokyo.

## HYOLITHES Eichwald, 1840

Eichwald established *Hyolithes* on *H. acutus* from Ordovician strata of Estonia. The genus seems to be valid for other species extending from the Lower Cambrian into the Devonian. In the earlier years *Hyolithes* was confused with various cephalopod genera, particularly *Orthoceras* but this confusion was cleared up long ago. Several authors attempted classification of the family but no one has completed the job.



Matthew erected the genus *Camarotheca* for the hyolithid forms which show internal septa and a structure analogous to the cephalopod siphuncle. Examination of many species shows that cameration depends on preservation and may be found in any species. The other genera excepting *Camarotheca* are apparently all valid, or at any rate express definite and distinctive structures.

*Orthotheca* Novak is valid only for Ordovician organisms, which are unrelated to the rounded tubes oftentimes placed in *Hyolithes*. Therefore, the practice, followed by the author and others, of assigning tapered tubes with circular cross-section to *Orthotheca*, is improper.

Revision of Cambrian Hyolithidae is greatly needed. Not only must a series of genera be established but the species themselves have been so carelessly handled that most are of little value. Recent stratigraphic studies occasioned review, in part, of *H. primordialis* and *H. billingsi*. Several of the resulting nomenclatural changes are recorded below.

***Hyolithes gregarius* (Meek and Hayden)**

*Theca (Puginuculus) gregaria* MEEK and HAYDEN, and Proc. Acad. Nat. Sci. Philadelphia, p. 436, 1861; Amer. Journ. Sci., 2d ser., vol. 33, p. 73, text fig. 3, 1862.

*Theca gregaria* MEEK and HAYDEN, Pal. Upper Missouri, Smithsonian Contr. Knowl., vol. 7, p. 5, text figs. a-d, 1865.

This species averages much smaller than *H. primordialis* to which it was referred and, therefore, is again recognized.

Upper Cambrian, Depass; Powder River, Big Horn Mountains, Wyoming.

*Cotypes*.—U.S.N.M. no. 1181.

***Hyolithes gallatinensis*, n. sp.**

*Hyolithes primordialis* WALCOTT (part), U. S. Geol. Surv. Mon. 32, pt. 2, p. 454, pl. 63, fig. 2, 1899.

This wide species is characterized by a very slightly convex posterior surface and an evenly, semicircular anterior side. The surface is smooth in the specimens available but they may be interiors only. The lingual extension is broken away.

Upper Cambrian, Dry Creek; (loc. 151c) Crowfoot Ridge, Gallatin Range, Yellowstone National Park, Wyoming.

*Holotype*.—U.S.N.M. no. 35218.

***Hyolithes whitei*, n. sp.**

*Hyolithes primordialis* ? WHITE, Geogr. Geol. Expl. Surv. West 100th Merid., Prelim. Rep. Invert. Foss., p. 6, 1874. Idem, vol. 4, pt. 1, p. 37, pl. 1, figs. 5a-e, 1875.

*Hyolithes billingsi* WALCOTT (part), U. S. Geol. Surv. Bull. 30, p. 134, pl. 13, figs. 1, 1a-d, 1886; idem, 10th Ann. Rep., p. 620, pl. 75, figs. 1, 1a-d, 1891; LESLEY (part), Geol. Surv. Pennsylvania, Rep. P4, p. 294, figs. 1889; GRABAU and SHIMER, N. A. Index Foss., vol. 2, p. 3, figs. 1211e-g, 1910.

*H. whitei* is a rather small species with a thick shell. The posterior side is nearly flat; the anterior is angulated giving the tube a nearly equilateral triangular outline. The lateral corners are rounded.

Lower Cambrian, Pioche; (loc. 31a) southeast of Pioche, Highland Range, Nevada.

*Cotypes*.—U.S.N.M. nos. 8579, 15377.

***Hyolithes poulsenii*, n. sp.**

*Hyolithes billingsi* POULSEN, Meddels. Grønland, vol. 70, p. 254, pl. 15, figs. 26, 27, 1927.

*Hyolithus (Hyolithus) billingsi* POULSEN, idem, vol. 87, no. 6, p. 22, pl. 3, fig. 6, 1932.

This species has a flat posterior side and a rounded anterior face. It expands much more rapidly and is larger than *H. billingsi*. The anterior surface is striated.

Lower Cambrian, Cape Kent; Cape Kent, North Greenland. Bastion; Hyolithus Creek, East Greenland.

*Cotypes and plesiotypes*.—Min. Mus. Copenhagen; plastotypes, U.S.N.M. no. 70951.

## CRUSTACEA

### STENOTHECA Salter, 1872

*Stenotheca* HICKS (Salter MSS.), Quart. Journ. Geol. Soc. London, vol. 28, p. 180, 1872; WALCOTT, U. S. Geol. Surv. Bull. 30, p. 128, 1886; MATTHEW, Trans. Roy. Soc. Canada, vol. 8, p. 132, 1891; GRABAU and SHIMER, N. A. Index Foss., vol. 2, p. 373, 1910; COBBOLD, Geol. Mag., vol. 71, p. 463, 1934.

*Watsonella* GRABAU, Occ. Pap. Boston Soc. Nat. Hist., vol. 4, p. 631, 1900.

*Stenotheca*, a generic name attached to museum specimens, was published without description in 1872. In 1886 Walcott described the genus but quite clearly based his remarks on *Helcionella rugosa* and its allies. Consequently his description is that of the gastropod genus *Helcionella*. More recently Cobbold restudied Salter's types and presented a generic diagnosis.

In 1891 Matthew recognized the crustacean characters of *Stenotheca*, in which he was followed by Grabau and Shimer. The latter, however, assigned only gastropod species to the genus. Cobbold assigns the genus to the Notostraca.

It will be observed that Cobbold's generic description of *Stenotheca* agrees in every detail with that of *Watsonella* Grabau. The illustrations also agree; therefore *Watsonella* must be regarded as a synonym of *Stenotheca*.

All known species of *Stenotheca* are confined to the Atlantic province.

*Genotype*.—*S. cornucopia* Salter.

The following are regarded as valid species of *Stenotheca*:

<i>S. angusta</i> Cobbold	<i>S. hicksiana</i> Matthew
<i>S. concentrica</i> Matthew	<i>S. lata</i> Cobbold
<i>S. cornu</i> Wiman	<i>S. nasuta</i> Matthew
<i>S. cornucopia</i> Salter	<i>S. radiata</i> Matthew
<i>S. crosbyi</i> (Grabau)	

Species formerly referred to *Stenotheca* are given, together with their synonyms.

<i>S. abrupta</i> ? Cobbold	= <i>Helcionella cobboldi</i>
<i>S. abrupta</i> Grabau and Shimer	= <i>H. grabaui</i>
<i>S. abrupta</i> Shaler and Foerste	= <i>H. abrupta</i>
<i>S. (Parmorphorella) acadica</i> Matthew	= <i>Parmorphorella acadica</i>
<i>S. clurius</i> Walcott	= <i>Helcionella ? clurius</i>
<i>S. curvirostra</i> Grabau	= <i>H. alia</i>
<i>S. curvirostra</i> Shaler and Foerste	= <i>H. curvirostra</i>
<i>S. elongata</i> Walcott	= { <i>Stenothecoides elongata</i> <i>S. labradorica</i>
<i>S. levis</i> Grabau	= <i>Helcionella striata</i>
<i>S. pauper</i> Billings	= <i>H. pauper</i>
<i>S. pauper</i> Grabau	= <i>H. recurva</i>
<i>S. rugosa</i> Billings	= <i>H. rugosa</i>
<i>S. rugosa</i> Walcott	= { <i>H. curticei</i> <i>H. fordi</i> <i>H. walcotti</i> <i>H. halli</i> <i>Stenothecoides troyensis</i>
<i>S. rugosa</i> Sears	= <i>Helcionella abrupta</i>
<i>S. rugosa</i> Tate	= <i>H. tatei</i>
<i>S. ? rugosa acutacosta</i> Walcott	= <i>H. acutacosta</i>
<i>S. rugosa aspera</i> Noetling	= <i>Pseudotheca waageni</i>
<i>S. rugosa erecta</i> Walcott	= <i>Helcionella erecta</i>
<i>S. rugosa chinensis</i> Walcott	= <i>H. chinensis</i>
<i>S. ? rugosa levis</i> Walcott	= <i>H. levis</i>
<i>S. rugosa orientalis</i> Walcott	= <i>H. orientalis</i>
<i>S. rugosa pauper</i> Shaler and Foerste	= <i>H. foerstei</i>
<i>S. rugosa paupera</i> Walcott	= <i>H. pauper</i>
<i>S. simplex</i> Walcott	= <i>H. ? simplex</i>
<i>S. triangularis</i> Matthew	= <i>H. triangularis</i>
<i>S. wheeleri</i> Walcott	= <i>H. wheeleri</i>

***Stenotheca crosbyi* (Grabau)**

*Watsonella crosbyi* GRABAU, Occ. Pap. Boston Soc. Nat. Hist., vol. 4, p. 632, pl. 31, figs. 9a-f, 1900.

Lower Cambrian, Weymouth; Pleasant Beach and Sandy Cove, Cohasset, Massachusetts.

*Cotypes*.—Boston Soc. Nat. Hist. nos. 11951-11954.

**STENOTHECOIDES, n. gen.**

*Stenothecoides* is related to *Stenotheca*, but is much narrower and longer, with, a relatively wider aperture. The genus is characterized by the long narrow carapace which is curved longitudinally. This curvature is usually much greater in cross-section, amounting to a fold along the apex. The apertural outline increases from the narrow anterior end almost evenly to a broadly rounded rear margin. The marginal outline of some species is not bilaterally symmetrical, curving out more on one side than the other. The surface is marked with growth lines surrounding the anterior end, each extending itself rearward at a greater rate, so that while the anterior ends remain close together, the lines become longer and longer, reaching to the posterior portion of the test.

*Genotype*.—*Stenotheca elongata* Walcott.

***Stenothecoides elongata* (Walcott)**

*Stenotheca elongata* WALCOTT, U. S. Geol. Surv. Mon. 8, p. 23, pl. 9, figs. 2, 2a, 1884; idem (part), Bull. 30, p. 129, pl. 12, figs. 4a, b, 1886 (not fig. 4 = *S. labradorica*).

*Helcionella elongata* WALCOTT, Smithsonian Misc. Coll., vol. 67, no. 3, p. 63, 1917.

Middle Cambrian, Eldorado; (loc. 55b) West slope Prospect Peak, Eureka District, Nevada.

*Holotype*.—U.S.N.M. no. 15364.

***Stenothecoides labradorica*, n. sp.**

*Stenotheca elongata* WALCOTT (part), U. S. Geol. Surv. Bull. 30, p. 129, pl. 12, fig. 4, 1886.

This species was identified with that from the Eureka District, Nevada, but the drawing shows that it is clearly distinct. *S. labradorica* is shorter and wider and the apertural margin evidently is not as symmetrical as *S. elongata*. The growth lines are also somewhat weaker.

Lower Cambrian, Forteau; L'Anse au Loup, Labrador.

*Holotype*.—U.S.N.M. no. 14883.

**Stenothecoides troyensis, n. sp.**

*Stenotheca rugosa* WALCOTT (part), U. S. Geol. Surv. Bull. 30, p. 128, pl. 12, figs. 1d, e, 1886 (see *Helcionella rugosa*); idem, 10th Ann. Rep., p. 617, pl. 74, figs. 1h, i, 1891.

This a very small species, and is much wider than any of the others. Longitudinal curvature is accentuated at the anterior end so that a slightly recurved apex is developed.

Lower Cambrian, Schodack; (loc. 27) Troy, and other localities in New York.

*Holotype*.—U.S.N.M. no. 96484.

**Stenothecoides poulseni, n. sp.**

Undetermined lamellibranch POULSEN, Meddels Grønland., vol. 87, no. 6, p. 29, pl. 7, figs. 1-4, 1932.

It is possible that more than one species is represented by the specimens illustrated. Growth lines are coarse and irregular. This species is so constricted laterally toward the anterior end as to form a distinct apex.

Lower Cambrian, Ella Island; south coast Ella Island, east Greenland.

*Cotypes*.—Min. Mus. Copenhagen.

**TUZOIA Walcott, 1912****Tuzoia argenta (Walcott)**

*Leperditia? argenta* WALCOTT, U. S. Geol. Surv. Bull. 30, p. 146, pl. 8, fig. 5, 1886.

Middle Cambrian, Ophir; (loc. 30a) 1 mile below Argenta, Big Cottonwood Canyon, Wasatch Mountains; and (loc. 54a) Blacksmith Fork, Bear River Range, Utah.

*Holotype*.—U.S.N.M. no. 15401.

**UNCERTAIN POSITION****UROTHECA Matthew, 1899****Urotheca parasitum, n. sp.**

*Hyolithellus flagellum* WALCOTT (part), Smithsonian Misc. Coll., vol. 67, no. 2, p. 26, pl. 5, fig. 2a, 1917.

This species consists of narrow, long flexible tubes which had one or more longitudinal grooves. It is a much smaller tube than *U. flagellum*. The type and other specimens grew on shells of *Wimanelia*, which raises the question whether all species of *Urotheca* had such growth habit.

Middle Cambrian, Ptarmigan; (loc. 63j) Popes Peak,  $1\frac{1}{2}$  miles southwest of Stephen, and (loc. 35c) Mount Bosworth, British Columbia.

*Cotypes*.—U.S.N.M. no. 63723.

#### COLEOLOIDES Walcott, 1890

##### *Coleoloides hectori* (Walcott)

*Hyalithellus hectori* WALCOTT, Smithsonian Misc. Coll., vol. 67, no. 2, p. 27, pl. 5, fig. 1, 1917.

This species is referred to *Colcoloides* on the basis of its shape and the presence of striations. It differs from *C. typicalis* in that the striations are coarser, and the tube itself is of greater diameter. Too little of the tube preserves the striated outer surface to show whether the striations in *C. hectori* have a spiral course, but they seem to be slightly off parallel position in the short portion preserved.

Middle Cambrian, Ross Lake; (loc. 35c) 1 mile east of Hector, Mount Bosworth, British Columbia.

*Holotype*.—U.S.N.M. no. 63721.

### AGNOSTIDA

#### AGNOSTUS Brongniart, 1822

##### *Agnostus yellowstonensis*, n. sp.

*Agnostus bidens* WALCOTT, U. S. Geol. Surv. Mon. 32, pt. 2, p. 455, pl. 63, figs. 4, 4a, 1899.

This species is not the same as the Middle Cambrian *A. bidens* Meek. It is characterized by strong dorsal furrows in both shields, the anterior glabellar lobe being sharply separated. The published illustration of the pygidium is misleading because the artist failed to eliminate perspective when drawing the convex shield and therefore extended the axis too far rearward. In fact the space between the rhachis and rear margin is half the width of the pleural lobes.

Upper Cambrian, Dry Creek; (loc. 151c) Crowfoot Ridge, Gallatin Range, Yellowstone National Park, Wyoming.

*Cotypes*.—U.S.N.M. no. 35222.

### TRILOBITA

#### BAILIELLA Matthew, 1885

*Bailiella* RESSER, Smithsonian Misc. Coll., vol. 95, no. 4, p. 15, 1936.

Several species must be added to the list published in 1936. Some of them were overlooked, one correction was expected to appear elsewhere and others have since been described under *Conocoryphe*.

**Bailiella artagena (Howell)**

*Conocoryphe? artagena* HOWELL, Bull. Geol. Soc. Amer., vol. 48, no. 8, p. 1169, pl. 3, fig. 7, 1937.

Middle Cambrian, St. Albans; St. Albans, Vermont.

*Holotype*.—Princeton Univ. no. 9925.

**Bailiella frangtengensis (Reed)**

*Conocoryphe frangtengensis* REED, Mem. Geol. Surv. India, Pal. Ind., new ser., vol. 21, mem. 2, p. 7, pl. 2, figs. 9-12, 1934.

Middle Cambrian; Frangteng Hill, Hundwara, Kashmir, India.

*Cotypes*.—Geol. Surv. India nos. 15593-6.

**Bailiella lantenoisi (Mansuy)**

*Conocoryphe lantenoisi* MANSUY, Mem. Serv. Geol. l'Indo-Chine, vol. 5, fasc. 1, p. 30, pl. 4, figs. 6, 7; pl. 5, fig. 3, 1916; KOBAYASHI, Journ. Faculty Sci. Imp. Univ. Tokyo, sec. 2, vol. 4, pt. 2, p. 218, pl. 23, figs. 13, 14, 1935.

Middle Cambrian; Tien-fong, Tonkin.

**Bailiella sejuncta (Reed)**

*Conocoryphe sejuncta* REED, Mem. Geol. Surv. India, Pal. Ind., new ser., vol. 21, mem. 2, p. 8, pl. 2, figs. 13, 14, 1934.

Middle Cambrian; Wadapur, Hundwara, Kashmir, India.

*Cotype*.—Geol. Surv. India nos. 15597-8.

**Bailiella ulrichi (Resser and Endo)**

*Conocoryphe ulrichi* RESSER and ENDO, in Endo, Iwanami Lecture Ser., Geol. Pal., p. 54, figs. 5-8, December 1931.

Middle Cambrian, Tangshih; Tang-shih-ling, 2 miles southeast Yen-tai Colliery, Manchoukuo.

**BLOUNTIA Walcott, 1916*****Blountia polita*, n. sp.**

*Arionellus* sp. WALCOTT, U. S. Geol. Surv. Mon. 32, pt. 2, p. 463, pl. 65, fig. 2, 1899.

Walcott illustrated this pygidium as a cranidium. The artist drew "glabellar" furrows, but when his pencil marks were washed off the specimen, no trace of axial furrows remain.

*B. polita* is characterized by its flat lateral profile, and the rather elongate shape due to the lack of narrowing as the pleural lobes unite behind the axis. The dorsal furrow is shallow, but the axis is marked rather clearly by a change in the profile.

Upper Cambrian, Pilgrim; (loc. 151b) between Pebble and Soda Butte Creeks, Yellowstone National Park, Wyoming.

*Holotype*.—U.S.N.M. no. 96488.

**BRISCOIA** Walcott, 1924

***Briscoia texana* (Walcott)**

*Diklocephalus texanus* WALCOTT, Smithsonian Misc. Coll., vol. 57, no. 13, p. 372, pl. 65, fig. 4, 1914.

Upper Cambrian, Wilberns; (loc. 70a) Baldy Mountain, near Morgans Creek, 8 miles northwest of Burnet, Texas.

*Holotype*.—U.S.N.M. no. 58621.

**CHARIOCEPHALUS** Hall, 1863

*Chariocephalus* HALL, 16th Ann. Rep. New York State Cab. Nat. Hist., p. 175, 1863.

*Dartonaspis* MILLER, Journ. Pal., vol. 10, no. 1, p. 29, 1936.

Miller failed to observe that the criteria on which he based *Dartonaspis* are exactly those which led to the separation of *Irvingella* from *Chariocephalus*. These relationships are discussed under *Irvingella*.

***Chariocephalus knighti* (Miller)**

*Dartonaspis knighti* MILLER, Journ. Pal., vol. 10, no. 1, p. 29, pl. 8, figs. 34, 35, 1936.

Upper Cambrian, Boysen; Bull Lake Creek, Wind River Range, Wyoming.

*Holotype*.—Columbia Univ. no. 12626.

**CLEVELANDELLA** Resser, 1938

***Clevelandella volux* (Walcott)**

*Saratogia volux* WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 3, p. 198, pl. 35, figs. 2, 2a, 1916.

Upper Cambrian, Eau Claire; (loc. 78a) Eau Claire, Wisconsin.

*Holotype*.—U.S.N.M. no. 61714.

**CHUANGIA** Walcott, 1911

***Chuangia suni*, n. sp.**

*Chuangia batia* SUN, Pal. Sinica, ser. b, vol. 1, fasc. 4, p. 58, pl. 4, figs. 4a-e, 1924.

This species is narrower than *C. batia*. The eyes are situated somewhat more forward and are perhaps a little larger. The species



also has a wider preglabellar area. Glabellar furrows are evidently very faint.

Upper Cambrian, Kaolishanian; Pagoda Hill, Taianfu, Shantung, China.

*Cotypes*.—Geol. Surv. China nos. 579-583.

#### DEADWOODIA, n. gen.

This trilobite genus is represented by a single cranidium. However, it appears among undescribed material of Ironton age, from several localities and consequently description is warranted.

The cranidium is characterized by a very large, nearly quadrate glabella, highly arched in both directions and standing high above the fixigenes. Glabellar furrows essentially absent. Occipital furrow deep, but narrow. Brim is wide, concave as a whole. Preglabellar area slightly convex, dipping steeply down from the dorsal furrow. Anterior furrow shallow, with the essentially flat rim turned nearly into a horizontal position. Fixigenes narrow, as well as the posterolateral limbs. Eyes rather large, strongly bowed, and palpebral lobes separated by deep furrows.

*Genotype*.—*Ptychoparia (Liostracus) panope* Walcott.

#### *Deadwoodia panope* (Walcott)

*Ptychoparia (Liostracus) panope* WALCOTT, Proc. U. S. Nat. Mus., vol. 13, p. 275, pl. 21, fig. 13, 1890.

Upper Cambrian, Deadwood (Ironton equivalent); Spring Creek Canyon, about 7 miles southwest of Rapid City, Black Hills, South Dakota.

*Holotype*.—U.S.N.M. no. 23856.

#### EHMANIA Resser, 1935

#### *Ehmania ? agatho* (Walcott)

*Asaphiscus ? agatho* WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 5, p. 391, pl. 63, figs. 9, 9a, 1916.

Upper Cambrian, Nolichucky; (loc. 123a) Big Creek, 4 miles northeast of Rogersville, Tennessee.

*Cotypes*.—U.S.N.M. nos. 62819-20.

#### ELVINIA Walcott, 1924

#### *Elvinia roemeri* (Shumard)

*Dikelocephalus roemeri* SHUMARD, Amer. Journ. Sci., 2d ser., vol. 32, p. 220, 1861.

*Elvinia roemeri* WALCOTT (part), Smithsonian Misc. Coll., vol. 75, no. 2, p. 56, 1924; idem, no. 3, p. 88, 1925; BRIDGE (part), U. S. Geol. Surv. Prof. Pap., 186-M, p. 251, pl. 67, figs. 2a, b, 3a, b; pl. 69, figs. 1-8, 10, 15, 1937.

*E. roemeri* is not a widespread species, but many other forms have been mistakenly identified with it. Without Shumard's specimens it is impossible to know which Texas species received the name *E. roemeri*. Bridge studied Roemer's original material and commented on the other species of the genus, but he failed to select a type for *E. roemeri*. Inasmuch as Shumard's types are lost and Shumard specifically states that figure 2a of Roemer is the species he was describing, it is logical to choose that specimen as the lectotype. Bridge went so far as to say that this specimen "is the nearest thing to a type that exists."

Upper Cambrian, Wilberns;  $\frac{1}{2}$  mile east of Camp San Saba and (loc. 14i) 1 mile west of Cherokee, in San Saba County; (loc. 70) Morgans Creek, 8 miles northwest of Burnet, Texas.

*Lectotype and paratypes*.—Univ. Bonn; casts, U.S.N.M. no. 95485.

***Elvinia texana*, n. sp.**

*Elvinia roemeri* BRIDGE (part), in Sellards, Adkins, and Plummer, Texas Univ. Bull. 3232, p. 323, pl. 2, figs. 17, 18, 1933; BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 251, pl. 69, fig. 15, 1937.

This form is about the same size as *E. roemeri* but is relatively longer. The width across the fixigenes immediately in front of the eyes is less than in *E. roemeri*, and the profile is less highly arched in both directions. The glabella of *E. texana* is rather sharply truncate in front, and the anterior facial sutures extend almost straight forward.

No pygidium has been definitely assigned to this cranidium. Several are present in the collection, but only one is good enough to assign to a species. By its size and other features this pygidium seems to be more logically referred to a larger species.

Upper Cambrian, Wilberns; (loc. 68) Packsaddle Mountain, 12 miles southeast of Llano, Texas.

*Holotype*.—U.S.N.M. no. 93013.

***Elvinia shumardi*, n. sp.**

*Elvinia roemeri* WALCOTT (part), Smithsonian Misc. Coll., vol. 75, no. 2, p. 56, pl. 11, fig. 3, 1924; idem, no. 3, p. 88, pl. 17, figs. 9-13, 1925; BRIDGE (part), in Sellards, Adkins, and Plummer, Texas Univ. Bull. 3232, p. 323, pl. 2, fig. 19, 1933; BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 251, pl. 69, figs. 9, 10, 1937.

This is a large species, attaining an average size about twice that of *E. roemeri*. The anterior suture diverges more than *E. texana*, although the relative width immediately in front of the eyes is about the same. *E. shumardi* is decidedly flat in lateral profile. Longitudinally the species has a highly arched profile, but without being greatly curved. The neck furrow is discontinuous, a distinctive feature of the species.

It should be added that Walcott selected this species to represent Shumard's *E. roemeri*. This selection cannot stand because Roemer's figure 2a was specifically mentioned by Shumard.

Upper Cambrian, Wilberns; (loc. 70) Morgans Creek, about 8 miles northwest of Burnet; and (loc. 68) Packsaddle Mountain, 12 miles southeast of Llano, Texas.

*Holotype*.—U.S.N.M. no. 70259; paratypes, no. 70260, 1.

***Elvinia bridgei*, n. sp.**

*Elvinia roemeri* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 251, pl. 69, figs. 19-21, 1937.

Unfortunately only an incomplete cranidium of this species was illustrated. Although none of the numerous cranidia in the collection are complete, many are more so than the specimen illustrated. However, this cranidium shows sufficient of the width of the head and the depth of the furrows to characterize the species. The occipital furrow is deeper and wider than shown. The eyes are in a position about parallel to the course of the dorsal furrow. The preglabellar area is bulged so that the rather straight anterior furrow is deep, and is marked by irregular longitudinal ridges. The rim is rather wide and swollen, separated by a deep anterior furrow. This species is much more highly arched longitudinally than laterally.

The associated pygidium is of normal type, and has the rim turned up rather sharply.

There are several other species of *Elvinia* in the Oklahoma collections, but, since they require illustration, are not included in this paper.

Upper Cambrian, Honey Creek; (loc. 89v) NE.  $\frac{1}{4}$  Sec. 9, T. 1 S., R. 1 W., 4 miles southeast of Hennepin, Arbuckle Mountains, Oklahoma.

*Cotypes*.—U.S.N.M. no. 93025.

***Elvinia missouriensis*, n. sp.**

*Elvinia roemeri* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 251, pl. 69, figs. 12, 13, 1937.

Bridge figured one of the two species present at the locality. The holotype is a well-preserved cranidium.

This species is characterized by its relative narrowness immediately in front of the eyes. The eyes are not parallel to the dorsal furrow, but make a wide angle with the axis. Eyelines are rather heavy. The cranidium is arched considerably laterally, this being accentuated by the pronounced downward depression of the anterior angles of the brim. Longitudinally the head is also highly arched, the greatest curvature being in the anterior half. The preglabellar area is bulged a bit and the thickened rim is sharply upturned.

Upper Cambrian, Davis; (loc. 11k) near shaft of Federal Lead Mine No. 4, Flat River, Missouri.

*Holotype*.—U.S.N.M. no. 93011.

***Elvinia dakotensis*, n. sp.**

*Elvinia roemeri* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 251, pl. 69, figs. 14, 16, 1937.

This species is nearest like *E. missouriensis*, differing in the rounding of the anterior portion of the glabella and the slightly narrower width immediately in front of the eyes. *E. dakotensis* also has less rugged relief in the various portions of the brim. In *E. dakotensis* the glabella does not rise so much as the fixigenes, and the longitudinal curvature, which is considerable, forms a rather even curve.

The librigenes are large and wide, with a strongly curved outer margin, particularly toward the genal angle. The genal spine is short and small. The associated pygidium has an axis which stands well above the flat pleural lobes.

Upper Cambrian, Deadwood; (loc. 88a) northern part of Deadwood, Black Hills, South Dakota.

*Cotypes*.—U.S.N.M. no. 93024.

***Elvinia utahensis*, n. sp.**

*Elvinia roemeri* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 251, pl. 69, fig. 22, 1937.

This species is characterized by rugged relief due to the depth of all furrows, the arching of the preglabellar area and of the fixigenes and the depression of the anterior angles of the brim. The eyes are large and situated rather far forward.

Upper Cambrian, Orr; (loc. 32t) Fandango Spring Canyon, east side Dugway Range, Utah.

*Holotype*.—U.S.N.M., no. 93026.

**Elvinia matheri (Walcott)**

*Ptychoparia matheri* WALCOTT, Smithsonian Misc. Coll., vol. 57, no. 9, p. 268, pl. 44, figs. 15-17, 1912; BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 254, pl. 69, fig. 11, 1937.

Upper Cambrian, Potsdam; (loc. 110) east side of Whitehall, New York.

*Cotypes*.—U.S.N.M. nos. 58585-7.

**GENEVIEVELLA Lochman, 1936**

*Genevievella* LOCHMAN, Journ. Pal., vol. 10, no. 1, p. 40, 1936.

*Llanoaspis* LOCHMAN, idem, vol. 12, no. 1, p. 80, 1938.

When this genus was established, only the genotype was known. Two species were added from Texas, and the descriptions of eleven from the Appalachians are in press; consequently this is a well-represented trilobite genus. Thus far the genus is confined to the *Crepicephalus* zone.

*Llanoaspis modesta* and *L. undulata* Lochman become *Genevievella*.

**IRVINGELLA Ulrich and Resser, 1924**

*Irvingella* was applied to species which differ from *Chariocephalus* in a limited degree. *Chariocephalus* has large eyes situated rather far forward. The facial suture joins the dorsal furrow anterior to the eye, by which arrangement the anterior fixigene is eliminated and the brim is caused to be a single bar not attached to the fixigenes at the anterior angles. On the other hand *Irvingella* has even larger eyes than *Chariocephalus*, the extra length being attained by the rear portion of the palpebral lobes extending farther back. At the same time the eyes are slanted outward from the axis of the head. Above all, *Irvingella* differs from *Chariocephalus* by having anterior fixigenes which unite with the brim.

**Irvingella tumifrons (Hall and Whitfield)**

*Chariocephalus tumifrons* HALL and WHITFIELD, U. S. Geol. Expl. 40th Par., vol. 4, p. 224, pl. 2, figs. 38, 39, 1877.

Upper Cambrian, Secret Canyon; Pogonip Mountain, White Pine District, Nevada.

*Holotype*.—U.S.N.M. no. 24561.

**KOCHINA Resser, 1935****Kochina? lux (Walcott)**

*Ptychoparia lux* WALCOTT, Smithsonian Misc. Coll., vol. 67, no. 3, p. 90, pl. 12, fig. 5, 1917.

Lower Cambrian, Mount Whyte; (loc. 61d) southwest slope Mount Shaffer, British Columbia.

*Holotype*.—U.S.N.M. no. 64387.

#### LONCHOCEPHALUS Owen, 1852

##### *Lonchocephalus verrucosus* (Whitfield)

*Conocephalites verrucosus* WHITFIELD, Amer. Mus. Nat. Hist. Bull. 1, p. 146, pl. 14, figs. 9-12, 1884.

Upper Cambrian, Potsdam; near "Post office," Ausable Chasm, New York.

*Cotypes*.—A.M.N.H. no. 280.

#### MENOMONIDAE Walcott

##### MENOMONIA Walcott, 1916

*Menomonina* WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 3, p. 161, 1916.

*Millardia* WALCOTT, idem, p. 163, 1916.

Walcott referred three genera to the Proparian family Menomonidae, but he failed to recognize that two of them were identical. Evidence for a primitive aspect about *Menomonina* and *Dresbachia* may be questioned. Evidently Walcott based his idea of this on the numerous thoracic segments of *M. calymenoides*. Examination of available specimens fails to prove that this extraordinarily long thorax belongs to *Menomonina*, although association in three instances suggests the possibility. Even if the genotype has 42 thoracic segments, one can hardly consider this alone as evidence of primitive structure.

It seems rather that the Menomonidae are a highly specialized group descended from species now placed in *Alokistocare*.

*Menomonina* is a characteristic trilobite of the early Upper Cambrian *Cedaria* zone; thus far being confined to that zone. Whitfield's original specimens of the type species are on small pieces of rock with the types of *Cedaria woosteri*.

*Millardia* was distinguished from *Menomonina* by differences of brim and in having fewer thoracic segments. There is a difference in the brim of *M. calymenoides* and of *M. semele* but it involves no altered structure and the gap between the two species is bridged by intermediate forms. *M. calymenoides* has a much swollen brim, whereas other species obtain the same rigidity by arching the short brim. Many specimens referred to *Millardia* retain the librigenes, giving them a different aspect, which caused their reference to a separate genus.

*Dresbachia* is a distinct, but closely related genus. Compared with *Menomonina*, the glabella is essentially the same but the fixigenes are

much larger. The large librigenes—the part of this trilobite most commonly preserved—are attached to a very short brim, which is reduced to little more than a line, terminating in a swollen knob like the rim *Menomonina*. In other words *Dresbachia* is characterized by the lateral shortening of the preglabellar area to a mere line for the attachment of the librigenes which lies wholly in front of the glabella.

Besides the genotype and the species formerly referred to *Millardia*, several new species from the Appalachian Nolichucky formation are in press.

**Menomonina avitas (Walcott)**

*Millardia avitas* WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 3, p. 165, pl. 28, figs. 5-5e, 1916.

Upper Cambrian, Warrior; (loc. 107k) 2 miles north of Benore, Center County, Pennsylvania.

*Holotype*.—U.S.N.M. no. 61629.

**Menomonina magnagranulata (Lochman)**

*Millardia magnagranulata* LOCHMAN, Journ. Pal., vol. 12, no. 1, p. 84, pl. 18, fig. 3, 1938.

Upper Cambrian, Cap Mountain; southwest side of Lion Mountain, Highway 29, 9 miles northwest of Burnet, Texas.

*Holotype*.—U.S.N.M. no. 95015.

**Menomonina optata (Hall)**

*Conocephalites optatus* HALL, 16th Ann. Rep. New York State Cab. Nat.

Hist., p. 222, pl. 5A, fig. 7, 1863. Trans. Albany Inst., vol. 5, p. 195, 1867.

*Ptychoparia optata* MILLER, North Amer. Geol. Pal., p. 539, 1880.

*Millardia optata* WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 3, p. 165, pl. 28, figs. 4, 4a-f, 1916.

One cannot be certain that Hall's original type and the specimens figured by Walcott represent the same species. At any rate Hall's original is a very small specimen.

Upper Cambrian, Eau Claire; Willow River Falls, Trempealeau, and other localities in Wisconsin and Minnesota.

*Holotype*.—A.M.N.H. no. 322; plesiotypes, U.S.N.M. nos. 61626-8.

**Menomonina semele (Walcott)**

*Millardia semele* WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 3, p. 166, pl. 28, figs. 3-3c, 1916.

Upper Cambrian, Weeks; (loc. 30 n) Weeks Canyon, House Range, Utah.

*Cotypes*.—U.S.N.M. nos. 61622-5.

**Menomonion texana, n. sp.**

*Millardia avitas* LOCHMAN (not Walcott), Journ. Pal., vol. 12, no. 1, p. 84, pl. 18, figs. 4-5, 1938.

This species evidently was referred to *M. avitas* because it has smaller granules than *M. magnagranulata*. The reference to the Pennsylvania species cannot stand. *M. avitas* has a few scattered large granules on the glabella and fixigenes; the remainder of the cephalon is smooth to finely granulose or ornamented with lines. The eyes of *M. avitas* are elevated on rather long stalks. This may also have been the case in *M. texana* as the eyes are broken off. *M. texana* is further characterized by a long slender glabella and the eyes are rather far forward.

Upper Cambrian, Cap Mountain; southwest side Lion Mountain, Highway 29, 9 miles northwest of Burnet, Texas.

*Holotype*.—Mount Holyoke Mus. no. 655; paratype, no. 656.

**Menomonion lochmanae (Lochman)**

*Millardia avitas* LOCHMAN, Journ. Pal., vol. 12, no. 5, p. 469, pl. 56, figs. 27, 28, 1938.

This species differs from *M. avitas* in the more incurved anterior margin and considerably larger fixigenes.

Upper Cambrian, Petit Jardin; Cape St. George, Newfoundland.

*Holotype*.—Yale Peabody Mus. no. 15822.

**NORWOODIA Walcott, 1916**

*Norwoodia* WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 3, p. 168, 1916.

*Whitfieldina* RESSER, idem, vol. 95, no. 22, p. 27, 1937.

Just after the 1937 paper appeared, the genus *Norwoodia* was re-considered in conjunction with studies in the southern Appalachians. As soon as the extraneous species then in *Norwoodia* were removed, it became clear that *Whitfieldina* is not a valid genus, because its type species is a typical *Norwoodia*, contrary to the misleading published figures.

**Norwoodia quadrata (Whitfield)**

*Conocephalites quadratus* WHITFIELD, Ann. Rep. for 1879, Wisconsin Geol. Surv., p. 47, 1880; Geol. Wisconsin, vol. 4, p. 180, pl. 1, figs. 15, 16, 1882.

*Whitfieldina quadrata* RESSER, Smithsonian Misc. Coll., vol. 95, no. 22, p. 27, 1927.

Upper Cambrian, Eau Claire; Eau Claire and other localities in Wisconsin.

*Cotypes*.—Univ. Wisconsin.



## OLENOIDES Meek, 1877

*Olenoides expansus* (Walcott)

*Dicellocephalus* ? *expansus* WALCOTT, U. S. Geol. Surv. Mon. 8, p. 45, pl. 9, fig. 19, 1884.

*Dolichometopus* ? *expansus* WALCOTT, Smithsonian Misc. Coll., vol. 64, no. 5, p. 368, pl. 53, figs. 5, 5a, 1916.

Middle Cambrian, Eldorado; (loc. 55b) east slope Prospect Mountain, Eureka District, Nevada.

*Holotype*.—U.S.N.M. no. 15450.

## ORYCTOCEPHALUS Walcott, 1886

Species of this genus have not been carefully discriminated, and specific names were very carelessly used. A brief revision clears the way for erection of the necessary new species.

*Oryctocephalus*, as now constituted, contains two groups of species. The valid species previously recognized are listed under the two groups.

Group of <i>O. primus</i> (genotype)	<i>O. walcotti</i> Resser
<i>O. primus</i> Walcott	<i>O. salteri</i> Reed
<i>O. burgessensis</i> , n. sp.	<i>O. indicus</i> (Reed)
<i>O. walkeri</i> Matthew	<i>O. kobayashi</i> Saito
Group of <i>O. reynoldsi</i>	<i>O. orientalis</i> Saito
<i>O. reynoldsi</i> Reed	<i>O. saitoi</i> , n. sp.

In addition, one undescribed species of the *O. primus* group and several of the *O. reynoldsi* group are in hand.

*Oryctocephalus burgessensis*, n. sp.

*Oryctocephalus primus* KOBAYASHI, Journ. Faculty Sci. Imp. Univ. Tokyo, sec. 2, vol. 4, pt. 2, p. 147, pl. 15, fig. 1, 1935.

Kobayashi picked up a photograph in the National Museum collections and published it as *O. primus*, but this illustration was prepared by Walcott because he recognized that it was not *O. primus*.

*O. burgessensis* is the most abundant species of the genus in the Burgess shale. It is characterized by a normal cranium, seven thoracic segments, and slender pygidial spines of even length. The rear segments of the pygidium are turned back practically parallel to the axis. The pygidial spines of even length cause this species to look much like *O. walkeri*, but the rear pygidial segments are turned back more sharply.

Middle Cambrian, Burgess; (loc. 35k) Burgess Pass, near Field, British Columbia.

*Holotype*.—U.S.N.M. no. 96487.

**Oryctocephalus indicus (Reed)**

*Zacanthoides indicus* REED, Mem. Geol. Surv. India, Pal. Ind., ser. 15, vol. 7, p. 9, pl. 1, fig. 15, 1910.

*Oryctocephalus* cf. *reynoldsi* REED, idem, p. 12, pl. 1, figs. 22-24, 1910.

Reed recognized the generic position of the cranidium but referred the pygidium to *Zacanthoides*. Since both come from the same bed, at the same place, they can be regarded as representing one species.

*O. indicus* is chiefly distinguished from *O. salteri*, which occurs in beds at least 400 feet higher in the section, by the longer pygidial axis with proportionate reduction of the pleural lobes.

Middle Cambrian (horizon 2); Parahio Valley, Spiti, India.

*Cotypes*.—Geol. Surv. India plastotypes, U.S.N.M. no. 96489.

**Oryctocephalus saitoi, n. sp.**

*Oryctocephalus* cf. *reynoldsi* SAITO, Japanese Journ. Geol. Geogr., vol. 11, no. 3, p. 232, pl. 27, figs. 16-20, 1934.

Saito recognized the distinctness of this species from *O. reynoldsi* and *O. orientalis*. He pointed out that it has one more pair of glabellar furrows than in *O. reynoldsi*.

Middle Cambrian, *Ptychoparia* beds; near Hwangju, Hwanghaido, Chosen.

*Cotypes*.—Geol. Inst. Imp. Univ. Tokyo nos. 513, 516, 574.

**Oryctocephalus walcotti Resser**

*Oryctocephalus walcotti* RESSER (part), Smithsonian Misc. Coll., vol. 97, no. 3, p. 9, pl. 1, fig. 23, 1938.

In the description of this species a cranidium of *Oryctocare geikiei* was mistakenly assigned to it. The description was written before the genus was studied; consequently, the fact that much better material is available from the Spence shale was overlooked.

Middle Cambrian, Lakeview; (loc. 371) Lakeview, Pend Oreille Lake, and Spence; (loc. 55c) 5 miles southwest of Liberty, Idaho.

*Holotype*.—U.S.N.M. no. 95038.

**PARABRISCOIA Kobayashi, 1935****Parabriscoia flabellifera (Hall and Whitfield)**

*Dikellocephalus flabellifer* HALL and WHITFIELD, U. S. Geol. Expl. 40th Par., vol. 4, p. 227, pl. 2, figs. 29-30, 1877.

Upper Cambrian, Secret Canyon?; west side Pogonip Mountain, White Pine District, Nevada.

*Holotype*.—U.S.N.M. no. 24569.

## PTARMINGIA Raymond, 1928

*Ptarmingia longula*, n. sp.

*Bathyuriscus* cf. *rossensis* WALCOTT, Smithsonian Misc. Coll., vol. 67, no. 2, p. 49, pl. 5, figs. 6, 6a, 1917.

This species has a longer head than *P. rossensis*. The glabella is long, expanding only a little; eyes larger and prominent. A few widely scattered granules occur on the elevated portions of the test but appear to be much more numerous on exfoliated specimens.

The associated pygidium is very highly arched transversely and has a rather even border, with a large spine at the anterior angles.

Middle Cambrian, Ptarmigan; (loc. 63m') 1 mile east of Hector, south slope Mount Bosworth, British Columbia.

*Holotype*.—U.S.N.M. no. 63734; paratype, no. 63735.

## PTEROCEPHALIA Roemer, 1849

*Pterocephalia multincta* (Hall and Whitfield)

*Dicellocephalus multinctus* HALL and WHITFIELD, U. S. Geol. Expl. 40th Par., vol. 4, p. 226, pl. 2, fig. 37, 1877.

*Pterocephalia sanctisabae* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 249, pl. 68, figs. 37, 38, 1937.

Upper Cambrian, Secret Canyon; Eureka District, Nevada.

*Holotype*.—U.S.N.M. no. 24640; plesiotype, no. 93021.

*Pterocephalia laticeps* (Hall and Whitfield)

*Conocephalites (Pterocephalus) laticeps* HALL and WHITFIELD, U. S. Geol. Expl. 40th Par., vol. 4, p. 221, pl. 2, figs. 4-7, 1877.

*Pterocephalia sanctisabae* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 248, pl. 68, figs. 40-43, 1937.

Upper Cambrian, Secret Canyon; west side of Pogonip Mountain, White Pine District, Nevada.

*Cotypes*.—U.S.N.M. nos. 24562, 24561, 24579.

*Pterocephalia dakotensis*, n. sp.

*Pterocephalia sanctisabae* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 246, pl. 68, figs. 27-30, 32-36, 39, 1937.

This species averages about the same size as the largest specimens of *P. sanctisabae*. It is characterized by rather large eye lobes, set nearly parallel with the axis. The pygidium is ovate, partly flattened in the shaly matrix.

*P. dakotensis* has a less flaring course of the anterior facial suture than *P. sanctisabae*, the eyes are more nearly parallel to the axial line

of the head, and are larger. The course of the pygidial furrows is also more evenly curved and the border is wider behind the axis.

Upper Cambrian, Deadwood; Whitewood Canyon, Deadwood, Black Hills, South Dakota.

*Cotypes*.—Univ. Iowa; U.S.N.M. no. 93020.

***Pterocephalia bridgei*, n. sp.**

*Pterocephalia sanctisabae* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 246, pl. 68, figs. 25, 26, 1937.

This species is characterized by a wide brim, a relatively long glabella, and the curved course of the anterior facial suture. The pygidium assigned to the species has a narrower border than *P. sanctisabae*, and its rear margin is notched. The surface of the cranium behind the eyelines and on the glabella, is nearly smooth. Anterior to these parts the irregular longitudinal folds are rather heavy, and the surface is marked by the usual horizontal, anastomosing lines.

Upper Cambrian, Davis; (loc. 11k) near shaft Federal Lead mine no. 4, Flat River, Missouri.

*Holotype and paratype*.—U.S.N.M. no. 93019.

***Pterocephalia oriens*, n. sp.**

*Pterocephalia sanctisabae* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 246, pl. 68, fig. 24, 1937.

Associated with *P. bridgei* is another, possibly smaller, species characterized particularly by its highly elevated palpebral lobes. The eyes are large, and the eyelobes are sharply separated by a deep furrow. The surface is ornamented similarly to *P. bridgei* except that the anastomosing lines are heavier.

Upper Cambrian, Davis; (loc. 11k) near shaft Federal Lead mine no. 4, Flat River, Missouri.

*Cotypes*.—U.S.N.M. no. 96485.

***Pterocephalia potosiensis*, n. sp.**

*Pterocephalia sanctisabae* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 246, pl. 68, fig. 23, 1937.

Only a few specimens were obtained in a rather large collection, so that this species seems to be rare. The presence of a large librigena may be interpreted as indicating that *P. potosiensis* grew to a much larger size than the holotype indicates, or that there is more than one species present.

*P. potosiensis* has a wider and longer brim than other Missouri species, but it is shorter than that of *P. bridgei*. The new species is

characterized particularly by well-developed anastomosing lines on the glabella and librigenes.

Upper Cambrian, Davis; (loc. 11e) southwest of Potosi, Missouri.  
*Holotype*.—U.S.N.M. no. 93018.

***Pterocephalia ulrichi*, n. sp.**

*Pterocephalia sanctisabae* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 246, pl. 68, figs. 19, 21, 1937.

This is a large, wide species with a wide flaring brim. In fact, this is the widest species thus far found. The glabella is wide and rounded in front. Likewise the anterior margin of the cranidium is more rounded than in most species. The dorsal furrow is both wide and deep, so that the glabella and cheeks next to it have considerable relief.

The pygidium is rather wide, the border of moderate width and the rear margin evidently not notched.

Upper Cambrian, Honey Creek; (loc. 9q) 15 miles northwest of Fort Sill, and (loc. 91L<sup>2</sup>) northeast of Big Baldy, Wichita Mountains, Oklahoma.

*Holotype*.—U.S.N.M. no. 93016; paratype, no. 93014.

***Pterocephalia silvestris*, n. sp.**

*Pterocephalia sanctisabae* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 246, pl. 68, fig. 20, 1937.

This is also a wide form and has a very large brim. Compared with *P. ulrichi*, the brim is longer and the dorsal and glabellar furrows shallower.

Upper Cambrian, Honey Creek; (loc. 91a) 4 miles southeast of Hennepin, West Timbered Hills, Arbuckle Mountains, Oklahoma.

*Holotype*.—U.S.N.M. no. 93015.

***Pterocephalia deckeri*, n. sp.**

*Pterocephalia sanctisabae* BRIDGE (part), U. S. Geol. Surv. Prof. Pap. 186-M, p. 246, pl. 68, figs. 22, 31, 1937.

This species is particularly wide opposite the front end of the glabella. The eyelines are heavy and the eyes prominent by reason of their upturned position, but the palpebral lobes slope up only moderately. The surface is highly ornamented in the usual fashion, but the anastomosing lines on the glabella and fixigenes have such a fine mesh that the surface appears to be granulated.

The pygidium is rather narrow and high.

Upper Cambrian, Honey Creek; (loc. 89v) 4 miles south of Henepin, west Timbered Hills, Arbuckle Mountains, Oklahoma.

*Holotype*.—U.S.N.M. no. 93017.

**PTEROCEPHALINA, n. gen.**

For many years the genotype has been referred from one genus to another, which, besides those listed below, include *Anomocare*, *Niobe*, *Saukia*, and *Platycolpus*. The pygidium resembles that of both *Pterocephalia* and the Saukinae but does not fit into either. Careful search of the collections has revealed a partial cranidium which also has affinities with *Pterocephalia* but cannot be placed in that genus.

*Pterocephalina* is characterized by a broad bordered pygidium in which the wide doublure is almost severed by the deep notch in the rear margin of the tail. The axis, which is subcylindrical, extends almost to this notch, being connected with it by a sharp postaxial ridge. Unexfoliated specimens show that pleural fusion is far advanced, but the furrows are traceable on the upper surface nearly to the border. The holotype shows the underside and hence the extent of the doublure, but not the pleural furrows.

The cranidium assigned to the species is incomplete. It consists of a large prominent, highly arched glabella, on which the rear pair of furrows are represented by slight, rearward directed indentations. Eyelines present. Eyes evidently of moderate size. Fixigenes less than half glabellar width. Brim very wide, apparently with a flat, sharply upturned rim. Wide preglabellar area is striated by coarse irregular lines among which are interspersed scattered lumps. The entire cranidium is highly arched in both directions.

*Genotype*.—*Dikellocephalus bilobatus* Hall and Whitfield.

***Pterocephalina bilobata* (Hall and Whitfield)**

*Dikellocephalus* [*Pterocephalus*] *bilobatus* HALL and WHITFIELD, U. S. Geol.

Expl. 40th Par., vol. 4, p. 226, pl. 2, fig. 36, 1877.

*Dicellocephalus bilobatus* WALCOTT, U. S. Geol. Surv. Mon. 8, p. 40, 1884.

*Platycolpus bilobatus* WALCOTT, Smithsonian Misc. Coll., vol. 57, no. 13, p. 349, 1914.

Upper Cambrian, Secret Canyon; (loc. 65) east side Sierra Canyon, opposite Pinnacle Peak, and (loc. 61) south of Hamburg Mine, Eureka District, Nevada.

*Holotype*.—U.S.N.M. no. 24568.

**SAUKIELLA Ulrich and Resser, 1933****Saukiella junia (Walcott)**

*Saukia junia* WALCOTT, Smithsonian Misc. Coll., vol. 57, no. 13, p. 378, text fig. 17, 1914.

Upper Cambrian, Signal Mountain; (loc. 12j) 2 miles southwest of Signal Mountain, Wichita Mountains, Oklahoma.

*Holotype*.—U.S.N.M. no. 60677.

**SINOSAUKIA Sun, 1935****Sinosaukia bella (Walcott)**

*Ptychaspis bella* WALCOTT, Proc. U. S. Nat. Mus., vol. 30, p. 585, 1906; Research in China, vol. 3, Carnegie Inst. Publ. 54, p. 180, pl. 17, fig. 9, 1913.

Upper Cambrian, Fengshan; (loc. C 74) east of Fang-lan-chon, Shansi, China.

*Holotype*.—U.S.N.M. no. 58124.

**TELLERINA Ulrich and Resser, 1933****Tellerina rustica (Walcott)**

*Saukia rustica* WALCOTT, Smithsonian Misc. Coll., vol. 57, no. 13, p. 383, text figs. 18-19a, 1914.

Upper Cambrian, Signal Mountain; (loc. 12j) 2 miles southwest of Signal Mountain, Wichita Mountains, Oklahoma.

*Holotype*.—U.S.N.M. no. 60678; paratypes, nos. 60679-80.

**TONKINELLA Mansuy, 1916****Tonkinella kobayashi, new name.**

*Tonkinella breviceps* KOBAYASHI, Journ. Faculty Sci. Imp. Univ. Tokyo, sec. 2, vol. 4, pt. 2, p. 150, pl. 15, figs. 6, 8, 9, 1935.

This name was previously used for a species in Kashmir.

Middle Cambrian, Taiki; Neietsu, south Chosen.

*Cotypes*.—Geol. Inst. Imp. Univ. Tokyo.