Mississippian Ostracoda of the Amsden Formation (Mississippian and Pennsylvanian) of Wyoming

GEOLOGICAL SURVEY PROFESSIONAL PAPER 848-G

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By I. G. SOHN

THE AMSDEN FORMATION (MISSISSIPPIAN AND PENNSYLVANIAN)
OF WYOMING

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Descriptions and illustrations of
22 species of ostracodes

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MISSISSIPPIAN OSTRACODA OF THE AMSDEN FORMATION (MISSISSIPPIAN AND PENNSYLVANIAN) OF WYOMING

By I. G. SOHN

ABSTRACT

The types of the ostracode assemblage described by Morey from the Horseshoe Shale Member of the Amsden Formation of Wyoming are reillustrated and reassigned to 14 genera. A lectotype for *Healdia ornata* Morey, 1935 is designated and illustrated. Two of the species originally described as *Bairdia* by Morey are reillustrated, but considered as indeterminate; a third species in this genus is not illustrated because there is doubt that the specimens in the type-slide are those studied by Morey. The speciments identified by Morey as *Paraparchites nicklesi* (Ulrich, 1891) are presumed lost; based on the original description and illustration that taxon is questionably referred to *Shishaella moreyi* described here as new. One ostracode is illustrated but not formally named, two are provisionally referred to known species, and *Cavellina* spp. are illustrated. Specimens of *Nuferella, Glyptopleurites,* and *Sansabella* are illustrated in open nomenclature. *Glyptopleurites* cf. *G. windfieldi* Scott, 1942 and *Sansabella* cf. *S. bella* Scott, 1942 are related to species in the Otter Formation of Montana. The type-species or other species in *Acratia, Balantoides, Glyptopleurites, Nuferella, Sansabella,* and *Sargentina* are illustrated in order to document the generic reassignments. All the specimens from outside of Wyoming that have been referred to Morey's species were misidentified.

The ostracode assemblage in the Horseshoe Shale Member of the Amsden Formation is endemic, and suggests a relationship to the Otter Formation (Late Mississippian) of Montana. Based on the presence of *Balantoides, Glyptopleurites,* and *Tetratylus,* the age of the ostracode-bearing rocks in the Horseshoe Shale Member is older than Pennsylvanian.

INTRODUCTION

This report is based on a poorly preserved faunule from USGS collection 18788–PC (colln. 117 herein), obtained by heating some sandstone chunks and then crushing them, and on a restudy of the type-specimens of the assemblage described by Morey (1935) from the Wind River Range. All the localities are in the Horseshoe Shale Member of the Amsden Formation. Morey described and illustrated 17 species in 12 genera from the Amsden Formation. Except for *Paraparchites nicklesi* (Ulrich, 1891), all the species and the genus *Balantoides* Morey, 1935 were described as new. Morey's ostracodes were extracted from float material at two localities: Cherry Creek (colln. 37 herein) and Amsden Hill (collns. 24, 25 herein). The lithology of the Cherry Creek locality was not given by Morey (1935, p. 474), but at Amsden Hill, two types of lithologies were collected: highly ferruginous red shade (colln. 25) underlain by more highly ferruginous purplish limestone (colln. 24), with the purplish limestone containing the same ostracode species as the Cherry Creek material. The following ostracodes were described:

- *Paraparchites nicklesi* (Ulrich, 1891)=?*Shishaella moreyi* Sohn, n. sp.
- *Sansabella amsdenensis* Morey, 1935=*Sargentina*? *amsdenensis* (Morey, 1935)
- *Sansabella*? *dubia* Morey, 1935
- *Sansabella reversa* Morey, 1935
- *Jonesina*? *puncta* Morey, 1935=*Nuferella*? *puncta* (Morey, 1935)
- *Glyptopleura multicostata* Morey, 1935
- *Amphissites warei* Morey, 1935="*Ectodemites*" *warei* (Morey). Sohn 1962
- *Amphissites robertsi*, Morey, 1935
- *Balantoides quadrilobatus* Morey, 1935
- *Hollinella typica* Morey, 1935
- *Bairdia contracta* Morey, 1935=nomen dubium (Sohn, 1960, p. 36)
- *Bairdia delicata* Morey, 1935=nomen dubium (Sohn, 1960, p. 37)
- *Bairdia nasuta* Morey, 1935=nomen dubium (Sohn, 1960, p. 39)
- *Bythocypris amsdenensis* Morey, 1935=*Pseudobythocypris*? *amsdenensis* (Morey, 1935)
- *Healdia ornata* Morey, 1935
- *Acratia disjunctus* Morey, 1935=*A.*? *disjuncta* Morey, 1935
- *Cytherella bransoni* Morey, 1935=*Cavellina bransoni* (Morey, 1935)

Morey's types and a vial of sediment containing poorly preserved ostracodes that bears the label "Amsden—Amsden Hill, Little Popo Agie" were borrowed from the Department of Geology, University of Missouri, Columbia. Unfortunately, only the type-slides are now available at the University of Missouri, and the slide containing the illustrated specimen of *Paraparchites nicklesi* (Ulrich, 1891) is presumed to be lost at this time. During the past 35 years, some of the specimens on the type-slides have spalled, and the slide for *Bairdia contracta* (Univ. Missouri 0.1029–5) contains three badly corroded steinkerns, none of which matches the illustrated holotype.

Table 1 shows the recorded distribution by Morey and the locality of each of Morey's specimens as shown on the type-slides.

Because the type-series of *Bairdia contracta* is recorded in table 1 as consisting of only two specimens, and the slide now contains three poorly preserved specimens, the entire collection of types should be cautiously evaluated, and unless the specimens can be matched perfectly with the illustrations, they should be considered as not belonging to the types. In order to do that, and to document my decisions, all the types, except *B. contracta*, were photographed for this study.

Prior to 1935, Upper Mississippian ostracodes in North America were described in only 13 papers (Sohn, 1960, p. 2); these represent less than half the number of papers and a fraction of the taxa known now. Many of the species described by Morey from the Amsden Formation of Wyoming have been identified from Mississippian (late Chesterian) rocks in the midcontinent by later workers. By comparing these identifications with Morey's types, I have been able to determine that all of the recorded occurrences outside of Wyoming were misidentified. Fortunately, I was able to borrow many of C. L. Cooper's types (Cooper, 1941) and the uncataloged types of Coryell and Johnson (1939) and Coryell and Sohn (1938) for direct comparison. Some of these specimens are reillustrated in order to substantiate some of my generic and specific reassignments. The only faunistic relationship that I can determine is that with Scott's (1942) assemblage from the Big Snowy Group of Montana from which *Glyptopleurites windfieldi* Scott, 1942 and *Sansabella bella* Scott, 1942 were described. *Hollinella radiata* (Jones and Kirkby) of Cooper, 1947 from the upper part of the Kinkaid Formation of Illinois is similar to, but not conspecific with *H. typica* Morey, 1935. All the genera known in the Amsden Formation have been recorded elsewhere in rocks of Mississippian and Pennsylvanian ages, but *Balantoides* Morey, 1935, *Glyptopleurites* Coryell and Johnson, 1939, and *Tetratylus* Cooper, 1941 have not yet been recorded in rocks of Pennsylvanian age. I conclude from this study that the ostracodes in the Horseshoe Shale Member of the Amsden Formation of Wyoming represent an endemic assemblage of Mississippian, probably of late Chesterian age, that is distinct from the ostracodes of approximately the same age in the midcontinent.

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I am grateful to the following for assistance: Prof. R. L. Ethington, University of Missouri, Columbia, for Morey's types; Prof. H. V. Howe and Mr. A. M. Phillips, Jr., Louisiana State University,

TABLE 1.—*Recorded distribution of Morey's species*

[×, recorded locality on the type-slide]

	Cherry Creek	Amsden Hill	
	Collection 37	Purple limestone Collection 24	Red Shale Collection 25
Paraparchites nicklesi (Ulrich, 1891)		1 specimen	
Sansabella amsdenensis Morey, 1935	×, abundant	Abundant	
Sansabella? dubia Morey, 1935	×, 1 specimen		
Sansabella reversa Morey, 1935	×, abundant, 200+	Abundant, 250+	
Jonesina? puncta Morey, 1935	Common	×, common	
Glyptopleura multicostata Morey, 1935	×, 2 specimens	2 specimens	
Amphissites warei Morey, 1935	×, rare	Rare	Common
robertsi Morey, 1935	[1]×?		×, common
Balantoides quadrilobatus Morey, 1935	×, rare	Rare	
Hollinella typica Morey, 1935			×, 1 specimen
Bairdia contracta Morey, 1935	×, 2 specimens		
delicata Morey, 1935	×, rare		
nasuta Morey, 1935	×, 2 specimens		
Bythocypris amsdenensis Morey, 1935	×, common	Common	
Healdia ornata Morey, 1935	×, 2 specimens		
Acratia disjunctus Morey, 1935	×? common	Common	
Cytherella bransoni Morey, 1935			×, rare

[1] See discussion.

for the type-series of Ehrlich's *Polytylites alabamensis;* Dr. C. W. Collinson, Illinois Geological Survey, for Cooper's types; Dr. E. S. Richardson, Jr., Field Museum of Natural History, Chicago, for Croneis and Bristol's holotype of *Healdia? menardensis;* Prof. G. H. Springer, University of Dayton, for the types of Coryell and Johnson and Coryell and Sohn. My colleagues W. J. Sando and Mackenzie Gordon, Jr. for advice; Sando collected the additional ostracodes, and Gordon found the vial of topotypes? at the University of Missouri. The photographs are by R. H. McKinney, and the plates were composed by Elinor Stromberg.

OSTRACODE LOCALITIES

In addition to the types described by Morey (1935), ostracodes from the Amsden Formation studied for this report are from four of the collections treated in more detail by Sando, Gordon, and Dutro (1974). Collections 24 and 25 are from the lower part of the Horseshoe Shale Member at Amsden Hill, about 4 miles southeast of the Little Popo Agie River, probably in the SW¼ sec. 32, T. 31 N., R. 99 W., Fremont County. Collection 37 is from the lower part of the Horseshoe Shale Member at Cherry Creek, about 2 miles south of the Little Popo Agie River, in sec. 19, T. 31 N., R. 99 W., Fremont County. In addition to these collections from the Wind River Range in central Wyoming, a fourth collection (colln. 117) is from western Wyoming, from the Horseshoe Shale Member, about 34 feet above the base, at Hoback Canyon in sec. 2, T. 38 N., R. 115 W., Teton County.

The Horseshoe Shale Member is the middle unit of the Amsden Formation in most of Wyoming. It occurs between the Darwin Sandstone Member at the base of the Amsden and the Ranchester Limestone Member, which represents the upper part of the Amsden. A fourth member, the Moffat Trail Limestone Member, is present in western Wyoming between the Horseshoe Shale and the Ranchester Limestone Members. The Horseshoe Shale Member is part of a transgressive sequence in Wyoming that ranges in age from the Chesterian to Morrowan. (See Sando and others, 1974.) Other fossils associated with the ostracodes in the collections from the Horseshoe Shale Member are of Chesterian age, thus confirming the Late Mississippian age suggested by the ostracodes.

Because the ostracodes in the Horseshoe Shale Member of the Amsden Formation in Wyoming suggest a relationship to some of the ostracodes described by Scott (1942) from the Otter Formation equivalent in southwest Montana, I searched the collections from the Otter and the overlying Heath Formations in which Easton (1962, p. 103) recorded ostracodes. Of the three collections from the Heath Formation and the eight collections from the Otter Formation in the above list, I found ostracodes in only one collection from the Heath Formation (USGS colln. 13416–PC) and four from the Otter Formation (USGS collns. 13358, 13379, 13390, and 17227); none of these ostracodes is found in the Amsden Formation of Wyoming.

Localities outside of Wyoming from which ostracodes were either illustrated or used in this study are listed below.

Locality No. USGS upper Paleozoic	*Field No.*	*Stratigraphic position, description of locality, and collector*
12840–PC	5/18/16/54	Upper Clore Limestone, S½ sec. 19, T. 12 S., R. 5 E., Brownfield quadrangle, Pope County, Ill. Shale at base of 11 ft section of shale, limestone, and chert in railroad cut of Illinois Central at Robbs. East side of cut, south of bridge, 100 ft north of signal and directly below power line. This is location 5 of Cooper (1941) which he considered Kinkaid. Collected by I. G. Sohn and D. B. Saxby, May 18, 1954.
12857–PC	------------	Spergen Limestone. Gosport 7½ minute quadrangle, Monroe County, Ind. Quarries at Stineville. Collected by Elliott Marshall for G. H. Girty.
12888–PC	------------	Mauch Chunk Formation, Monongalia County, W. Va. Greer quarry (now covered) located 6½ miles southeast of Morgantown; 6-in. layer of dark, calcareous shale, 4 in. from top of Reynolds Member. Unit 7 of Coryell and Sohn (1938, p. 597). Collected by Dana Wells for C. L. Cooper.

SYSTEMATIC DESCRIPTIONS

Class OSTRACODA Latreille, 1842

A discussion of the elevation of this taxon to Class category is in Sohn (1972, p. B2). During the past decade there have been several proposals to modify parts of the classification in Moore (1961). Henningsmoen (1965, p. 390) revised the classification of the Palaeocopida in which he introduced "Group" as a category between the Order and the Suborder. Future study may disclose that the Order Palaeocopida can be raised to Superorder status, and Henningsmoen's Suborder categories to Order status. Gründel (1967, p. 326) proposed the Suborder Bairdiocopina, and Sohn (1970, p. 203) accepted this category in a restricted sense. Sohn (1968, p. 17) elevated the Cavellininae Egorov, 1950 in a restricted sense to Cavellinacea in the Platycopina, Platycopida sensu Sohn (1961, p. 109) not Moore (1961). Gründel (1969, p. 353) proposed the new Suborder Kirkbyocopina in which he included superfamilies without a kirkbyan pit and marginal rims. Gründel's Kirkbyocopina is an amplification of his revision of the Kirkbyacea (Gründel, 1965) which I had previously discussed (Sohn, 1970, p. 196). Because a revision of ostracode classification is still premature, the classification used in Moore (1961) is only slightly modified in this report.

Order PALAEOCOPIDA Henningsmoen, 1953
Suborder unknown
Superfamily unknown

Family AECHMINELLIDAE Sohn, 1961

In a previous study (Sohn, 1968, p. 12), I had emended the diagnosis of the Aechminellidae in the Superfamily Drepanellacea. I removed *Cornigella* Warthin, 1930 and *Mauryella* Ulrich and Bassler, 1923, previously referred to that family (Sohn in Moore, 1961, p. Q125), to the family Judahellidae Sohn, 1968, because these two genera are dimorphic in lateral outline and bear nodes near the ventral half of the valves. The family Aechminellidae differs from the Judahellidae in lacking nodes near the ventral half of the valves, but may be similar in dimorphic lateral outline, as illustrated in *Balantoides multilobus* (Jones and Kirkby, 1886) discussed below. Both the Aechminellidae and the Judahellidae do not belong in the Drepanellacea because dimorphism is unknown in that superfamily.

Beyrichia multiloba Jones and Kirkby, 1886 was originally illustrated by a more elongated carapace (Jones and Kirkby, 1886, p. 258, pl. 8, figs. 9a–c) than the carapace illustrated (Sohn, 1961, pl. 7, figs. 28, 29) as *Aechminella multiloba*=*Balantoides multilobus* (Jones and Kirkby, 1886), and the slide of probable topotype specimens from which I illustrated the carapace (USNM 119825a) has 13 additional specimens some of which resemble in lateral outline Jones and Kirkby's specimen and some the one that I illustrated. Because growth stages are not available in this and other suites of *Balantoides*, it cannot be proved that this difference is due to the type of dimorphism I illustrated (Sohn, 1968, p. 13, pl. 3, figs. 30–34) for *Cornigella tuberculospinosa* (Jones and Kirkby, 1886) in the Judahellidae Sohn, 1968.

I had erred when I referred *Balantoides* Morey, 1935 to *Aechminella* Harlton, 1933 as a junior synonym (Sohn in Moore, 1961; Sohn, 1961, p. 112), and questionably referred *Mammoides* Bradfield, 1935 to *Beyrichiana* Kellett, 1933. I now consider the type-species of *Aechminella, A trispinosa* Harlton, 1933, and the second species, *A. buchanani* Harlton, 1933, which I had referred to *Mammoides* (Sohn, 1961, p. 114), to be congeneric, and to differ from *Balantoides* in having a posterior spine. Because *Mammoides* Bradfield, 1935 is now considered to be a synonym of *Aechminella* Harlton, 1933, all the species referred to *Mammoides* (Sohn, 1961, p. 113, 114) should be assigned to *Aechminella.* Except for *Aechminella trispinosa* Harlton, 1933, all the species that I had referred to *Aechminella* (Sohn, 1961, p. 112, 113) belong in *Balantoides.* The reassignment of the species into *Balantoides* and *Aechminella* extends the stratigraphic range of *Aechminella* to the Lower Mississippian because Green (1963, p. 72) described *Aechminella longispinosa* (Green, 1963) from the Banff Formation in Alberta.

Genus BALANTOIDES Morey, 1935

Balantoides Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 478.

Boursella Turner, 1939, Bulls. Am. Paleontology, v. 25, no. 88, p. 13.

Aechminella Sohn *in* Moore, 1961, [part], Treatise on invertebrate paleontology, v. Q, Arthropoda 3, p. Q125; Sohn, 1962 [part], U.S. Geol. Survey Prof. Paper 330–B, p. 112; Becker, 1968, Senckenbergiana Lethaea, v. 49, p. 551, 558.

Pseudonodellina Polenova, 1955, Trudy VNIGRI, vyp. 87, p. 205.

Type-species (original designation).—*Balantoides quadrilobatus* Morey, 1935, p. 479, pl. 54, fig. 10. Amsden Formation, Wyoming.

Diagnosis.—Small, about 0.5 mm or less in greatest length, straight backed, quadrilobed or trilobed, unfrilled and unrimmed. Sulci vertical, central lobe largest, extends above hingeline, either rounded or pointed. Hingement ridge and groove, left valve overlaps slightly along free margins. Surface reticulated. Probably dimorphic in lateral outline.

Discussion.—In addition to the species referred to *Aechminella* in Sohn (1961, p. 112, 113), and all the species in *Pseudonodellina* Polenova (1955, p. 205) the following species belong to *Balantoides:*

Polytylites alabamensis Ehrlich, 1964, p. 10, pl. 2, fig. 4. Pennington Formation, Alabama=*B. moreyi* Croneis and Funkhouser, 1939.

Aechminella brauni Becker, 1968, p. 258, pl. 1, figs. 3–5, text figs. 3, 4. Upper Devonian, Germany.

Aechminella clivusbestiola McGill, 1963, p. 3, pl. 1, figs. 1–3. Upper Devonian, Alberta, Canada.

Dr. Loranger very kindly sent me topotype specimens of *Balantoides biltmorensus* Loranger, 1954 and *B. fribourgellus* Loranger, 1954. *B. fribourgellus* was listed as a species to be investigated (Sohn, 1961, p. 113); examination of a carapace and a left valve confirms that the species belongs in *Balantoides*. *B. biltmorensus* has a marginal ridge on both valves that eliminates the species from *Balantoides*. This ridge was described by Loranger and can be seen in the original illustration (Loranger, 1954, p. 197, pl. 1, fig. 10), and also in McGill's (1963, pl. 1, figs. 4 and 6) illustrations of *Aechminella biltmorensis* (Loranger). Although it probably should not be assigned to *Waldronites* Coryell and Williamson, 1942 to which I had questionably referred this species (Sohn, 1961, p. 113), I do not know the genus to which *B. biltmorensis* belongs.

Geologic range.—Middle Devonian-Upper Mississippian.

Balantoides quadrilobatus Morey, 1935

Plate 1, figures 9–13

Balantoides quadrilobatus Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 479, pl. 54, fig. 10.

Aechminella quadrilobata (Morey). Sohn, 1962, U.S. Geol. Survey Prof. Paper 330–B, p. 113, pl. 7, fig. 30.

Discussion.—The holotype and only available specimen has deteriorated between the time it was originally illustrated and now. This is shown by comparing the original illustration here reproduced (pl. 1, fig. 13) with the new illustration of the same view. Morey's orientation should be reversed 180°, making his illustration a right view. As individual variation is known in *Balantoides* (*B. alabamensis* (Ehrlich, 1964) = *B. moreyi* Croneis and Funkhouser, 1939, discussed below), it is not possible to diagnose Morey's *B. quadrilobatus* adequately because the taxon is based on a single specimen.

Through the courtesy of Prof. H. V. Howe, I borrowed the type-series of *Polytylites alabamensis* Ehrlich, 1964 from the Louisiana State University. The types consist of four specimens, the holotype which is a right valve, and three paratypes, two right valves and a crushed carapace (pl. 1, figs 1–8). The holotype (pl. 1, figs. 1, 2) differs from *B. quadrilobatus* in having better defined lobes and in that the central and anterior lobes do not merge ventrally with the surface of the valve. Paratype LSU 7549 (pl. 1, figs. 3, 4) has a robust posterior lobe that resembles the lobe on *B. moreyi* Croneis and Funkhouser, 1939 from the Clore Limestone of Illinois. Paratypes LSU 7550 (pl. 1, figs. 5, 6) is a broken and abraded right valve that has relatively smaller nodes, and paratype LSU 7548 (pl. 1, figs. 7, 8) is a crushed carapace that has a pointed central lobe on the right valve and a rounded central lobe on the left valve.

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Holotype pl. 1, figs. 9–13) ----	0.54	0.34	0.18

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (collns. 24, 37).

Suborder HOLLINOMORPHA Henningsmoen, 1965
Superfamily HOLLINACEA Swartz, 1936
Family HOLLINELLIDAE Bless and Jordan, 1971

[not] Family HOLLINELLIDAE Swartz. Cooper, 1941

Cooper (1941, contents, p. 45) used Hollinellidae which he credited to Swartz as the family heading in his discussion of *Hollinella* Coryell, 1928. Because it is clear from his later publication (Cooper, 1946, p. 87) that this is a typographical error for Hollinidae Swartz, 1936, and because the family was properly established by Bless and Jordan (1971, p. 880), the family taxon should be credited to Bless and Jordan, 1971.

Genus HOLLINELLA Coryell, 1928

Hollinella Coryell, 1928b, Jour. Paleontology, v. 2, no. 4, p. 378; Kesling *in* Moore, 1961, Treatise on invertebrate paleontology, v. Q, Arthropoda 3, p. Q137.

Type-species (original designation).—*Hollinella dentata* Coryell, 1928, b p. 378, pl. 51, fig. 1. Wewoka Formation, Oklahoma.

Discussion.—Bless and Jordan (1970) divided the genus into two subgenera, *H.* (*Hollinella*) Coryell, 1928 and *H.* (*Keslingella*) Bless and Jordan, 1970 (type-species *H. pumila* Kesling, 1952, Middle Devonian, Michigan) based on the presence in juveniles of a pair of velar spurs on each valve in *H.* (*Keslingella*) and of the presence of a tubulous layer and external chitin layer in juveniles of *H.* (*Hollinella*). They considered the stratigraphic range for *H.* (*Hollinella*) to be from Westphalian A (Morrowan) to Permian and for *H.* (*Keslingella*) to be Middle Silurian to Namurian A-B (Springerian, lowermost Pennsylvanian). The diagnostic features of *H.* (*Keslingella*) are two spurs which I do not consider homologus to the two spines in *Hollinella longispina* (Jones and Kirkby, 1886). Because a growth series of an undescribed species from the Permian of Oregon has spines similar to those in *H. longispina,* I do accept Bless and Jordan's subgenera in this paper, pending additional study.

Geologic range.—Middle Silurian-Permian, ?Lower Triassic.

Hollinella typica Morey, 1935

Plate 1, figures 58–61

Hollinella typica Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 479, pl. 54, fig. 19.

[not] *Hollinella radiata* (Jones and Kirkby). Cooper, 1941,

Illinois Geol. Survey Rept. Inv. 77, p. 46, pl. 9, figs. 42–44. Glen Dean to Kinkaid Formations, Illinois=*Hollinella cestriensis* (Ulrich, 1891).

[not] *Hollinella radiata* (Jones and Kirkby). Cooper, 1947, Jour. Paleontology, v. 21, no. 2, p. 85, pl. 22, figs. 20–23. Upper Kinkaid Formation, Illinois=*Hollinella* sp.

Discussion.—Cooper (1941, p. 46) identified specimens from Illinois as *Hollinella radiata* (Jones and Kirkby, 1886), and in his synonymy referred *Hollinella typica* and other American species including *Beyrichia radiata cestriensis* Ulrich, 1891 to that species. The American species in the synonymy differ from the English specimens of *H. radiata* in that the distance between the two nodes is wider in *H. radiata* than in the American species. *H. radiata* and all the American species in Cooper's synonymy except *H. typica* Morey, 1935 have a frill that extends to the anterior cardinal angle; in *H. typica* the frill terminates below the cardinal angle. Because *H. cestriensis* (Ulrich, 1891) is the oldest available name in Cooper's synonymy, the American specimens, except *H. typica,* should be called *H. cestriensis.* In order to check whether the fact that the frill does not reach the dorsoanterior angle is a valid criterion for distinguishing *H. typica,* 42 right adult valves and 48 left adult valves of *Hollinella* sp. from the Summum cyclothem of Illinois were examined, and all had frills that reach the dorsoanterior corner, thus confirming the above supposition. These specimens have a strong terminal spine at the posterior end of the frill. On one carapace, 7 left and 12 right valves of *H. kellettae* Knight described by Cooper (1946, p. 92) from the Liverpool cyclothem of Illinois the frill terminates below the dorsal margin, and this upper Des Moines species also has a strong terminal spine on the frill.

Hollinella radiata (Jones and Kirkby) illustrated by Cooper (1947, pl. 22, figs. 20–23) from the upper Kinkaid Formation of Illinois has a frill that does not reach the anterior cardinal angle. I interpret the apparent continuation of the frill on the right valve in dorsal view (pl. 22, fig. 20) to be a piece of lint and not part of the frill. Because the distance between the nodes is greater than that in *H. typica,* I do not consider the specimens from Illinois to be conspecific with *H. typica.*

Measurements (in mm).—

	Greatest length (posterior end of frill)	*Greatest height (end of frill to dorsal margin)*	*Greatest width*
Holotype (pl. 1, figs. 58–61	1.36	0.81	0.66

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (colln. 25).

Suborder unknown
Superfamily KIRKBYACEA Ulrich and Bassler, 1906
Family AMPHISSITIDAE Knight, 1928

Genus AMPHISSITES Girty, 1910

Amphissites Girty, 1910, New York Acad. Sci. Annals, v. 20, pt. 2, p. 235; Sohn, 1962, U.S. Geol. Survey Prof. Paper 330–B, p. 115. (See for discussion and synonymy.)

Type-species (original designation).—*Amphissites rugosus* Girty, 1910, p. 236; Sohn, 1969, p. 44, pl. 6, figs. 20–23. Fayetteville Shale, Arkansas.

Discussion.—Of the two species described by Morey, *Amphissites robertsi* Morey, 1935 belongs to *Amphissites,* and *Amphissites warei* Morey, 1935 was referred to *"Ectodemites"* Cooper, 1941 (Sohn, 1961, p. 121, 127). Scott (in Moore, 1961, p. Q165, comment under *Amphissites*) stated that *Brillius* Brayer, 1952 was judged to be based on a male of *Ectodemites* and accordingly classed doubtfully as synonyms of *Amphissites.* This statement was included without my knowledge because the Kirkbyacea are not known to be dimorphic (Sohn in Moore, 1961, p. Q165). *Brillius* Brayer, 1952, was described to include two new species, the type-species *B. distortus* and *B. yveus,* and both species lack the kirkbyan pit, subcentral node, ridges, and carinae diagnostic of *Amphissites* and *Ectodemites. Ectodemites* Cooper, 1941 (type-species *E. primus* Cooper, 1941) does not have the dorsal shield of *Amphissites,* and Zanina, Zaspelova, and Polenova (in Tchernysheva, 1960, p. 319) and several subsequent European students have considered *Ectodemites* as a subgenus of *Amphissites.* I shall follow my previous usage (Sohn, 1961, p. 126) and use *"Ectodemites"* in this paper. In the Treatise (Moore, 1961, p. Q166), the caption "3b" for the dorsal view of *A. rugosus* was omitted, and the orientation of the ventral view (fig. 3c) should be reversed 180°.

Geologic range.—Middle Devonian—Permian.

Amphissites robertsi Morey, 1935

Plate 3, figures 46–51

Amphissites robertsi Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 748, pl. 54, fig. 20; Sohn, 1962, U.S. Geol. Survey Prof. Paper 330–B, p. 121, pl. 8, figs. 23–26.

Discussion.—Sohn (1961, p. 121) designated and illustrated a lectotype for this species, which has not been identified from any other formation. The lectotype and a paralectotype are reillustrated.

Geologic range.—Known only from the Horseshoe Shale Member of the Amsden Formation of Wyoming (collns. 25, 37).

Genus "ECTODEMITES" Cooper, 1941

Ectodemites Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 49.

"Ectodemites" Cooper. Sohn, 1962, U.S. Geol. Survey Prof. Paper 330–B, p. 126.

Type-species (original designation).—*Ectodemites primus* Cooper, 1941, p. 51, pl. 9, figs. 46, 47. Probably upper Clore Limestone, Illinois.

Discussion.—See discussion under *Amphissites.*

Geologic range.—Middle Devonian-Lower Pennsylvanian.

"Ectodemites" warei (Morey, 1935)

Plate 1, figures 32–36

Amphissites warei Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 477, pl. 54, fig. 7.

"Ectodemites"? warei (Morey, 1935). Sohn, 1962, U.S. Geol. Survey Prof. Paper 330–B, p. 127, pl. 10, figs. 21–26. (See for synonymy.)

Discussion.—The lectotype designated by Sohn (1961, p. 127) and a paralectotype are reillustrated here. Cooper (1941, p. 51) identified specimens from the Kinkaid and Clore Formations of Illinois as this species, but Sohn (1961, p. 127) suggested that the Illinois specimens probably belong to *"Ectodemites"? batalinae* (Posner, 1951). This species has not been identified in any other formation.

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Lectotype (pl. 1, figs. 32–35)	0.80	0.44	0.43
Paralectotype (pl. 1, fig. 36)	.77	.45	.40

Geologic range.—Known only from the Horseshoe Shale Member of the Amsden Formation in Wyoming (collns. 24, 25, 37).

?Order PALAEOCOPIDA Henningsmoen, 1953
Suborder KLOEDENELLOCOPINA Scott, 1961
Superfamily KLOEDENELLACEA Ulrich and Bassler, 1906
Family SANSABELLIDAE Sohn, 1961

Genus SANSABELLA Roundy, 1926

Sansabella Roundy, 1926, U.S. Geol. Survey Prof. Paper 126, p. 5; Sohn *in* Moore, 1961, Treatise on invertebrate paleontology, Q, Arthropoda 3, p. Q187. (See for synonyms.)

Type species (original designation).—*Sansabella amplectans* Roundy, 1926, p. 6, pl. 1, figs. 3a, b, 4, 5; Sohn in Moore, 1961, p. Q187, text fig. 122, figs. 7a, b). Shale in upper part of Marble Falls Limestone (may be base of Smithwick Shale), San Saba County, Tex.

Diagnosis.—The following diagnosis is from Moore (1961, p. Q187) "Dorsum incised along entire length of hinge; pseudovelum of some specimens preserved as spines along free margins of both valves; reversal of overlap usual."

Discussion.—Sohn (in Moore, 1961) illustrated by photographs the original of Roundy's plate 1, figures 3a, b, and designated that syntype as the lectotype of *Sansabella amplectans* Roundy, 1926. This lectotype, here reillustrated by different photographs (pl. 2, figs. 29–31), was erroneously listed as Mississippian (Moore, 1961, p. Q187); it is Pennsylvanian in age. The trivial name was misspelled *"amplectens,"* an error that has no status in nomenclature, and the dorsal view was retouched to obscure the diagnostic hingement. The type-series of *S. amplectans* contains both left over right and right over left carapaces. The specimens do not show any dimorphism in width of posterior, nor do they have any marginal spines. Marple (1952, p. 936) described and illustrated *Sansabella stewartae* Marple, 1952 that has reversal of overlap, dimorphism in width of posterior, and marginal spines. She noted that the marginal spines may be seen extending into the shale, but are broken with only their bases preserved when the specimens are freed from the matrix. I have specimens of *Sansabella* from various localities that suggest these spines to be a thin flange that seals the contact of the valves, and Cooper (1941, pl. 13, figs. 38, 39, 41) illustrated such a structure in *S. truncata* Cooper, 1941. This does not explain the spines on the overlapping valve (Marple, 1952, pl. 135, figs. 9–11). It is not known whether this structure was confined to certain species or was present but not preserved in all species of this and related genera.

Well-preserved and silicified or pyritized single valves retain the calcified part of the inner lamella and typically have an internal thickening of the shell material in the area of the adductor muscle scar. This thickening is present in both smooth and sulcate specimens.

Stratigraphic range.—Mississippian-Pennsylvanian.

Sansabella reversa Morey, 1935

Plate 2, figures 32–40

Sansabella reversa Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 476, pl. 54, fig. 6.

[not] *Sansabella reversa* Morey. Scott, 1942, Jour. Paleontology, v. 19, no. 2, p. 154, pl. 25, figs. 28, 29. Otter Formation, Montana.

[not] *Sansabella reversa* Copeland, 1957, Canada Geol. Survey Mem., no. 286, p. 31, pl. 2, figs. 9–17. Lower Pennsylvanian, Nova Scotia. Junior homonym.

[not] *Reversabella reversa* (Morey). Coryell and Johnson, 1939, Jour. Paleontology, v. 13, no. 2, p. 221, pl. 26, figs. 12a, b. Clore Limestone, Illinois.

[not] *Lochriella reversa* (Morey). Cooper, 1941, Illinois Geol. Survey, Rept. Inv. 77, p. 57, pl. 12, figs. 18, 19. Clore Limestone, Illinois.

Discussion.—The type-slide contains a badly corroded steinkern (pl. 2, figs. 32, 33) from the Cherry Creek locality. The species was recorded as abundant both at the type-locality and at the Amsden Hill purple limestone locality. The vial of sediment from Amsden Hill contains abundant specimens of this species showing about 50 percent reversal of overlap. Both types are illustrated, but a neotype is not designated because this species will probably never be of sufficient importance to warrant such action.

Coryell and Johnson (1939, p. 221) designated this species as the type-species of *Reversabella,* and illustrated a specimen from the Clore Limestone of Illinois. Their specimen differs from the one illustrated by Morey and those ilustrated in this paper in having blunter ends in dorsal outline and probably is not conspecific. Scott (1942) illustrated a specimen from the Otter Formation of Montana that resembles the specimen from Illinois in dorsal outline, but not in lateral outline, and that may represent still another species. Cooper (1941) illustrated a steinkern from the Clore Limestone of Illinois that differs in lateral and dorsal outlines from the species in Wyoming.

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Figured specimen (pl. 2, figs. 34-36) ----------	0.77	0.55	0.36
Figured specimen (pl. 2, figs. 37-40) ----------	.78	.53	.35

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (collns. 24, 37).

Sansabella? dubia Morey, 1935

Plate 2, figures 55–62

Sansabella? dubia Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 476, pl. 54, fig. 21.

Discussion.—Morey (1935, p. 476) recorded only one specimen, the holotype, which he illustrated as a left valve view. The slide labeled holotype contains a poorly preserved carapace the photographs of which do not match in lateral outline Morey's illustration, but that is of the same dimensions as recorded by Morey. In collection 117, I found a right valve that probably represents the above species. The holotype is widest near the center of the greatest length and probably represents a male; the valve is widest near the posterior and is probably a female of this species.

Both Morey and I question the assignment to *Sansabella* because the diagnostic "canoe-shaped" indentation along the hinge is not discernible.

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Holotype (pl. 2, figs. 55–58) ---------	0.99	0.64	0.42
Figured specimen (pl. 2, figs. 60–62) --------------	1.00	.61	.31

Geologic range.—Horseshoe Shale Member, Amsden Formation, Wyoming (collns. 37, 117?).

Sansabella cf. S. bella Scott, 1942

Plate 2, figures 26–28

Sansabella bella Scott, 1942, Jour. Paleontology, v. 16, no. 2, p. 155 pl. 25, figs. 12, 13. Otter Formation, north bank of Missouri River, half a mile west of Lombard, Mont.

Discussion.—A carapace from USGS collection 18788–PC resembles *Sansabella bella* Scott, 1942, except in dorsal aspect. Scott's holotype has a wider incision along the dorsum.

Measurements (in mm).—

	Greatest height	*Greatest length*	*Greatest width*
Figured specimen (pl. 2, figs. 26–28) ----	0.87	0.54	0.42

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (colln. 117).

Family unknown

Genus SARGENTINA Coryell and Johnson, 1939

Sargentina Coryell and Johnson, 1939, Jour. Paleontology, v. 13, no. 2, p. 223; Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 38; Sohn *in* Moore, 1961, Treatise on invertebrate paleontology, v. Q, Arthropoda 3, p. Q197.

Type-species (original designation).—*Sargentina allani* Coryell and Johnson, 1939, p. 223, pl. 25, figs. 9a–c. Clore Limestone, Illinois.

Diagnosis.—See Sohn in Moore, 1961, p. Q197.

Discussion.—The illustrations of the type-species in the Treatise (p. Q196, figs. 12a–c) were inadvertantly credited to me. I have recently obtained Coryell and Johnson's types and am illustrating the holotype (pl. 2, figs. 49–51) that differs in lateral outline and shape of subcentral pit from the drawings in Moore (1961). Cooper (1941, p. 38) demonstrated that *Sargentina forsetti* Coryell and Johnson, 1939 (here illustrated on pl. 2, figs. 52–54) is the female of *S. allani,* and he described the nonsulcate *S. asulcata* Cooper, 1941 from the Kinkaid Formation of Illinois.

Geologic range.—Upper Devonian?, Mississippian-Pennsylvanian.

Sargentina? amsdenensis (Morey, 1935)

Plate 2, figures 41–48

Sansabella amsdenensis Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 474, pl. 54, fig. 17.

[not] *Sansabella amsdenensis* Morey. Scott, 1942, Jour. Paleontology, v. 16, no. 2, p. 155, pl. 26, fig. 17. Otter Formation, Montana.

The type-series (UM Os. 1028–3) consists of two abraded carapaces from the Cherry Creek locality. Glued to the slide is the impression of a right valve here illustrated as figure 45 of plate 2. One of the carapaces has a greatest length of 0.71 mm, the second measures 0.80 mm. It is evident by comparison with the original illustration that Morey illustrated the larger specimen, which is now exfoliated. This specimen (pl. 2, figs. 46, 47) is here designated as the lectotype, and the second steinkern (pl. 2, figs. 42–44) as a paralectotype. Additional specimens from the vial with sediments do not have the "sinus" described by Morey.

Scott (1942, pl. 26, fig. 17) illustrated a damaged specimen that has a different outline, is smaller and more elongated, and may not be congeneric with Morey's species.

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Paralectotype (pl. 2, figs. 42–44)	0.71	0.47	0.32
Lectotype (pl. 2, figs. 46, 47)	.80	.51	.37
Figured specimen (pl. 2, fig. 48)	1.07	.69	.44

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (collns. 24, 37).

Genus NUFERELLA Bradfield, 1935

Nuferella Bradfield, 1935, Bulls. Am. Paleontology, v. 22, no. 73, p. 45.

Type-species (original designation).—*Nuferella infrequens* Bradfield, 1935, p. 46, pl. 3, figs. 4a, b. Probably base of Upper Pennsylvanian (Hoxbar Formation, ?Deese Formation), Ardmore Basin, Okla.

Diagnosis.—Bradfield's diagnosis was as follows: Carapace small, subrhomboidal in lateral outline, with slight forward swing; hingeline long, straight, not depressed; anterior height much greater than posterior height; right valve largest, overlapping left at least on vental margin; sulcus prominent, located near the middle of the carapace, bordered anteriorly by a low but distinct node; a round tubercle is present in the posterior cardinal area.

Discussion.—I had questionably referred *Nuferella* to *Geisina* Johnson, 1936 (Sohn in Moore, 1961, p. Q182) because I had assumed that the type-species as well as *N. rothi* Elias, 1958 and *N. wellsi* Coryell and Sohn, 1938, all 0.6 mm or less in greatest length, were based on immature individuals, and the hinge in these specimens had not yet become incised. A collection of *Nuferella wellsi* Coryell and Sohn, 1938 from the Mauch Chunk of West Virginia (Cooper colln. 31) consists of a growth series that ranges in greatest length from 0.4 to 0.7 mm, with presumed males and females in the 0.7 mm range that differ in width of posterior (pl. 2, figs. 1–7). Because all have hinges that are not incised, I now conclude that *Nuferella* is a valid genus.

Geologic range.—Upper Mississippian - Upper Pennsylvanian.

Nuferella? puncta (Morey, 1935)

Plate 2, figures 20–25

Jonesina? puncta Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 476, pl. 54, fig. 1.

[not] *Jonesina puncta* Morey. Coryell and Johnson, 1939, Jour. Paleontology, v. 13, no. 2, p. 214, pl. 26, fig. 3= *Nuferella odini* Coryell and Johnson, 1939.

[not] *Jonesina puncta* Morey. Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 56, pl. 12, figs. 20, 21. Clore Limestone, Illinois.

Discussion.—The reason that I question the generic assignment is the poor development of the node in front of the sulcus. The holotype is a corroded carapace, and similarly corroded carapaces are present in the vial of sediment from Amsden Hill, one of which is illustrated (pl. 2, figs. 20, 21). Cooper (1941) illustrated a slightly smaller carapace from the Clore Limestone of Illinois that differs from the holotype of *N.? puncta* in lateral outline, has a better developed node in front of the sulcus, and does not have the posterodorsal spines shown on the figured specimen from the Amsden Formation (pl. 2, fig. 20). Cooper referred to *Jonesina puncta* Morey, 1935 the following Chesterian species: *Jonesina consimilis* Croneis and Bristol, 1939, *Kloedenella sigurdi* Coryell and Johnson, 1939 and *Nuferella wellsi* Coryell and Sohn, 1938.

Jonesina consimilis from the Menard Formation of Illinois was described and illustrated as having an anterior marginal ridge (orientation reversed 180°), and there was no mention of any dorsoposterior spines. I examined the holotype in 1954 and noted that the carapace may be an internal mold; it definitely is not conspecific with Morey's species. *Kloedenella sigurdi* Coryell and Johnson, 1939 from the Clore Limestone of Illinois is based on a steinkern of a young individual of *Nuferella odini* (Coryell and Johnson, 1939). The apparent left over right overlap noted by Coryell and Johnson (1939, p. 215) is caused by adhering matrix(?) along the venter. Coryell and Johnson's specimens are reillustrated (pl. 2, figs. 8–15). *Nuferella wellsi* Coryell and Sohn, 1938 from the Mauch Chunk Formation of West Virginia differs from *N.? puncta* Morey in lateral outline and also in the presence of spines on each valve on the dorsoanterior corner (pl. 2, figs. 1–7). *Jonesina spinigera* Cooper, 1941 from the

Paint Creek Formation of Illinois also has the dorsoanterior spines, and is probably conspecific with *N. wellsi.*

Measurement (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Holotype (pl. 2, figs. 22–25)	0.79	0.46	0.34
Figured specimen (pl. 2, figs. 20, 21)	.83	.50	.36

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (collns. 24, 37).

Nuferella sp.

Plate 2, figures 16–19

Discussion.—Because only one carapace of *Nuferella* was recovered from USGS colln. 18788–PC, it is not formally described. Part of the posterior part of the left valve is exfoliated, but the dorsoposterior spines and the node anterior to the sulcus are well preserved.

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Figured specimen	0.64	0.40	0.28

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (colln. 117).

Superfamily unknown

Family GLYPTOPLEURIDAE Girty, 1910

Scott in Moore (1961, p. Q184) referred to this family *Glyptopleura* Girty, 1910 including the following synonyms: *Ceratopleurina* Coryell and Johnson, 1939; *Glyptopleurites* Coryell and Johnson, 1939; *Mesoglypha* Cooper, 1941; *Glyptopleurina* Coryell, 1928; and ?*Svantovites* Pokorny, 1950. The incipient frill in *Mesoglypha* and *Glyptopleurina* remove these two genera from the Glyptopleuridae. *Glyptopleurina* Coryell, 1928 is more closely related to the Beyrichiopsiidae Henningsmoen, 1953 (ending corrected herein for Beyrichiopsidae, Henningsmoen, 1953; see Sohn in Moore, 1961, p. Q185). *Mesoglypha* Cooper, 1951 may belong to the Sansabellidae Sohn, 1961. In addition to the type-species *Mesoglypha mediocre* Cooper, 1941 from the Glen Dean Formation of Illinois (Cooper, 1941, p. 17, 44), only one other species, *M. pulchra* Gorak, 1964 (p. 193, pl. 4, figs. 5a, b, 6a, b) from the Lower Namurian of the Dnieper-Donets Basin of the U.S.S.R. has been described. *Glyptopleura atypica* Tschigova, 1960 (p. 213, pl. 6, figs. 1–3) probably should be referred to *Mesoglypha.*

Because the species referred to *Glyptopleurites* Coryell and Johnson, 1939 differ from the type-species and other species described in *Glyptopleura* Girty, 1910 in dimorphism exhibited by posterior swelling on lateral surface and also in the configuration of the costae, I recognize this group as a valid genus.

Genus GLYPTOPLEURA Girty, 1910

Glyptopleura Girty, 1910, New York Acad. Sci. Annals, v. 20 no. 3, pt. 2, p. 236; Sohn, 1969, U.S. Geol. Survey Prof. Paper 606–F, p. 47.

Type-species (original designation).—*Glyptopleura inopinata* Girty, 1910, p. 237; Sohn, 1969, p. 49, pl. 7, figs. 1–7, 11–20, text fig. 2. Fayetteville Shale, Arkansas.

Diagnosis.—See Sohn (1969, p. 47) for a description and discussion of this genus.

Discussion.—Sohn (1969) noted that species in *Glyptopleura* have either a single subcentral pit that is reflected on the inside of the valve as a node, presumed to be the place of attachment of the adductor muscle, or have two pits transected by one of the ridges (Brayer, 1952, p. 167, text fig. 3). The major ridges connect near the end margins in some species; in other they either terminate abruptly near the posterior margin, or extend as small spines. Compare Cooper (1941, pl. 7, figs. 24, 41) with other species of *Glyptopleura* illustrated on his plates 6–8.

In order to determine whether the presence of two pits and (or) the connection of the ridges near the posterior margin are due to ontogenetic development, I examined a suite of *G. reniformis* Croneis and Thurman, 1939 from USGS collection 12840, the same locality as Cooper (1941, p. 22, colln. 5), from which Cooper illustrated a carapace (pl. 7, figs. 25–27). The specimens range in size from 0.7 to 1.2 mm in greatest length, and all have a single pit. Croneis and Thurman (1939, p. 322, pl. 8, figs. 1, 2) stated that *G. reniformis* is distinguished from all other species in the genus by the almost complete joining at the posterior of "* * * its first and second major ribs ventrad of the broken dorsal one." Cooper (1941) illustrated a carapace in which those ribs do not join. My collection shows that the ribs in valves as small as 0.7 mm in greatest length do not join near the posterior margin, and that there is a tendency for the ribs to curve towards each other in specimens that are slightly more than 1 mm in greatest length. There is also a progressive strengthening of some of the intermediate ribs as the specimens become larger. The tendency for ribs to join near the posterior can be seen also in the type-species of *Glyptopleura* by comparing figure 14 and 18 of *G. inopinata* Girty (Sohn, 1969, pl. 7).

I do not know whether or not the ribs of those species that terminate in spines behave in the same manner during ontogeny. This group has an arrow-shaped dorsal outline and may possibly be segregated as a distinct taxonomic unit.

Ceratopleurina Coryell and Johnson, 1939 was described as having one or two pits and having a variable number of ribs of which all or some end posteriorly in pronounced spines. The holotype of *C. mimiri* Coryell and Johnson, 1939, the type-species, is a somewhat corroded carapace on which the dorsal rib is wide near the posterior end and may have terminated in a spine. The original illustrations (Coryell and Johnson, 1939, pl. 26, figs. 9a, b) were retouched to show dorsoanterior-trending hooks at the posterior ends of the dorsal ribs, and as having two pits, one anterior to midlength below the dorsal rib (fig. 9a) and the second above the dorsal rib and posterior to midlength (fig. 9b). Except for the pit below the dorsal rib, these features are not present on the carapace. In addition to *C. mimiri* Coryell and Johnson, 1939, they referred *Glyptopleura spinosa* (Jones and Kirkby, 1867) to *Ceratopleurina*. *C. mimiri* Coryell and Johnson, 1939 is not congeneric with *Glyptopleura spinosa* (Jones and Kirkby, 1867), the latter belongs to the undescribed taxonomic unit discussed above.

I conclude from the above discussion that species in *Glyptopleura* should be based on the number of pits, the number and trend of ribs in adult specimens, and the dorsal outline. So far as the published record shows, species with two pits have not yet been described from Pennsylvanian and Permian rocks, whereas in the Mississippian both single and double pitted species have been recorded.

Geologic range. — Early Mississippian-Middle Permian.

Glyptopleura multicostata Morey, 1935

Plate 3, figures 16–18

Glyptopleura multicostata Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 477, pl. 54, fig. 9.

[not] *Glyptopleura multicostata* Morey. Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 41, pl. 7, figs. 33, 34. Clore Limestone, Illinois.

Diagnosis.—Single pit located below second complete ridge when the dorsal ridge is counted as the first and with four additional complete ridges below the pit. One short ridge in front of pit, between first and second ridges, a second short ridge behind pit, between second and third ridges, and a third short ridge between fifth and marginal ridges. The second ridge makes an angle with the dorsal margin, trending forward and downward, where it connects near the anterior margin with the third ridge. All the ridges terminate at the point of greatest convexity, near the posterior, may have terminated in spines.

Discussion.—Although Morey recorded four specimens, the slide labeled holotype of *G. multicostata* contained only one badly corroded carapace, which when removed from the slide in a drop of water, left part of the shell adhering to the slide (pl. 3, fig. 17). The discussion of this species is therefore based on the original description and illustration. Morey's orientation of his illustration should be reversed 180° and is the left lateral view of the holotype. Several poorly preserved specimens of *Glyptopleura are* present in collection 117, but none fits this species. These specimens are not illustrated because they are poorly preserved. Cooper (1941) illustrated a specimen from the Clore Limestone of Illinois that differs in lateral outline and that has the pit above the second complete ridge and therefore is not considered by me to be conspecific. Cooper considered *Glyptopleura valkyriae* Coryell and Johnson, 1939, also from the Clore Limestone of Illinois, to be a junior synonym of *G. multicostata*. *G. valkyriae* was described and illustrated as having two pits, consequently, it cannot be conspecific with either Morey's species or the species to which Cooper's illustrated carapace belongs.

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Holotype (pl. 3, fig. 16)	0.86+	0.48+	0.40+

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (collns. 24, 37).

Genus GLYPTOPLEURITES Coryell and Johnson, 1939

Glyptopleurites Coryell and Johnson, 1939, Jour. Paleontology, v. 13, no. 2, p. 219, pl. 26, figs. 10a–c.

Type-species (original designation).—*Glyptopleurites tyri* (Coryell and Johnson, 1939, p. 219, pl. 26, figs. 10 a–c. Clore Limestone, Illinois.

Cooper (1941, p. 42) and Scott in Moore (1961, p. Q184) considered this genus as a synonym of *Glyptopleura* Girty, 1910. Scott (1942, p. 160) described and illustrated the only other species in *Glyptopleurites*, *G. windfieldi,* from the Otter Formation of Montana, and he demonstrated that the species is dimorphic. Cooper (1941, p. 42) recorded as "rare" *Glyptopleura tyri* (Coryell and Johnson, 1939) from the Clore Limestone of Illinois, and he illustrated an additional specimen (pl. 8, figs. 10, 11) showing punctae on the centroposterior node of the female. The same punctae were shown by Cooper (1947, pl. 23, figs. 9–11) on a female carapace from the Kinkaid Formation in Johnson County, Ill. Two European species, originally described in *Glyptopleura,* may be congeneric: *Glyptopleura annularis* Kummerow, 1939, middle Visean of Western Germany, and *G. sokolskyae* Egorov, 1950 [part], Tournaisian, U.S.S.R. Egorov (1950, p. 106) illustrated a growth series in addition to the holotype and androtype (1950, pl. 17). The female holotype (pl. 17, figs. 28, 29), the adult male (pl. 17, figs. 30, 31), and a fragment of a valve (pl. 17, fig. 26) show the diagnostic features of *Glyptopleurites,* but the instars (pl. 17, figs. 13–25, 27) resemble more the Beyrichiopsiidae than *Glyptopleurites.*

The holotype and a paratype of *Glyptopleurites tyri* Coryell and Johnson, 1939 are here illustrated (pl. 3, figs. 21–28). Both specimens are females according to Scott's interpretation (1942, p. 160).

Geologic range.—Mississippian.

Glyptopleurites cf. G. windfieldi Scott, 1942
Plate 3, figures 19, 20

Glyptopleurites windfieldi Scott, 1942, Jour. Paleontology, v. 16, p. 160, pl. 25, figs. 4, 5. Otter Formation, Montana.

One poorly preserved left valve of a female and a fragment of a right valve of a male that are remarkably similar to Scott's species were recovered from USGS collection 18788–PC. The only difference is that the rim surrounding the ridge around the posterior node of the female is not as weakly developed on the posterior part of the inflated area as in *G. windfieldi.*

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Female (pl. 3, fig. 19)	0.86	0.42	0.17+

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (colln. 117).

Order PODOCOPIDA Sars, 1866
Suborder unknown
Superfamily PARAPARCHITACEA Scott, 1959

See Sohn (1971, p. A5) for a discussion of this superfamily.

Family PARAPARCHITIDAE Scott, 1959

While my revision of the Paraparchitacea was still in press (Sohn, 1971), Schallreuter (1971) described the monotypic Ordovician genus *Jaanussonia* in the new family Jaanussoniidae which he referred to Paraparchitacea. He based the Jaanussoniidae on the asymmetry of the valves (Klappendimorphismus). *Jaanussonia* Schallreuter, 1971 was described as small, less than 0.65 mm in greatest length, with the right valve overlapping the left along the free margin, and with a dorsoposterior spine on the left valve. *Shishaella* Sohn, 1971 differs from *Jaanussonia* in reversal of overlap and in greater size. A growth series of the type-species, *S. cyclopea* (Girty, 1910), ranges in greatest length from 0.47 mm to 3.30 mm. Because Schallreuter did not record sexual dimorphism in his Jaanussoniidae and *Shishaella* is dimorphic in width of the posterior or near the venter, I am tentatively retaining *Shishaella* in the Paraparchitidae.

Shishaella Sohn, 1971

Shishaella Sohn, 1971, U.S. Geol. Survey Prof. Paper 711–A, p. A14.

Type-species (original designation).—*Paraparchites nicklesi* var. *cyclopea* Girty, 1910=*Paraparchites? cyclopeus* Girty. Sohn, 1969, p. 50, pl. 8, figs. 15–24. Fayetteville Shale, Arkansas.

See Sohn (1971, p. A14) for a description of this genus.

Geologic range.—Lower Mississippian-Lower Permian.

Shishaella moreyi Sohn, n. sp.
Plate 3, figures 1–15

?*Paraparchites nicklesi* (Ulrich). Morey, 1935, Jour. Paleontology v. 9, p. 474, pl. 54, fig. 8.

Name.—In honor of P. S. Morey

Holotype.—USNM 178627.

Paratypes.—USNM 178579–178582.

Material.—In addition to the illustrated specimens, 37 fragments, valves and carapaces of varying sizes.

Type-locality.—North side of Hoback Canyon, sec. 2, T. 38 N., R. 115 W., Jackson quadrangle, Teton County, Wyo.

Type-level.—Siltstone in Horseshoe Shale Member of the Amsden Formation, 42.8–43.3 feet above top of the Darwin Sandstone Member. Collection 117.

Diagnosis.—Differs from all other species referred to *Shishaella* in subovate lateral outline, in having the spine closer to the dorsal margin than to the posterior margin, in slight overreach of the right valve along the dorsal margin, and in posterior bend above the midheight.

Description.—The valves of individuals having a greatest length of 1 mm or more are subovate in lateral outline, the anterior margin is evenly rounded, the posterior margin breaks above midheight to form a less convex dorsoposterior margin. Growth stages smaller than 1 mm are more truncated in the ventroposterior, so that the greatest height is in the anterior half. The dorsoposterior spine on the right valve is closer to the dorsal margin than the dorsoposterior corner. Dimorphism is exhibited in the width of the posterior in dorsal outline (pl. 3, fig. 14) in presumed females, whereas presumed males and young growth stages are relatively narrower in that area (pl. 3, figs. 3, 5, 7, 10). The right valve barely overreaches the left along the dorsum in subadults (pl. 3, fig. 10), less so in younger stages (pl. 3, figs. 3, 5, 7).

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Paratype (pl. 3, figs. 1–3)	0.54	0.35	0.29
Paratype (pl. 3, figs. 4–6)	.64	.47	.33
Paratype (pl. 3, figs. 7–9)	.80	.65	.45
Paratype (pl. 3, figs. 10–12)	1.37	.96	.67
Holotype (pl. 3, figs. 13–15)	1.4+	1.05	.86

Discussion.—Except for the illustrated presumed male (pl. 3, figs. 10–12) all the larger specimens are either steinkerns or broken carapaces. Although the holotype (pl. 3, figs. 13–15) is a broken carapace, it is the only specimen that shows sexual dimorphism in the width of the posterior (pl. 3, fig. 14) consequently it is designated as the holotype. Morey (1935, p. 475) described *Paraparchites nicklesi* (Ulrich) as abundant in limestone of the Amsden of Dinwoody Canyon and as represented by both long and short forms. Morey's illustration of the right view of a carapace resembles in lateral outline the presumed male paratype (pl. 3, fig. 11), but does show the dorsoposterior spine. The fact that he identified this carapace as *P. nicklesi*, which was described and illustrated as having a dorsoposterior spine, indicates that Morey had specimens with that spine. *S. moreyi* differs from *Shishaella nicklesi* (Ulrich, 1891) in the position of the dorsoposterior spine which is closer to the dorsal margin in the new species. *Shishaella juvensis* (Croneis and Gale, 1939) from the Golconda Formation of Illinois is based on a juvenile with a recorded greatest length of 0.42 mm (1939, p. 255) and resembles the juvenile of *S. moreyi* in lateral outline (pl. 3, fig. 2) it differs, however, in having a more robust dorsoposterior spines and in a more distinct dorsoposterior margin.

Geologic range.—Upper Mississippian, Horseshoe Shale Member of Amsden Formation in Hoback Canyon (colln. 117) and Amsden Hill (colln. 24), Wyoming.

Suborder BAIRDIOCOPINA Grundel, 1967

Gründel (1967, p. 325) proposed the suborder Bairdiocopina for the Bairdiacea Sars, 1888, Cypridacea Baird, 1845 and ?Darwinulacea Brady and Norman, 1889. The relationship between the bairdiids and the cyprids has been known for a long time, and *Bairdia* has been considered a subgenus of *Cythere* (Sohn, 1960, p. 12), but the Darwinulacea are not related to the previously listed two superfamilies.

Superfamily BAIRDIACEA Sars, 1887

Although most writers consider the date of publication of Sars' Ostracoda Mediterranea to be 1888, volume 12 of Archiv for Mathematik og Naturvidenskab, Kristiana contains 4 parts, and parts 2 and 3, containing Sars' paper were published in August, 1887.

Family BAIRDIIDAE Sars, 1887

Genus BAIRDIA McCoy, 1844

See Sohn (1960, p. 12) for a discussion of this genus. The three species described by Morey were all listed under doubtful and indeterminate species by Sohn (1960, p. 36, 37, 39), and examination of Morey's types confirms that designation. As stated in the introduction to this report, the slide for *Bairdia contracta* Morey, 1935 contains three badly corroded steinkerns, none of which matches the illustrated holotype. Morey stated that he had only two specimens of this species, consequently, none of the specimens in the slide is here illustrated because they may not be the types.

Geologic range.—Devonian-Permian, ?Triassic.

Bairdia contracta Morey, 1935

Bairdia contracta Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 480, pl. 54, figs. 11, 12.

Sohn (1960, p. 36) indicated that this binomen was a junior homonym of *B. hisingeri* var. *contracta* Jones and Kirkby, 1895 and that this species is indeterminate. Because it is not possible to describe this species adequately, there is no advantage in proposing a substitute name for this taxon. Scott (1942, p. 161, pl. 25, figs. 14, 15) identified specimens from the Otter Formation of Montana as *Bairdia contracta* Morey, 1935. Sohn (1960, p. 21, 34) referred Scott's specimens to an undescribed species in open nomenclature as *Bairdia* sp. M.

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (colln. 37).

Bairdia delicata Morey, 1935

Plate 1, figures 37–40

Bairdia delicata Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 480, pl. 54, figs. 14, 16.

[not] *Bairdia delicata* Morey. Copper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 25, pl. 1, figs. 45, 46=*Bairdia* sp. K Sohn, 1961, p. 21, 34.

The specimen now in the slide labeled holotype has either been broken and corroded since the original illustration, or is a different specimen. This is evident by comparing the original illustrations with the new photographs (pl. 1, figs. 37, 38). This binomen was considered a nomen dubium by Sohn (1960, p. 37). Cooper (1941) identified specimens from the Menard Formation of Illinois as *B. delicata.* Sohn (1961, p. 21, 34) referred Cooper's specimens to *B.* sp. K.

Measurements (*in mm*).—

	Greatest length	Greatest height	Greatest width
Plate 1, figure 37, 38	1.07	0.48	0.36

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (colln. 37).

Bairdia nasuta Morey, 1935

Plate 1, figures 41–45

Acratia Delo, 1930, Jour. Paleontology, v. 4, no. 2, p. 174; p. 480, pl. 54, figs. 13, 15.

Sohn (1960, p. 39) considered this species a nomen dubium. Morey stated that he had two specimens of this species. The type-slide, labeled "holotype," contains one steinkern on which the anterior is broken as shown in the original illustration, but differs from the original illustration in dorsal outline and also in having a pointed posterior located in the lowest third of the greatest height, whereas in the original illustration the posterior is blunt and extends higher towards the dorsum. Whether or not this is the result of exfoliation, or represents a different specimen cannot be proved. I suspect that the specimen now on the slide is not the same as the one illustrated by Morey.

Measurements (*in mm*).—

	Greatest length	Greatest height	Greatest width
Plate 1, figures 41–43	1.18	0.55	0.39

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (colln. 37).

Subfamily ACRATIINAE Grundel, 1962

Genus ACRATIA Delo, 1930

Acratia Delo, 1930, Jour. Paleontology, v. 4, no. 2, p. 174; Shaver *in* Moore, 1961, Treatise on invertebrate paleontology v. Q. Arthropoda 3, p. Q203.

Type-species (original designation). — *Acratia typica* Delo, 1930, p. 175, pl. 13, figs. 12a, b. Well in upper Carboniferous, Pecos County, Tex.

Diagnosis.—Rostrate, with flat, almost straight venter, curved dorsum, attenuated posterior. Tumid, greatest length and width in ventral half of greatest height. Overlap along free margins, but not along dorsum.

Discussion.—The genus was established by Delo on specimens of two species from cable-tool cuttings of undifferentiated upper Carboniferous strata from wells in western Texas. The holotype, and presumably only specimen of the type species, *Acratia typica,* is a corroded carapace of what was probably an immature individual (USNM 81780) and the anterior beak is not preserved (pl. 3, figs. 43–45). The holotype of *A. magna* Delo, 1930 is also based on an abraded carapace of an adult individual (USNM 81799) that lacks the anterior beak (pl. 3, figs. 40–42). Kellett (1935, p. 140) identified specimens from the Elmdale formation (Permian), Chase County, Kans., as *Acratia typica*?; her specimens (USNM 90105–90107) are probably internal casts and therefore unidentifiable.

My diagnosis is based on specimens of *Acratia deloi* Geis, 1932 (p. 183, pl. 26, figs. 3a, b) from the Salem Limestone of Indiana (USGS loc. 769A green). I have duplicated in the laboratory a specimen similar to the types of *A. typica* and *A. magna* by dissolving shell material from a specimen of *A. deloi* (pl. 3, figs. 33–35) that had a pronounced ventroanterior rostrum and obtained a carapace that resembles Delo's illustrations. (Compare pl. 3, figs. 36–39 with figs. 40–45.) Because Delo's specimens of *Acratia* are corroded, I consider the rostrum as diagnostic of the genus, in which species are differentiated on shape.

Over the years the following list of genera and their type-species were split from *Acratia:*

Acratina Egorov, 1953, p. 43 (*A. pestrozvetica* Egorov, 1953).

Acratia (*Cooperina*) Gründel, 1962, p. 87 *A.* (*C.*) *cooperi* Gründel, 1962).

Cooperacratia Loranger, 1963, p. 9 (*Cooperia biltmorensa* Loranger, 1954).

Cincturacratia Loranger, 1963, p. 11 (*C. spinosa* Loranger, 1963).

Egorovia McGill, 1963, p. 10 (*E. longituda* McGill, 1963).

Shaver (in Moore, 1961) considered *Acratina* as a synonym of *Acratia,* and based on the experiment discussed above, I would agree with his designation. I am not certain whether the distinction between *A.* (*Cooperina*) and *A.* (*Acratia*) is valid, and I cannot assess Loranger's two genera because of inadequate data. McGill stated in his description of *Egorovia* that the absence of a duplicature excludes his genus from the Bairdiidae, however, his illustration of a longitudinal section (1963, pl. 2, fig. 18) of the type-species, *E. longituda* McGill, 1963, shows the calcified part of the inner lamella on both valves. *Acratia disjuncta* Morey, 1935 may eventually be referred to *Egorovia,* should further study prove that the genus is valid. In the meantime, I am retaining Morey's species questionably in *Acratia.*

Geologic range.—Devonian-Triassic.

Acratia? disjuncta Morey, 1935

Plate 3, figures 29–32

Acratia disjunctus Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 481, pl. 54, fig. 18.

Discussion.—This species does not have the ventroanterior rostrum diagnostic of *Acratia.* In addition to the well-preserved holotype, I have found five abraded carapaces belonging to this species in the vial with sediment. *Acratia tumida* Cooper, 1941 (p. 24, pl. 1, figs. 35–37) from the Kinkaid Formation of Illinois appears to be congeneric with this species in that it also does not have the anteroventral hook. It differs, however, from *A.? disjuncta* in lateral outline and in being more tumid. *A. obtusa* Cooper, 1941 p. 24, pl. 1, figs. 1–3), from the Paint Creek Formation of Illinois, is similar to *A.? disjuncta* in dorsal and lateral outlines, but this species has an anteroventral hook, and differs in the overlap in dorsal and ventral views. This species is not congeneric with the species from the Amsden Formation because of the diagnostic anteroventral hook.

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Holotype (pl. 3, figs. 29–32)	1.10	0.51	0.52

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (collns. 24, 37).

Suborder METACOPINA Sylvester-Bradley, 1961
Superfamily HEALDIACEA Harlton, 1933
Family HEALDIIDAE Harlton, 1933

Genus HEALDIA Roundy, 1926

Healdia Roundy, 1926, U.S. Geol. Survey Prof. Paper 146, p. 8; Shaver *in* Moore, 1961, Treatise on invertebrate paleontology, v. Q, Arthropoda 3, p. Q361.

Type-species (original designation). — *Healdia simplex* Roundy, 1926, p. 8, pl. 1, figs. 11a–c. Upper Pennsylvanian, Texas.

Discussion.—Roundy described two species in this genus, the type-species without any posterior spines or ridges, and *Healdia ampla* Roundy, 1926 with two posterior spines on each valve. Other species in this genus have transverse posterior ridges that are either straight or curved, or ridges that bear spines on either or both ends. *Healdia* and some of the related genera in the Healdiidae need further study.

Because revision of these genera is beyond the scope of this paper, the classification in Moore (1961) is used here. Sohn (1960, pl. 6, figs. 1–5) illustrated a carapace of *Cribroconcha* Cooper, 1941 (type-species *C. costata* Cooper, 1941) that differs from ridged and spined species of *Healdia* by having punctae scattered on the surface of the valves, which he subjected to dilute acid to remove part of the shell and thus manufactured a carapace that looked like *Healdia* (Sohn 1960, pl. 6, fig. 4). Additional removal of the shell by acid resulted in a specimen that looked like a *"Bythocypris"* = *Pseudobythocypris* Shaver, 1958.

Geologic range.—Devonian to Permian, ?Lower Mesozoic.

Healdia ornata Morey, 1935

Plate 1, figures 14–21

Healdia ornata Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 481 pl. 54, fig. 4.

[not]*Healdia ornata* Morey. Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 32, pl. 4, figs. 1, 2. Glen Dean Formation, Illinois=*H. triangularis* Croneis and Gale, 1939.

Discussion.—Morey had two syntypes, and probably illustrated the right valve of a presumed male (pl. 1, figs. 19–21). The second syntype, a presumed female, (pl. 1, figs. 14–18) is here designated as the lectotype. Cooper (1941) illustrated a carapace from the Glen Dean Formation (Homberg Group) of Illinois that differs from the Amsden specimens in lateral outline, having the dorsal angulation (point of greatest height) farther towards the posterior. Because Cooper considered *H. triangularis* Croneis and Gale, 1939 a synonym of his *H. ornata,* the specimens from the Glen Dean Formation should be called *H. triangularis.*

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Lectotype (pl. 1, figs. 14–18)	0.50	0.33	0.27
Paralectotype (pl. 1, figs. 19–21)	.51	.34	.22

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (colln. 37).

Family BAIRDIOCYPRIDIDAE Shaver, 1961

Genus PSEUDOBYTHOCYPRIS Shaver, 1958

Pseudobythocypris Shaver, 1958, Am. Midland Naturalist, v. 59, no. 1, p. 122; Shaver *in* Moore, 1961, Treatise on invertebrate paleontology, v. Q, Arthropoda 3, p. Q366.

Type-species (original designation).—*Bythocypris pediformis* Knight, 1928, p. 326, pl. 44, figs. 3a–c. Upper Fort Scott Limestone, Missouri.

Discussion.—Shaver (1958, p. 122) included *Bythocypris amsdenensis* Morey, 1935 in his list of species that he assigned to *Pseudobythocypris.* Because the only available specimen of *Bythocypris amsdenensis* is a broken steinkern that may not even represent the original specimen illustrated by Morey, I am questionably referring the species to *Pseudobythocypris.*

Geologic range.—Mississippian-Permian.

Pseudobythocypris? amsdenensis (Morey, 1935)

Plate 1, figures 22–25

Bythocypris amsdenensis Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 481, pl. 54, figs. 2, 3.

[not] *Bythocypris amsdenensis* Morey. Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 28, pl. 2, figs. 35, 36. Clore Formation, Illinois and upper Fayetteville Shale, Arkansas.

[not] *Bythocypris amsdenensis* Morey. Scott, 1942, Jour. Paleontology v. 16, no. 2, p. 162, pl. 25, fig. 18. Otter Formation, Montana.

[not] *Bythocypris* aff. *amsdenensis* Morey. McLaughlin and Simons, 1951, Jour. Paleontology, v. 25, no. 4, p. 516, pl. 76, fig. 14. Chewelah Argillite (probably Pennsylvanian), Washington.

Discussion.—Although Morey wrote that this species was common at two localities (collns. 24 and 27), only one broken steinkern in the slide labeled holotype is available. It may not be the illustrated specimen. McLaughlin and Simons (1951, p. 516) suggested that because Morey's original photograph of the right valve does not show any overlap of the larger left valve along the venter, the height-length ratio is misleading. The original photograph (Morey, 1935, pl. 54, fig. 2) shows a suggestion of overlap along the posterior margin, and also near the dorso-anterior; these features however, cannot be discerned (pl. 1, fig. 23). Cooper (1941) illustrated a carapace as *B. amsdenensis* that differs in lateral and dorsal outlines from Morey's illustration, and his specimen from the Fayetteville of Arkansas is recorded to be 0.48 mm in length. Morey's specimen, however, was recorded as 0.7 mm. Scott's specimen measures on the illustration 14.5 mm, and the stated magnification is × 25, which makes his specimen from the Otter Formation 0.58 mm in greatest length. McLaughlin and Simons recorded 0.62 as the length of their specimen. Shaver (1958, fig. 1) illustrated the lateral and dorsal outlines of *P. pediformis* (Knight, 1928) and recorded the average length of each growth stage (Shaver, 1958, table 1, fig. 3). Based on Shaver's data, Cooper's specimen, were it conspecific with Morey's, represents the seventh instar. Because the dorsal and lateral outlines of Cooper's specimen differ more from Morey's specimen than the outlines of the seventh and the adult males and females in *P. pediformis,* I consider Cooper's specimen not to be conspecific with Morey's *P.? amsdenensis.* Using the same criteria, Scott's specimen should represent the eighth instar, and the lateral outline rules that specimen out from *P.? amsdenensis,* and the same is true for the specimen illustrated by McLaughlin and Simons.

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Holotype (pl. 1, figs. 22, 23)	0.63	0.31	0.23

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (collns. 24, 37).

Order PLATYCOPIDA Sars, 1865

Suborder PLATYCOPINA Sars, 1865

Superfamily CAVELLINACEA Egorov, 1950

See Sohn (1968, p. 17) for a discussion of this classification.

Family CAVELLINIDAE Egorov, 1950

Genus CAVELLINA Coryell, 1928

Cavellina Coryell, 1928a, Jour. Paleontology, v. 2, no. 2, p. 89; Kellett, 1935, Jour. Paleontology, v. 9, no. 2, p. 144; Benson *in* Moore, 1961, Treatise on invertebrate paleontology, v. Q, Arthropoda 3, p. Q369.

Type-species (original designation).—*Cavellina pulchella* Coryell, 1928a, p. 90, pl. 11, fig. 5; Cooper, 1946, p. 74, pl. 10, figs. 9–18. Seminole and Holdensville Formations, Oklahoma. See Cooper, 1946 for synonymy and other localities.

Discussion.—Coryell based *Cavellina* on a female (Kellett, 1935, p. 144) and the genus is identical in outside shell morphology and dimorphism to *Cytherella* Jones, 1849 based on the Cretaceous *Cytherina ovata* Roemer, 1840 (type-species subsequently designated by Ulrich, 1897 [1894], p. 684). Kellett (1935, p. 145) noted that the vertical ridge setting off the posterior depression in females of *Cavellina* extends dorsad farther than in *Cytherella* (pl. 1, figs. 46–49), and suggested that *Cavellina* be restricted to Paleozoic species, and *Cytherella* used for post-Paleozoic to living species. Triebel (1941, pl. 14, figs. 162a, b) was the first to note that the muscle scar pattern of *Cavellina* differed from that of *Cytherella* (1941, pl. 13, fig. 154), thus validating the distinction between the two genera. About 150 species were either described in or transferred to *Cavellina.*

Shaver (1953) discussed the ontogenetic development and sexual dimorphism of *Cytherella* and *Cavellina,* and showed that although there is a minor amount of variation in the shape of the dorsal overlap during ontogeny, it is similar in adult males and females of *Cytherella bullata* Alexander, 1932; presumably the same is true for *Cavellina.*

Geologic range.—Silurian-Permian.

Cavellina bransoni (Morey, 1935)

Plate 1, figures 50–54

Cytherella bransoni Morey, 1935, Jour. Paleontology, v. 9, no. 6, p. 482, pl. 54, fig. 5.

[not] *Càvellina bransoni* (Morey). Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 35, pl. 5, figs. 22, 23.

Because the shells in *Cavellina* are smooth, it is difficult to determine specific characters. The lateral and dorsal outlines and shape of the overlap along the dorsum and venter are used to discriminate species. Cooper (1941) illustrated as *C. bransoni* a specimen from the Kinkaid Formation of Illinois that differs from the holotype in both lateral and dorsal outlines, and also in the overlap along the dorsal margin. By comparing Cooper's figure 23, stated to be the right side but actually the left side, with Morey's original figure and the new illustration (pl. 1, fig. 53) which has a slightly different orientation, the differences in lateral outline are as follows: posterior part of dorsal margin is more truncated in the Illinois specimen, the anterior part of the smaller valve is less truncated, and the ventral margin is more convex. The dorsal outline of Cooper's specimen (1941, pl. 5, fig. 22) differs markedly from *C. bransoni* in outline and in the shape of the overlap which is smoothly convex in the Illinois specimen, and sinuous in the holotype. The holotype is probably a female, whereas Cooper's specimen is either a juvenile or a male of a different species.

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Holotype (pl. 1, figs. 50–54)	0.85	0.56	0.38

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (colln. 25).

Cavellina spp.

Plate 1, figures 46–49, 55–57, 62–65

One steinkern and two carapaces were recovered from collection 117; these are illustrated but not described because of inadequate material. The steinkern (pl. 1, figs. 46–49) is evidently that of an adult female that may have been smaller than *C. bransoni* (Morey, 1935); the two carapaces are larger than *C. bransoni.* One (pl. 1, figs. 62–65) represents a female; the other possibly a male (pl. 1, figs. 55–57).

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Plate 1, figures 46–49	0.63	0.34	0.26
Plate 1, figures 55–57	1.01	.62	.42
Plate 1, figures 62–65	1.20	.70	.51

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (colln. 117).

Genus TETRATYLUS Cooper, 1941

Tetratylus Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 34; Benson and others *in* Moore, 1961, Treatise on invertebrate paleontology, v. Q, Arthropoda 3, p. Q370.

Type-species (original designation).—*Tetratylus elliptica* Cooper, 1941, p. 35, pl. 5, figs. 1–6. Paint Creek Formation, core sample, 2454 feet, well in Jefferson County, Ill.

Discussion.—Cooper (1941) described this genus on well material from which he described *T. ellipticus,* and *T. elongatus.* In addition, he identified and illustrated *T. menardensis* (Croneis and Bristol, 1939) originally described as *Healdia? menardensis.* The genus has not been recorded again, nor was it present in several surface collections of the Paint Creek Formation. Cooper's generic diagnosis follows:

> Carapace ovate, ends rounded, dorsum curved, venter straight or convex, end margins of *some species* [italics added] bordered by low ridge, terminated above and below by round, knoblike spines of variable length; valves highest anteriorly, with shallow sinus just back of center which is elongate vertically, extending from the dorsum down to about one-third of shell height, deepest near bottom; right valve overlaps left around entire margin, but overlap is inconspicuous except along venter; surface smooth to finely punctate.

Pribyl (1953, p. 299, 332) suggested that *Tetratylus* is a junior synonym of *Bufina* Coryell and Malkin, 1936. I am grateful to Dr. Charles Collinson, Illinois Geological Survey, for sending me Cooper's types, one of which, the holotype of *T. elongata,* is a left valve that shows the hinge. Dr. E. S. Richardson, Jr., Field Museum of Natural History, Chicago, very kindly sent me the holotype of *Healdia? menardensis* Croneis and Bristol, 1939, a right valve of a specimen slightly more than 0.4 mm in greatest length that has the diagnostic terminal nodes along the posterior end, and none along the anterior. The hinge of *Tetratylus* is of the peripheral type while that of *Bufina* is merodont (terminology in Moore, 1961, p. Q36). Because of the different hinge structures, the two genera should not be placed in synonymy. Kummerow (1953, p. 56, pl. 6, figs. 9a, b) described and illustrated a Middle Devonian species from Poland as *Waylandella retusa.* This species has terminal knobs on each of the four corners of the valve but not the dorsomedian sulcus, and may possibly belong to *Tetratylus.*

I have only two poorly preserved carapaces from the Amsden Formation in Wyoming, neither of which has the diagnostic dorsomedian sulcus well developed, although there is a faint suggestion of such a structure on the left valve of the better preserved carapace (pl. 1, fig. 28), and on both valves of the more poorly preserved carapace (pl. 1, figs. 29, 30). Because only two specimens are available, I am not formally describing and naming this species.

Geologic range.—Devonian?, Upper Mississippian.

Tetratylus sp.

Plate 1, figures 26–31

Two poorly preserved carapaces were recovered from USGS collection 18788–PC. The end ridges were either poorly developed in this species or were not preserved. Because these are the first record of this genus outside of Illinois, both are illustrated.

Measurements (in mm).—

	Greatest length	*Greatest height*	*Greatest width*
Plate 1, figures 26–28	0.51	0.31	0.24
Plate 1, figures 29–31	.61	.33	.28

Geologic range.—Amsden Formation, Horseshoe Shale Member, Wyoming (colln. 117).

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[Italic page numbers indicate both major references and descriptions]

PLATES 1-3

Contact photographs of the plates in this report are available, at cost, from U.S. Geological Survey Library, Federal Center, Denver, Colorado 80225.

PLATE 1

[Magnification approximately × 30; photographs by R. H. McKinney]

FIGURES 1–8. *Balantoides alabamensis* (Ehrlich, 1964) (p. G5).

1, 2. Outside and inside views of a right valve, the holotype of *Polytylites alabamensis.* LSU 7547.

3, 4. Inside and outside views of a right valve, a paratype. LSU 7549.

5, 6. Dorsal and lateral views of a partly broken right valve, paratype. LSU 7550.

7, 8. Right and left views of a crushed carapace, paratype. LSU 7548.

9–13. *Balantoides quadrilobatus* Morey, 1935 (p. G5).

9–12. Left, dorsal, ventral, and right views of the holotype, UM Os. 1027–O.

13. Original illustration of the holotype, right valve. Amsden Formation, Wyoming.

14–21. *Healdia ornata* Morey, 1935 (p. G15).

14-18. Right, left, dorsal, dorsal oblique, and posterior views of a presumed female syntype, here designated as the lectotype, UM Os. 1029–1.

19–21. Right, dorsal, and left views of a presumed male syntype, here designated as a paralectotype, UM Os. 1029–1A. Amsden Formation, Wyoming.

22–25. *Pseudobythocypris? amsdenensis* (Morey, 1935) (p. G16).

22, 23. Dorsal and right views of holotype as it is now.

24, 25. The original illustrations of the same specimen, UM Os. 1030–1.

26–31. *Tetratylus* sp. (p. G18).

26–28. Right, ventral, and left views of a carapace, either a juvenile or a male. Figured specimen USNM 178568.

29–31. Left, right, and dorsal views of a carapace, presumed female. Figured specimen USNM 178569. Amsden Formation, Wyoming (colln. 117).

32–36. "*Ectodemites*" *warei* (Morey, 1935) (p. G7).

32–35. Left, ventral, right, and dorsal views of lectotype, UM Os. 1027–1. Amsden Formation, Wyoming.

36. Right view of paralectotype, UM Os. 1027–1. Amsden Formation, Wyoming.

37–40. *Bairdia delicata* Morey, 1935 (p. G13).

37, 38. Dorsal and right views of a steinkern in the slide labeled "holotype" of Morey's species, UM Os. 1029–3.

39, 40. Dorsal and right views of the holotype, Morey's original illustration. Amsden Formation, Wyoming.

41–45. *Bairdia nasuta* Morey, 1935 (p. G14).

41–43. Dorsal, right, and left views of a steinkern in the slide labeled "holotype," UM Os. 1024–4.

44, 45. Right and dorsal views of holotype, Morey's original illustration. Amsden Formation, Wyoming.

46–49. *Cavellina* sp. (p. G17).

Ventral, right, dorsal, and left views of a steinkern of a female showing the dorsad extension of the vertical groove made by the ridge that is diagnostic of the genus. Figured specimen USNM 178570. Amsden Formation, Wyoming (colln. 117).

50–54. *Cavellina bransoni* (Morey, 1935) (p. G17).

50. Left view of the holotype, Morey's original illustration.

51–54. Ventral, dorsal, left, and right views of holotype, UM Os 1030–3. Amsden Formation, Wyoming.

55–57. *Cavellina* sp. (p. G17).

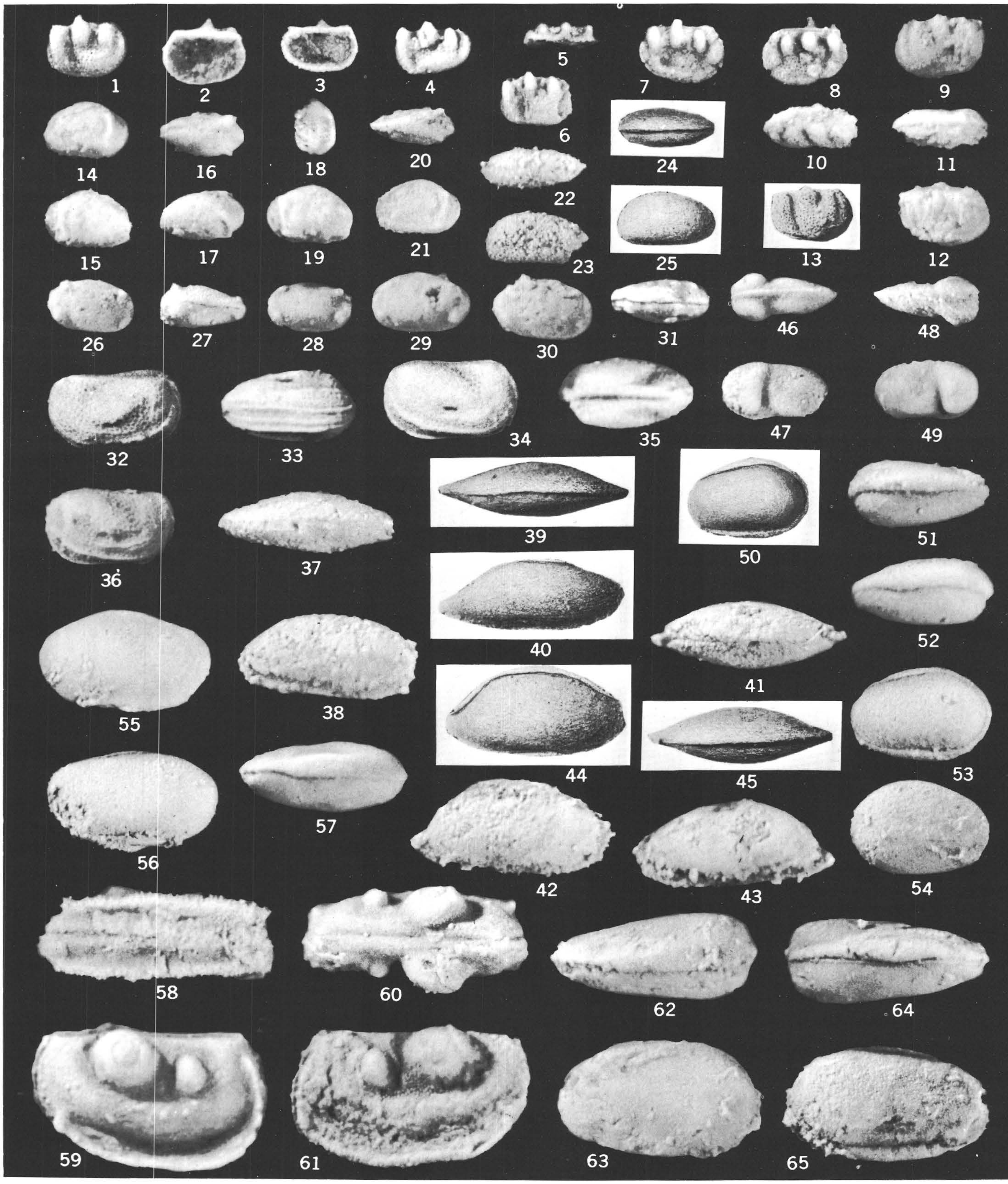
Left, right, and dorsal views of presumed male. Figured specimen USNM 178511. Amsden Formation, Wyoming (colln. 117).

58–61. *Hollinella typica* Morey, 1935 (p. G5).

Ventral, right, dorsal, and left views of the holotype, UM Os. 1026–1. Amsden Formation, Wyoming.

62–65. *Cavellina* sp. (p. G17).

Dorsal, right, ventral, and left views of a female carapace. Figured specimen USNM 178572. Amsden Formation, Wyoming (colln. 117).



BALANTOIDES, HEALDIA, PSEUDOBYTHOCYPRIS?, TETRATYLUS,
"ECTODEMITES," BAIRDIA, CAVELLINA, AND *HOLLINELLA*

PLATE 2

[Magnification approximately × 30; photographs by R. H. McKinney]

FIGURES 1–7. *Nuferella wellsi* Coryell and Sohn, 1938 (p. G9).

1–4. Ventral, right, dorsal, and left views of holotype.

5. Left view of carapace, young growth stage. Figured specimen USNM 178573.

6, 7. Two left views of adult carapaces showing dimorphism. Figured specimens USNM 178574, 178575. Mauch Chunk Formation, West Virginia.

8–15. *Nuferella odini* (Coryell and Johnson), 1939 (p. G9).

8–10. Right, dorsal, and left views of the specimen illustrated by Coryell and Johnson, 1939 as *Jonesina puncta* Morey.

11, 12. Ventral and left views of the holotype of *Kloedenella sigurrdi* Coryell and Johnson, 1939.

13–15. Dorsal, right, and left views of the holotype of *Jonesina odini* Coryell and Johnson, 1939. Clore Limestone, Illinois.

16–19. *Nuferella* sp. (p. G10).

16–19. Ventral, left, dorsal, and right views of carapace. Figured specimen USNM 178576. Amsden Formation, Wyoming, USGS loc. 18788–PC.

20–25. *Nuferella*? *puncta* (Morey, 1935) (p. G9).

20, 21. Dorsal and left views of carapace. Figured specimen USNM 182669. Vial with sediment labeled "Amsden Hill, Little Popo Agie," Wyoming.

22–25. Right, left, ventral, and dorsal views of holotype, UM Os. 1026–3. Amsden Formation, Wyoming.

26–28. *Sansabella* cf. *S. bella* Scott, 1942 (p. G8).

26–28. Dorsal, right, and left views of carapace. Figured specimen USNM 178577. Amsden Formation, Wyoming, USGS loc. 18788–PC.

29–31. *Sansabella amplectans* Roundy, 1926 (p. G8).

29–31. Dorsal, right, and left views of lectotype, USNM 119286. Marble Falls Limestone, San Saba County, Tex.

32–40. *Sansabella reversa* Morey, 1935 (p. G7).

32, 33. Photograph of remnant of holotype and original illustration of right side of holotype (pl. 54, fig. 6), UM Os. 1027–2.

34–36. Right, dorsal, and left views of a carapace showing right valve overlapping left. Figured specimen USNM 182670. Vial with sediment labeled "Amsden Hill, Little Popo Agie," Wyoming.

37–40. Right, dorsal, left, and ventral views of a carapace showing left valve overlapping right. Figured specimen USNM 182671. Same collections as above.

41–48. *Sargentina*? *amsdenensis* (Morey, 1935) (p. G8).

41. Left view of holotype, original illustration (Morey, 1935, pl. 54, fig. 17).

42–44. Right?, left?, and dorsal views of a steinkern, paralectotype, UM Os. 1028–3A.

45. Impression of carapace glued to slide labeled "Syntypes."

46, 47. Dorsal and right views of a corroded carapace designated as the lectotype, UM Os 1028–3. Amsden Formation, Wyoming.

48. Left view of carapace. Figured specimen USNM 182672. Vial with sediments labeled "Amsden Hill, Little Popo Agie."

49–54. *Sargentina allani* Coryell and Johnson, 1939 (p. G8).

49–51. Dorsal, right, and left views of the holotype of *S. allani*, showing the presumed male dimorphic character in dorsal outline.

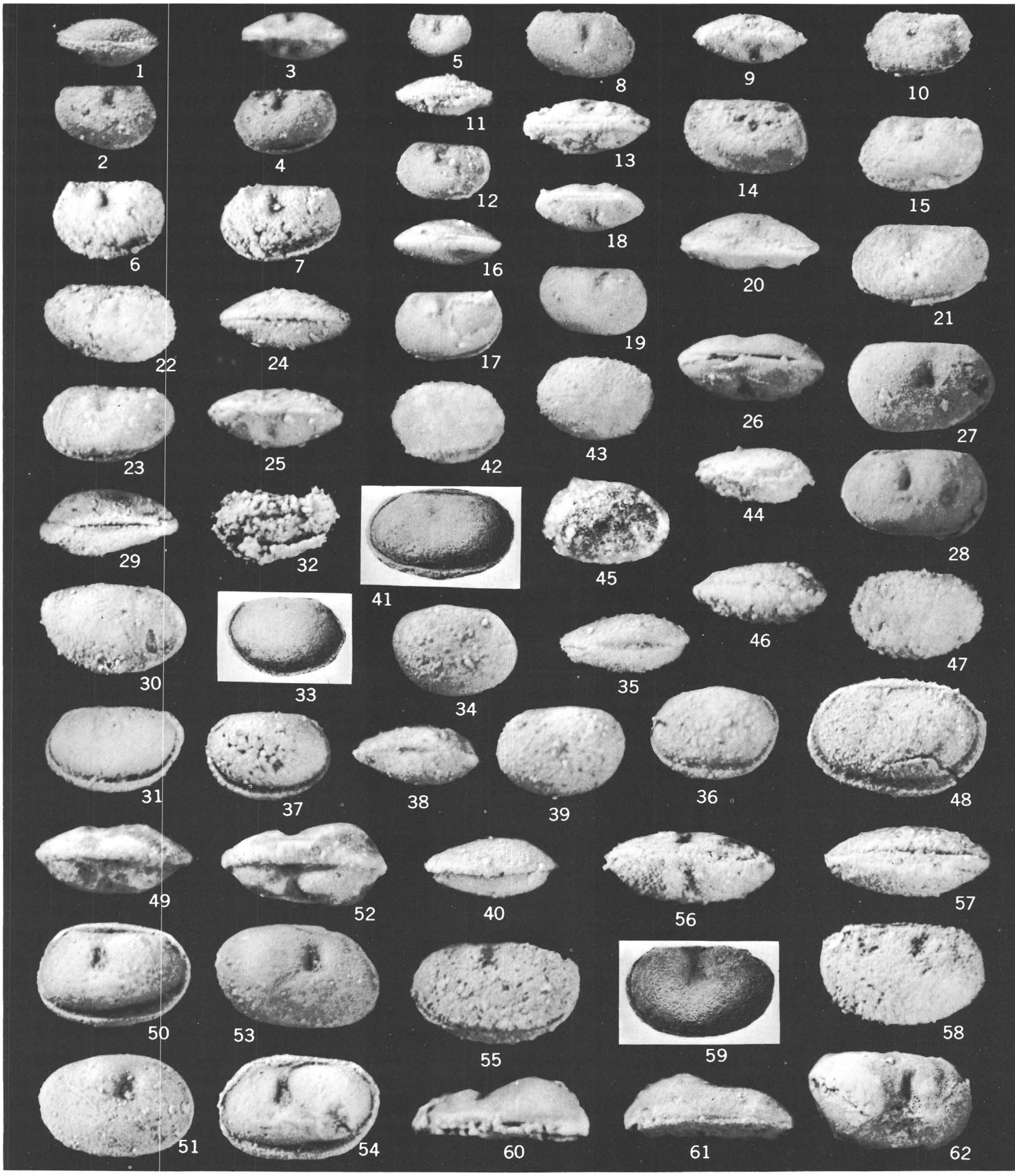
52–54. Dorsal, right, and left views of the holotype of *S. forsetti* Coryell and Johnson, 1939, showing the presumed female dimorphic character in dorsal outline. Clore Limestone, Illinois.

55–62. *Sansabella*? *dubia* Morey, 1935 (p. G8).

55–58. Left, dorsal, ventral, and right views of presumed male carapace, Morey's holotype, UM Os. 1028–2.

59. Original illustration of the holotype, left view (Morey, 1935, pl. 54, fig. 21).

60–62. Dorsal, ventral, and left views of a valve, presumed female. Figured specimen USNM 178578. Amsden Formation, Wyoming, USGS loc. 18788–PC.



NUFERELLA, SANSABELLA, AND *SARGENTINA*

PLATE 3

[Magnification approximately × 30, photographs by R. H. McKinney]

FIGURES 1–15. *Shishaella moreyi* Sohn, n. sp. (p. G12).

1–3. Left, right, and dorsal views of young growth stage. Paratype USNM 178579.

4–6. Left, dorsal, and right views of slightly larger growth stage. Paratype USNM 178580.

7–9. Dorsal, right, and left views of still larger growth stage. Paratype USNM 178581.

10–12. Dorsal, right, and left views of still larger growth stage (presumed male). Paratype USNM 178587.

13–15. Right, dorsal, and left views of a broken carapace, presumed female. Holotype USNM 178627. Amsden Formation, Wyoming (colln. 117).

16–18. *Glyptopleura multicostata* Morey, 1935 (p. G11).

16–17. Right view of exfoliated carapace, holotype, and inside of part of the carapace adhering to slide, UM Os. 1026–4.

18. Original illustration of the holotype. Amsden Formation, Wyoming.

19, 20. *Glyptopleurites* cf. *G. windfieldi* Scott, 1942 (p. G12).

19. Lateral view of left valve, female.

20. Lateral view of a fragment of a right valve, male. Figured specimens USNM 178628, 178629. Amsden Formation, Wyoming (colln. 117).

21–28. *Glyptopleurites tyri* Coryell and Johnson, 1939 (p. G12).

21–24. Right, ventral, left, and dorsal views of holotype.

25–28. Right, left, dorsal, and ventral views of carapace, paratype. Clore Limestone, Illinois.

29–32. *Acratia*? *disjuncta* Morey, 1935 (p. G15).

Right, ventral, dorsal, and left views of holotype, UM Os. 1025–2. Amsden Formation, Wyoming.

33–39. *Acratia deloi* Geis, 1932 (p. G14).

33–35. Ventral, dorsal, and right views of carapace.

36–39. Left, ventral, dorsal, and right views of a carapace from which shell material was removed by acid. Salem Limestone, Indiana, USGS loc. 12857.

40–42. *Acratia magna* Delo, 1930 (p. G14).

Right, ventral, and left views of holotype, USNM 81799. Well material, upper Carboniferous, Pecos County, Tex.

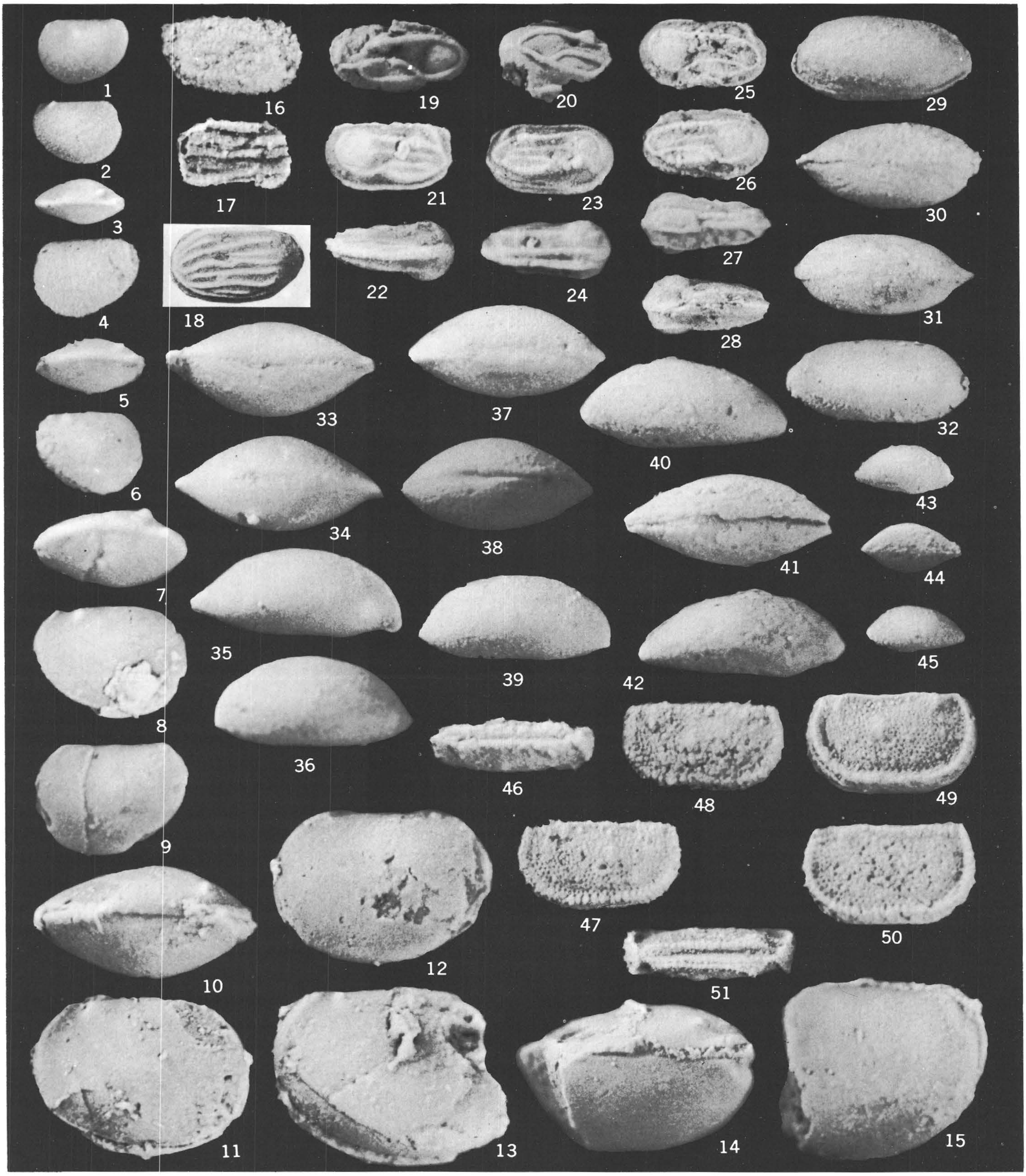
43–45. *Acratia typica* Delo, 1930 (p. G14).

Right, ventral, and left views of holotype, USNM 81780. Same collection as above.

46–51. *Amphissites robertsi* Morey, 1935 (p. G6).

46–48. Dorsal, left, and right views of paralectotype UM Os. 1027–3B. Amsden Formation, Wyoming.

49–51. Left, right, and dorsal views of lectotype, UM Os. 1027–3A. Amsden Formation, Wyoming.



SHISHAELLA, GLYPTOPLEURA, GLYPTOPLEURITES, ACRATIA, AND *AMPHISSITES*

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