THE UNIVERSITY OF KANSAS
PALEONTOLOGICAL CONTRIBUTIONS
NEW SERIES

NUMBER 17

SUPRASPECIFIC TAXA OF THE BIVALVIA FIRST NAMED, DESCRIBED, AND PUBLISHED IN CHINA (1927–2007)

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The University of Kansas Paleontological Institute

The University of Kansas, Lawrence, Kansas
ISSN 1046-8390
May 15, 2009

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Abstract.—A total of 209 bivalve generic (subgeneric) and 19 familial (subfamilial) names first proposed by Chinese palaeontologists and published in China are treated herein as an annotated database. The present paper is designed especially for the *Treatise on Invertebrate Paleontology* Bivalvia revision project, because access to bivalve taxa published by Chinese authors in China has been difficult for non-Chinese researchers. The original diagnoses of these taxa, including the original descriptions and explanation of figures of all the type species, have been translated from Chinese into English, so that non-Chinese colleagues can more easily have access to them.

Keywords: Bivalvia, supraspecific name, China, translation, Chinese, English

INTRODUCTION

The present taxonomic list is designed especially for the Bivalvia *Treatise* revision project, because bivalve taxa published by Chinese authors in China have proven particularly difficult for non-Chinese researcher to access. This is due to a variety of reasons: first, some taxa were published entirely in Chinese without English text, sometimes even without an English abstract, whereas Chinese may be one of the most difficult languages in the world; second, a large number of original descriptions on fossil bivalves are distributed in local journals or edited books, which are not easily available for foreign researchers; third, the rules of nomenclature as required by the ICZN (the International Code of Zoological Nomenclature, Fourth edition) were not always followed, for example, a new genus may not be available under the ICZN from the publication where it is declared new, but from a subsequent publication. This is why a project for the translation work was proposed in the Nanjing Institute of Geology and Palaeontology. The present authors have redoubled their efforts to translate the original Chinese diagnoses or descriptions of all the supraspecific taxa and their type species into English one by one and include their original illustrations.

The present taxonomic list only contains the supraspecific names of the Bivalvia *first named, described, and published in China*. Those published in the West are not included, because they are easy to access and there is no language barrier. We hope the list will facilitate the use of Chinese material by non-Chinese colleagues. Although some Chinese publications, such as *Acta Palaeontologica Sinica*, have English abstracts or summaries and are available in most western countries, other Chinese publications lack such abstracts or summaries and are more difficult for non-Chinese researchers to obtain. Even where English abstracts or summaries are available, critical information regarding stratigraphic and geographic distribution and taxonomic comparisons is not always included. We hope that this list will provide non-Chinese colleagues with a complete overview of the Chinese literature on supraspecific bivalve taxa. In view of the incompleteness of our library and the possibility for errors in translation, some additions and corrections may be necessary in the future. We welcome communication from our colleagues in this regard.

We have attempted to include all supraspecific names of Bivalvia first described by Chinese palaeontologists and published in China. The database incorporates the following data for each nominal taxon: generic type species, authorship, year of publication with a full bibliographic reference, original diagnosis or description of the taxon and original description of its type species, type locality and stratigraphic position, original designation and subsequent

suggestions for taxonomic position, and repository of the type material. We have done our best to keep the translations true to the original in order for authors to bear the primary responsibility for their descriptions. All diagnoses or descriptions are kept unchanged and given in full even though they may include obvious mistakes, unless indicated otherwise. For some doubtful taxa, we add a subentry for suggested revision of taxonomic position and probable synonymies for reference only. In general, it was not necessary to retranslate original Chinese diagnoses or descriptions into English when original English versions were provided, unless the original English version did not coincide with the original Chinese.

A total of 209 bivalve generic (subgeneric), 19 familial (subfamilial), and 1 superfamilial name are treated herein, including probable synonyms and invalid and rejected names. This list excludes of 5 nonbivalve generic names, originally considered to be Cambrian bivalves, i.e., *Praelamellodonta* Zhang Ren-jie, 1980; *Cycloconchoides* Zhang Ren-jie, 1980; *Hubeinella* Zhang Ren-jie, 1980; *Xianfengoconcha* Zhang Ren-jie, 1980; *Yangtzedonta* Yu, 1985; and 3 nonbivalve suprageneric names (Cycloconchoididae Zhang Ren-jie, 1980; Praelamellodontidae Zhang Ren-jie, 1980; and Praelamellodontoiidea Zhang Ren-jie, 1980). Generic and subgeneric taxonomic and chronological distributions are shown in Table 1, exclusive of the nonbivalve generic names. Taxonomic ordering of these names follows Carter, Campbell, and Campbell (2000, 2006) and Bieler and Mikkelsen (2006) with only minor modifications. All the supraspecific taxa are arranged by their currently proposed taxonomic position rather than by their original classification. A systematic index of the supraspecific names is given on p. 155 herein).

This compilation was begun during the spring of 2006, when Dr. Joseph Carter, the coordinating author of the Bivalvia *Treatise* revision, invited the primary author (Fang Zong-jie) to contribute to this project. Dr. Carter recognized the need for the translation of supraspecific taxa named in Chinese journals, books, and monographs. In 2006, Fang prepared a catalogue of all supraspecific taxa of the Bivalvia from Chinese sources. At this stage, Fang obtained financial support from the Chinese Academy of Sciences (KZCX3-SW-149) and the Major Basic Research Project of MST, China (2006CB806400). After the Barcelona International Congress on Bivalvia in 2006 (July 22–27), Fang proposed a project for the translation work with the support of the Special Basic Research Program of the Ministry of Science and Technology, China (2006FY120400), the Knowledge Innovation Programme of Nanjing Institute of Geology and Palaeontology (KIP2007), and the State Key Laboratory of Palaeobiology and Stratigraphy, NIGPCAS (No. 073102), thus establishing the present working team. In 2007, we completed the following sections: (1) genera and families of Nuculoida and Fordilloida first described and published in China (Fang Zong-jie); (2) genera and families of Pteriomorphia first described and published in China. I. Orders Praecardioida, Mytiloida, Arcoida, and Pterioida (Chen Chu-zhen and Fang Zong-jie); (3) genera and families of Pteriomorphia first described and published in China. II. Order Pectinoida (Fang Zong-jie and Chen Chu-zhen); (4) genera and families of Cycloconchoidea first described and published in China (Fang Zong-jie); (5) genera and families of Trigonioida first described and published in China (Wen Shi-xuan, Chen Chu-zhen, and Fang Zong-jie); (6) genera and families of Unionoida first described and published in China. I. Superfamily Unionoidea (Chen Jin-hua and Fang Zong-jie); (7) genera and families of Unionoida first described and published in China. II. Superfamilies Anthracosioidea and Pseudocadinioidea (Chen Jin-hua and Fang Zong-jie); (8) genera and families of Unionoida first described and published in China. III. Superfamily Trigonioidoidea (Sha Jin-geng and Fang Zong-jie); (9) genera of heterodonts first described and published in China (Lan Xiu and Fang Zong-jie); (10) genera and families of Anomalodesmata first described and published in China (Fang Zong-jie, Wen Shi-xuan, and Chen Chu-zhen). Fang Zong-jie was responsible for merging these works into the present compilation. It is expected that the present paper will greatly benefit the updated version of the Bivalvia *Treatise* and future research on fossil bivalves in China and in the world. The present project is a product of true teamwork, and cordial gratitude is expressed to all the above-mentioned sponsors and to our Institute, which provided excellent research facilities.

SYSTEMATIC PALAEONTOLOGY

Class BIVALVIA Linné, 1758
Subclass and Superorder UNCERTAIN
Order FORDILLOIDA Pojeta, 1975
Superfamily FORDILLOIDEA Pojeta, 1975
Family FORDILLIDAE Pojeta, 1975
Genus JELLIA Li & Zhou, 1986, p. 41

[in Chinese]

Figure 1.1–1.3

Discussion and diagnosis.—"Original diagnosis" (Li & Zhou, 1986, p. 44): dentition of fossils (*Pojetaia*) discussed in the present paper may be divided into two kinds, i.e., one in which the central main teeth are in the left valve, and the other in which the central main teeth are in the right valve. *Pojetaia* Jell, 1980 has the central main teeth in the left valve, whereas *Jellia* Li and Zhou (*gen. nov.*) has the central main teeth in the right [*sic*].

Type species.—*Jellia elliptica* Li & Zhou, 1986, p. 42, pl. 1,*5–8;* pl. 2,*1* (holotype), *2–4*; by original designation.

Type locality.—Yutaishan, Huoqiu, Anhui, eastern China.

Type occurrence.—Fourth Member of Yutaishan Formation, lower Cambrian.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Ministry of Land and Resources, Chengdu, Sichuan, southwestern China; accession number: A8301 (holotype); A8022, 8303, 8306, 8318, 8331, 8346, 8349.

Taxonomic position.—Fordillidae (by original designation).

Revision suggestion.—As Fang (2004a) pointed out, *Pojetaia* and *Jellia* represent the same taxon, and their central main teeth can be explained by the phenomenon of transposed hinges. *Jellia* is therefore a junior synonym of *Pojetaia* Jell, 1980.

Table 1. Taxonomic and chronologic distributions of generic and subgeneric names first published in China. Abbreviations: *Cam,* Cambrian; *O,* Ordovician; *S,* Silurian; *D,* Devonian; *Car,* Carboniferous; *P,* Permian; *T,* Triassic; *J,* Jurassic; *K,* Cretaceous; *Cz,* Cenozoic.

Order	**Superfamily**	**Cam**	**O**	**S**	**D**	**Car**	**P**	**T**	**J**	**K**	**Cz**	**Total**
Fordilloida	Fordilloidea	2										2
Nuculoida	Nuculoidea			1	1			1		1		4
Nuculanoida	Afghanodesmatoidea				1			1				2
	Nuculanoidea				1			4	1		1	7
Praecardioida	Praecardioidea			1	6							7
Arcoida	Arcoidea					1		2		1		4
Pterioida	Ambonychioidea				3			1		1		5
	Pterioidea							3		1		4
	Posidonioidea							1				1
	Ostreoidea						1	1		1	2	5
Pectinoida	Pterinopectinoidea						2	2				4
	Aviculopectinoidea					7	4	1				12
	Pseudomonotoidea						2					2
	Monotoidea							4	1			5
	Halobioidea							1				1
	Pectinoidea							4	2			6
Actinodontoida	Cycloconchoidea		4									4
Trigonioida	Trigonioidea			1	3			4	1			9
Unionoida	Anthracosioidea						3	2		1		6
	Unionoidea							5	26	4	4	39
	Pseudocardinioidea							6	10			16
	Trigonioidoidea									27		27
Lucinoida	Lucinoidea				1	1						2
Hippuritoida	Megalodontoidea							1				1
	Hippuritoidea									1		1
Veneroida	Crassatelloidea							1	1			2
	Cardioidea							2				2
	Hiatelloidea								1			1
	Arcticoidea							1	3	5		9
	Glossoidea							1				1
	Tellinoidea									1		1
	Corbiculoidea									2		2
Pholadomyoida	Modiomorphoidea				5	1						6
	Pholadomyoidea			1	1			3				5
	Thracioidea							3				3
Septibranchia	Cuspidarioidea							1				1
Total		2	4	4	22	10	12	56	46	46	7	209

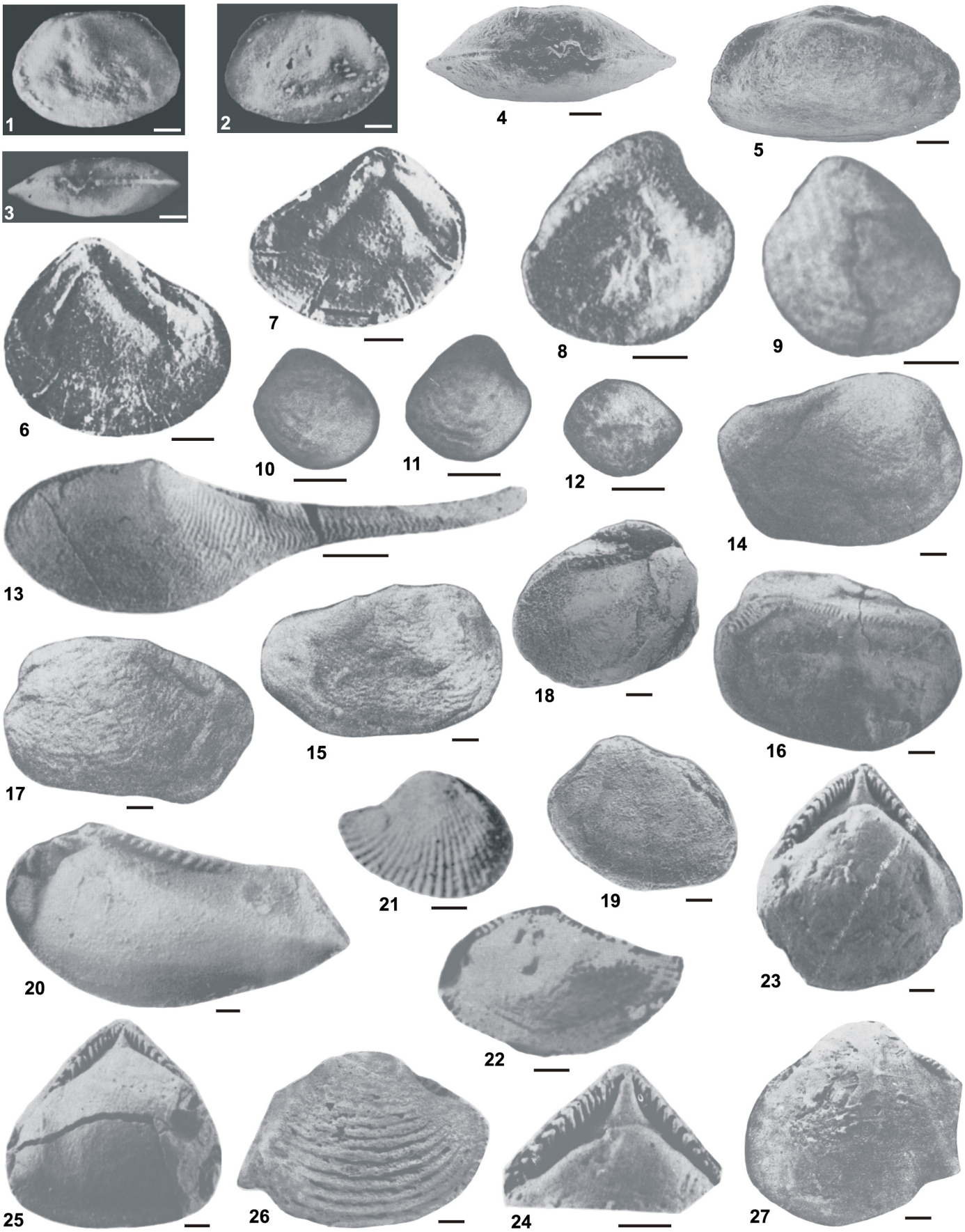

Figure 1. *For explanation, see facing page.*

Genus ORYZOCONCHA He & Pei, 1985, p. 63

[in Chinese with English description, p. 66]

Figure 1.4–1.5

Discussion and diagnosis.—Original diagnosis (He & Pei, 1985, p. 66): shell small (about 1 mm), equivalved, and semiequilateral. Oval to long elliptical outline in lateral view, umbos prosogyrate, with feeble posterior auricle and well-developed ligament areas. Dentition is taxodont: seven comblike teeth and corresponding sockets in both forward and backward sides of umbos. Pallial line clear [distinct] with pallial sinus. External ornament of shell surface unknown, and internal surface smooth [*sic*].

Type species.—Oryzoconcha prisca He & Pei, 1985, p. 64, pl. 1,*2,5;* pl. 2,*1* (holotype), *2–3*; by original designation; by monotypy.

Type locality.—Sanjianfang, Fangcheng, Henan, North China.

Type occurrence.—Upper part of Xinji Formation, lower Cambrian.

Repository of type material.—Chengdu University of Technology (=Chengdu College of Geology), Chengdu, Sichuan, southwestern China; accession number: 20142 (holotype); 20146, 20147, 20198, 20199.

Taxonomic position.—Nuculidae (by original designation).

Revision suggestion.—Type material of *Oryzoconcha prisca* He & Pei shows clearly the same hinge structure as *Pojetaia runnegari* Jell. *Oryzoconcha* is therefore a junior synonym of *Pojetaia* Jell, 1980.

Subclass PALEOTAXODONTA Korobkov, 1954
Superorder NUCULIFORMII Gray, 1824
Order NUCULOIDA Dall, 1889
Superfamily NUCULOIDEA Gray, 1824
Family PRAENUCULIDAE McAlester in Cox et al., 1969
Genus BICRENUCULA Zhang, 1984, p. 587

[in Chinese with English description, p. 595]

Figure 1.6–1.7

Discussion and diagnosis.—Original diagnosis (Zhang, 1984, p. 595): equivalve, small, 7 mm maximum length; shell thin, with nuculoid profile. Shell longer posterior to beak than anterior to it ["Shell slightly longer anteriorly" in Chinese text, p. 587], posteriorly truncated. Ornamentation of weak commarginal growth lines and two furrows running downward from near umbo, which are parallel to anteroposterodorsal margins, with anterior furrow longer than posterior [furrow]. Taxodont dentition with more anterior denticles than posterior ones, but all teeth nearly equal sized and not interrupted by a resilifer beneath umbo. Muscular impressions, pallial sinus, and other internal structures unknown [*sic*].

Type species.—Bicrenucula elegans Zhang, 1984, p. 587, pl. 1,*1–2,3* (holotype), *4–9;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Zhang, 1984, p. 587): shell small, 5–6 mm long in general (below 7 mm); shell thin, nuculiform; length slightly longer than height. Equivalve, inequilateral; shell slightly longer anteriorly, with rounded anterior margin; posterior part shorter, with broadly rounded posterior margin, or slightly truncated. Umbo wide and obtuse, not quite projecting above dorsal margin, situated in anterior three-fifths length of shell. Dorsal margin convex, anterodorsal and posterodorsal margins meeting together at an angle of about 95°–100°. Anterodorsal margin arcuated, anterior umbonal slope slightly depressed. Posterodorsal margin broadly arched, gradually passing into posterior margin. Ventral margin rounded and convex, continuously passing into anterior and posterior margins respectively. Shell slightly inflated, supposedly due to lithologic character [i.e., due to compaction]. Surface marked with two sulci, with a distance of 1 mm from margins, running from 1 mm below the umbo toward anteroventral and posteroventral angles respectively, parallel to anterodorsal and posterodorsal margins respectively. Anterior sulcus longer, about 2 to 2.5 mm in length; posterior one about 1.2 to 1.7 mm. Occasionally, anterior and posterior sulci meet together under umbo, in an inverse V shape. On interior surface, two sulci corresponding to two internal septa. Taxodont dentition with anterior and posterior taxodont rows continuous in umbonal region, no resilifer; all teeth nearly equal sized, anterior taxodont row with 10–12 small teeth, posterior with about 8–10. Muscle impressions, pallial sinus, and other internal structures unknown. Surface covered by fine and weak concentric lines, evident only near ventral margin.

Figure 1. *1–3.* Holotype of *Jellia elliptica* Li & Zhou, scale bar 0.2 mm; *1,* left lateral view; *2,* right lateral view; *3,* dorsal view (adapted from Li & Zhou, 1986, pl. 2,*1l,1r,1d*).——*4–5.* Holotype of *Oryzoconcha prisca* He & Pei, scale bar 0.2 mm; *4,* dorsal view; *5,* left lateral view (adapted from He & Pei, 1985, pl. 1,*1a,1b*).——*6–7. Bicrenucula elegans* Zhang, scale bar 1 mm; *6,* holotype, right external mold; *7,* paratype, left external mold (adapted from Zhang, 1984, pl. 1,*3,1*).——*8–12. Phymodonucula concentrica* Guo, scale bar 1 mm; *8–9,* holotype, left valve; *8,* interior view, *9,* exterior view; *10–12,* paratype, articulated shell; *10,* left lateral view; *11,* right lateral view; *12,* dorsal view (adapted from Guo, 1988, pl. 4,*10a-b,11a–c*).——*13. Teinonuculana guangdongensis* Zhang, scale bar 10 mm; paratype, left composite mold (adapted from Zhang in Zhang, Wang, & Zhou, 1977, pl. 1,*14*).——*14–17. Dianucula sulcata* Guo, scale bar 2 mm; *14,* holotype, right valve; *15,* paratype, right valve; *16,* interior view of Fig. 1.15; *17,* paratype, left valve (adapted from Guo, 1988, pl. 6,*8,9a–b,10*).——*18–19. Manchurinucula wandensis* Gu, scale bar 2 mm; *18,* holotype, deformed left internal mold united with conjugated right internal mold; *19,* paratype, right internal mold (adapted from Gu in Gu, Li, & Yu, 1997, pl. 2,*10,11*).——*20.* Holotype of *Antactinodion biradiatum* Guo, scale bar 1 mm; left internal mold (adapted from Guo, 1980, pl. 1,*11* (=Guo, 1981a, pl. 1,*11*).——*21–22.* Type material of *Xiaoshuiculana elegansa* (Li & Li), scale bar 1 mm; *21,* right valve; *22,* left internal mold (adapted from Li & Li in Zhang, Wang, & Zhou, 1977, pl. 1,*10,11*).——*23–25. Similoconcha symmetrica* Zhang, scale bar 2 mm; *23,* holotype, left internal mold; *24,* enlarged ligament area of Fig. 1.23; *25,* paratype, left internal mold (adapted from Zhang in Zhang, Wang, & Zhou, 1977, pl. 189,*1a–b,2*).——*26–27. Eleganuculana nyeruensis* Chen & Yang, scale bar 1 mm; *26,* holotype, right valve; *27,* paratype, left internal mold (adapted from Chen & Yang, 1983, pl. 1,*1b,2b*).

Type locality.—Shimaxi, Cili, Hunan, China.

Type occurrence.—Luoreping Formation, upper lower Silurian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: S031 (holotype); S032, 034–038, 041, 042.

Distribution of genus.—upper lower Silurian; Hunan, China (Zhang, 1984, p. 587).

Taxonomic position.—Praenuculidae (by original designation).

Family NUCULIDAE Gray, 1824
Genus MANCHURINUCULA
Gu in Gu, Li, & Yu, 1997, p. 15

[in English]

Figure 1.18–1.19

Discussion and diagnosis.—Original diagnosis (Gu in Gu, Li, & Yu, 1997, p. 15): member of the Nuculidae with anterior myophoric ridge posterior to anterior adductor scar [*sic*].

Type species.—Manchurinucula wandensis Gu in Gu, Li, & Yu, 1997, p. 16, pl. 2,*10* (holotype), *11;* by original designation; by monotypy.

Original description of type species.—(Gu in Gu, Li, & Yu, 1997, p. 16): medium size. Length 12–15 mm, height approximately 11.5–12 mm. Moderately inflated; inflation of two valves being ~4–4.5 mm. Opisthogyrous umbos situated at approximately one-sixth the length of posterior. Escutcheon rather broad, deep, and distinct. Anterior margin rather narrowly and obliquely rounded, anterodorsal margin fairly curved, posterodorsal margin nearly straight or scarcely truncated. Posteroventral marginal arching not very distinct. With only concentric lines and very few concentric wrinkles. Anterior paleotaxodont teeth number approximately 12 and posterior ones number 9 to 10, with a resilifer between anterior and posterior rows of hinge teeth. There is a distinct groove on the molds extending from umbonal cavity to front of posterior adductor scar, showing a rounded posterior myophoric ridge. Groove on internal mold moderately deep and broad, roundly excavated, much deepened through deformation in individual bivalved molds, even showing growth lines of myophoric ridge [*sic*].

Type locality.—North of Peide, Mishan, Heilongjiang, northeastern China.

Type occurrence.—Qihulin Member, Longzhaogou Group, Lower Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 81343 (holotype); 81344.

Distribution of genus.—Lower Cretaceous; eastern Manchuria, northeastern China (Gu in Gu, Li, & Yu, 1997, p. 15).

Taxonomic position.—Nuculidae (by original designation).

Genus PHYMODONUCULA
Guo, 1988, p. 112

[in Chinese]

Figure 1.8–1.12

Discussion and diagnosis.—Original diagnosis (translation from the Chinese text in Guo, 1988, p. 112): shell small, subtrigonal, suboval, inflated, subequilateral, subequivalve; anterior margin rounded, ventral margin broadly rounded, posterodorsal margin arcuate; umbo highly salient above hinge margin, incurved, slightly prosogyrate, situated just anterior of center on hinge margin; surface ornamented with regular concentric ridge; taxodont teeth knoblike, simple; anterior and posterior taxodont rows continuous in umbonal region, no resilifer; anterior row shorter, posterior row longer.

Type species.—Phymodonucula concentrica Guo, 1988, p. 113, pl. 4,*10* (holotype), *11–12*; by original designation.

Original description of type species.—(Translation from Chinese text, Guo, 1988, p. 113): Shell small, 2–4 mm long, nearly as long as high, trigonally suboval or subtrigonal, inflated; anterior, ventral and posterior margins subrounded, posterodorsal broadly arcuate; umbo large, broadely rounded, salient, slightly incurved, slightly prosogyrate, situated just anterior of center on hinge margin; surface ornamented with regular concentric ridge; anterior and posterior hinge margins forming a rounded right angle under the umbo; posterior hinge margin nearly two times as long as anterior; taxodont teeth knoblike, anterior and posterior taxodont rows continuous in umbonal region, no resilifer; teeth below the umbo slim and thin, those near the ends larger, knoblike; ~8 teeth in front of umbo, ~15 teeth behind umbo.

Type locality.—Jinding, Lanping, Yunnan, southwestern China.

Type occurrence.—Sanhedong Formation, Carnian, Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0680 (holotype); IVy0681, 0682.

Distribution of genus.—lower Upper Triassic; western Yunnan, southwestern China (Guo, 1988, p. 113).

Taxonomic position.—Nuculidae (by original designation).

Revision suggestion.—Assignment of these specimens is dubious unless their ligament is properly expounded.

Genus SIMILOCONCHA
Zhang in Zhang, Wang, & Zhou, 1977, p. 475

[in Chinese]

Figure 1.23–1.25

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 475): shell medium, triangular in outline, equilateral; pointed-topped triangular resilifer under umbo, taxodont teeth concavodont, not interrupted below umbo, teeth becoming gradually smaller toward umbo; anterior and posterior tooth rows symmetrical in shape, size, and number of teeth, two tooth rows form a right angle under umbo; two adductor scars subequal, oval in outline, pallial line entire; surface smooth.

Type species.—Similoconcha symmetrica Zhang in Zhang, Wang, & Zhou, 1977, p. 475, pl. 189,*1a–b* (holotype), *2;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 475): Shell medium, rounded triangular in outline, equilateral, nearly as long as high; umbo center, with anterior and posterior margins making

an angle of 95º–100º; ventral margin broadly arcuate, anterior and posterior margins rounded equally; dentition consisting of a row of concavodont teeth on each side of umbo, anterior and posterior taxodont rows symmetrical, each one with 15 or so teeth; pointed-topped triangular resilifer under umbo, not interrupted by continuous anterior and posterior tooth rows; two adductor scars subequal, oval in outline, pallial line entire, no sinus; surface smooth.

Type locality.—Xiashankou, Changsha, Hunan, China.

Type occurrence.—Qiziqiao Formation, Givetian, Middle Devonian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: IV55044 (holotype); IV55045.

Distribution of genus.—Middle Devonian; Hunan, China (Zhang in Zhang, Wang, & Zhou, 1977, p. 475).

Taxonomic position.—Nuculidae (by original designation).

Superorder NUCULANIFORMII Carter, Campbell, & Campbell, 2000
Order NUCULANOIDA Carter, Campbell, & Campbell, 2000
Superfamily AFGHANODESMATOIDEA Scarlato & Starobogatov, 1979 [=Cardiolarioidea Cope, 2000]
Family AFGHANODESMATIDAE Scarlato & Starobogatov, 1979 [=Cardiolariidae Cope, 1997]
Genus DIANUCULA Guo, 1988, p. 113

[in Chinese]

Figure 1.14–1.17

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Guo, 1988, p. 113): shell small, elongate-oval in outline, equivalve, inequilateral, inflated; shell shorter anteriorly, with broadly rounded anterior margin; posterior part of shell longer, attenuated posteriorly, with angularly extended posterodorsal part and obtusely rounded posteroventral end; ventral margin broadly arcuate. Umbo obtusely rounded, incurved, and prosogyrate, projecting slightly above dorsal margin, situated in anterior quarter of shell. Posterior umbonal carina rounded and thick, evident near umbo, bounded anteriorly by wide and shallow trough. Surface ornamented with wrinkled concentric ridge. Anterior taxodont row rather short, with larger and stronger teeth; posterior one much longer, with much more teeth; anterior and posterior taxodont rows continuous under umbo.

Type species.—Dianucula sulcata Guo, 1988, p. 113, pl. 6,*8* (holotype), *9–11*; by original designation.

Original description of type species.—(Translation from Chinese text, Guo, 1988, p. 114): Suboval in outline, shell height about two-thirds length; shell shorter anteriorly, with broadly rounded anterior margin; posterior part of shell longer, attenuated posteriorly, with angularly extended posterior end and obtusely rounded posteroventral end; ventral and posterodorsal margins broadly arcuate. Umbo large and obtuse, broadly rounded, incurved, and prosogyrate, projecting slightly above dorsal margin, situated in anterior quarter of shell. Posterior umbonal carina well developed, broadly rounded, evident near umbo, becoming indistinct toward posteroventral end; bounded anteriorly by wide and shallow trough, with corresponding ventral sinus at ventral margin. Surface ornamented with wrinkled concentric ridge; anterior taxodont row composed of 8 longer and stronger teeth, posterior one being 3 times as long as anterior one, with more than 40 small and slender teeth becoming smaller and weaker toward the umbo.

Type locality.—Bridge Tuanjie, Mengla, Yunnan, southwestern China.

Type occurrence.—Dapingzhang Formation, upper Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0706 (holotype); IVy0707–0709.

Distribution of genus.—upper Upper Triassic; western Yunnan, southwestern China (Guo, 1988, p. 113).

Taxonomic position.—Malletiidae (by original designation).

Revision suggestion.—It seems better to place *Dianucula* in Afghanodesmatidae since it has a *Afghanodesmata*-type dentition, although all known afghanodesmatoids are pre-Carboniferous.

Family ANTACTINODIONTIDAE Guo, 1980, p. 51

[in Chinese]

Discussion and diagnosis.—Original diagnosis (Guo, 1981a, p. 38): shell small-medium, equivalve, cuneate, elongate-elliptical, subcircular or subtrigonal. Umbos broadly rounded, protruding or low; umbonal carina poorly developed generally. Surface ornamented with concentric lines of growth or with strong concentric plications. Anterior taxodont series radial from umbo. Anterior adductor scars strongly impressed, accompanied with a minute pedal scar; posterior one shallow and blurred. Buttresses developed [*sic*].

Type occurrence.—Lower Devonian.

Taxonomic position.—Nuculanoidea (by original designation).

Revision suggestion.—Pojeta, Zhang, and Yang (1986, p. 68) doubted the presence of a paleotaxodont-like resilifer in antactinodiontids. They suggested that the dentition of antactinodiontids is not typically paleotaxodont and gave a more precise description for the diagnosis of Antactinodiontidae. Since the separate anterior and posterior dentitions of antactinodiontids are quite similar to those of afghanodesmatoids, it may be better to place Antactinodiontidae within the superfamily Afghanodesmatoidea for the present. Devonian antactinodiontids may be descended from Ordovician afghanodesmatoids.

Genus ANTACTINODION Guo, 1980, p. 52

[in Chinese]

Figure 1.20, 2

Discussion and diagnosis.—Original diagnosis (Guo, 1981a, p. 38): equivalve, inequilateral, cuneate or elongate-ovate with slight

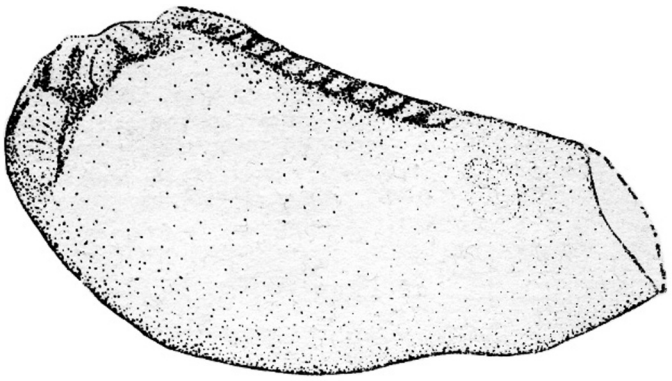

Figure 2. Diagrammatic drawing of *Antactinodion biradiatum* Guo (adapted from Guo, 1980, p. 52, text-fig. 1).

tendency to be rostrate posteriorly. Umbos prominent, rising high above hinge margin, placed more or less near anterior; umbonal carina poorly developed. Surface ornamented with concentric growth lines. Anterior taxodont series composed of longer teeth, short, radial from umbo; posterior series composed of shorter teeth, long, radial outward from inside shell. Radial directions opposite of the two series. Teeth crenulated. Resilium pit elongate-trigonal. Two adductor scars large, anterior one strongly impressed with wrinkles. Buttresses developed [*sic*].

Type species.—*Antactinodion biradiatum* Guo, 1980, p. 52, pl. 1,*11* (holotype); text-fig. 1; by original designation.

Original diagnosis of type species.—(Guo, 1981a, p. 39): Shell small, inequilateral, cuneate in outline, moderately inflated. Umbo prominent, placed at about one-fifth from front; umbonal carina poorly developed. Anterior part short, broadly rounded; posterior part long, narrow with slight tendency to be rostrate. Four teeth in anterior series and ~13 in posterior. Resilifer obliquely trigonal. Anterior adductor scar strongly impressed, accompanied by a minute pedal scar; posterior one faint [*sic*].

Type locality.—Daigu, Mengzi, Yunnan, southwestern China.

Type occurrence.—Pochiao Formation, Emsian, Lower Devonian.

Repository of type material.—Yunnan Institute of Geological Science, Kunming, Yunnan; accession number: 73098, holotype.

Distribution of genus.—Lower Devonian; South China and North Vietnam (Guo, 1981a, p. 38).

Taxonomic position.—Antactinodiontidae (by original designation).

Note.—Pojeta, Zhang, and Yang (1986, p. 68) suggested the presence of a paleotaxodont-like resilifer is unlikely because a large edentulous space is present between anterior and posterior taxodont rows.

Superfamily NUCULANOIDEA H. Adams & A. Adams, 1858
Family NUCULANIDAE H. Adams & A. Adams, 1858
Genus ELEGANUCULANA Chen & Yang, 1983, p. 355

[in Chinese with English description, p. 358]

Figure 1.26–1.27

Discussion and diagnosis.—Original diagnosis (Chen & Yang, 1983, p. 358): triangularly ovate, median sized, equivalve, inequilateral, strongly inflated. Umbo wide, strongly incurved, and turned forward, located near center of cardinal margin. Posterior umbonal ridge distinct and acutely angular in cross section; in front of it is a radial groove extending from umbo to posterior ventral margin and finally forming a sinus on ventral margin. Surface ornamented with 16–18 regular concentric costae, which are missing on the post-umbonal area. Paleotaxodont teeth series separated by a triangular resilifer under umbo. Anterior muscle scar ovate, posterior one ovate-orbicular. Pallial line simple [*sic*].

Type species.—*Eleganuculana nyeruensis* Chen & Yang, 1983, p. 356, pl. 1,*1a–d*, (holotype), *2a–e*,*3;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Chen & Yang, 1983, p. 356): Shell medium, triangularly ovate; strongly inflated, maximal convexity located in anterocentral part of shell. Umbo wide, incurved, and prosogyrate, rising above hinge margin, situated slightly anterior to median. Anterior margin rounded, posterior margin truncate, forming a posterodorsal angle of 100°–110° with posterodorsal margin; posteroventral angle acute

Figure 3. *1–5. Verteranella (Ledoides) langnongensis* Wen & Lan, scale bar 2 mm; *1–2,* holotype; *1,* right external mold; *2,* right internal mold; *3,* drawing of Fig. 3.1; *4,* paratype, left internal mold (adapted from Wen & Lan in Gu et al., 1976, pl. 19,*49,48,50,52*); *5,* plesiotype, right internal mold (adapted from Chen, Wen, & Lan in Wen et al., 1976, pl. 3,*6*).——*6–7. Teinonuculana guangdongensis* Zhang, scale bar 2 mm; *6,* holotype, right internal mold; *7,* paratype, left composite mold (adapted from Zhang in Zhang, Wang, & Zhou, 1977, pl. 1,13,15).——*8–11. Skyphoconcha beichuanensis* Liu & Gu, scale bar 2 mm; *8,* holotype, left interior view; *9,* paratype, right lateral view; *10,* paratype, left lateral view; *11,* paratype, right interior view (adapted from Liu & Gu in Liu, 1988, pl. 70,*5*; pl. 73,*8,12,13*).——*12.* Type material of *Xiaoshuiculana elegansa* (Li & Li), scale bar 1 mm; right valve (adapted from Li & Li in Zhang, Wang, & Zhou, 1977, pl. 1,*12*).——*13–16.* Type material of *Qiongzhounia yongguinia* Lan, scale bar 1 mm; *13,* right interior view; *14,* exterior view of Fig. 3.13; *15,* right interior view; *16,* exterior view of Fig. 3.15 (adapted from Lan in J. Chen, Liu, & Lan, 1983, pl. 3,*16,17,20,21*).——*17–18.* Holotype of *Glyptoleda (Menucula) venusta* Guo, scale bar 2 mm; *17,* right exterior; *18,* right interior (adapted from Guo, 1988, pl. 7,*9a–b*).

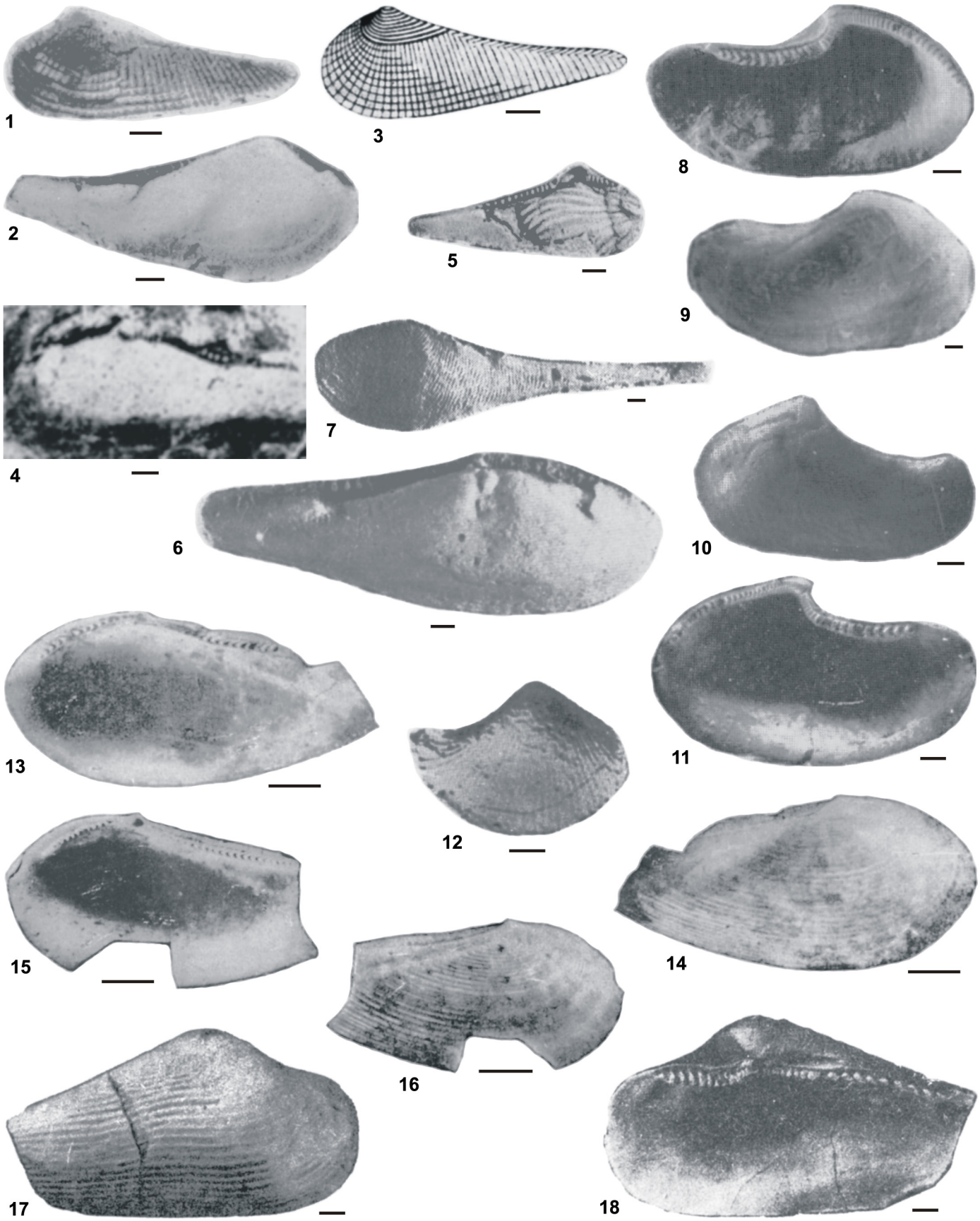

Figure 3. *For explanation, see facing page.*

and protruded, ventral margin broadly arcuate. Posterior umbonal carina strong and angular, bounded anteriorly by trough extending from umbo to posteroventral angle, becoming wider and deeper ventrally, with a corresponding sinus on ventral margin. Surface ornamented with 16–18 regular concentric costae, with narrower interspaces; concentric ridges confined only to flank anterior to umbonal sulcus, without bifurcating; posterior ridge and slope smooth, but with weak growth lines. Siphonal area concave, triangular. Anterior taxodont row composed of 12 teeth, posterior one with 14 teeth, separated by a triangular resilifer. Adductor scars weak, anterior one ovate, posterior one ovate-orbicular in form. Pallial line simple.

Type locality.—Nyeru River Section, Kangmar, Xizang (Tibet), China.

Type occurrence.—Unnamed formation, Norian, Upper Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 56526 (holotype); 56527–56528.

Distribution of genus.—Norian, Upper Triassic; Kangmar, Xizang (Tibet), China (Chen and Yang, 1983, p. 356).

Taxonomic position.—Nuculanidae (by original designation).

Genus GLYPTOLEDA Fletcher, 1945
Subgenus GLYPTOLEDA (MENUCULA) Guo, 1988, p. 114

[in Chinese]

Figure 3.17–3.18

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Guo, 1988, p. 114): shell medium, cuneate in outline, anterior margin rounded, posteriorly elongate and rostrate, ventral margin slightly concave; umbo large, incurved, orthogyrate, situated in anterior third of shell; surface ornamented with regular concentric ridges, subparallel to ventral margin; lunule small and deep, escutcheon not evident; resilifer subtrigonal, deep, below umbo; posterior taxodont row two times as long as anterior one; two adductor scars subequal, deeply impressed.

Type species.—*Glyptoleda (Menucula) venusta* Guo, 1988, p. 114, pl. 7,*9a–b* (holotype) by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1988, p. 114): Shell subcuneate in outline, anterior part short, anterior margin rounded; posterior part long, rostrate posteriorly; ventral margin slightly concave; umbo large, broadly rounded, salient, incurved, and orthogyrate, situated in anterior third of shell; surface ornamented with regular concentric ridge, subparallel to ventral margin; lunule small and deep, escutcheon not evident; resilifer subtrigonal, deep, below umbo; about 13 teeth in front of resilifer, about 18 teeth behind, posterior taxodont row two times as long as anterior one, teeth slightly smaller below umbo and at ends.

Type locality.—Coal Hill, Pingyuanjie, Nianshan, Yunnan, southwestern China.

Type occurrence.—Falang Formation, Ladinian, Middle Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0719, holotype.

Distribution of subgenus.—upper Middle Triassic; eastern Yunnan, southwestern China (Guo, 1988, p. 114).

Taxonomic position.—Nuculanidae (by original designation).

Revision suggestion.—Incomplete specimen prevents use of subgenus name. It seems best to place it provisionally in synonymy with *Veteranella* (*s.l.*).

Genus QIONGZHOUNIA Lan in J. Chen, Liu, & Lan, 1983, p. 622

[in Chinese with English description, p. 626]

Figure 3.13–3.16

Discussion and diagnosis.—Original diagnosis (Lan in J. Chen, Liu, & Lan, 1983, p. 626): shell small to medium, thin, equivalve, strongly inequilateral, nuculaniform. Anterior end round and posterior end strongly elongate. Umbo low and small, rather prominent. Beak opisthogyrous. Posterior umbonal ridge low and smooth. Surface ornamented regularly with concentric costae on flank, fine and weak growth lines on posterior slope, bordering on escutcheon by a radial ridge. An obtuse triangular resilifer interrupting hinge-teeth series and dividing it into two branches, posterior branch being longer than anterior. Radial internal ridge narrowly running from near beak to posterior ventral angle, corresponding to umbonal ridge on outer part of shell. Considering the characters of shell outline and hinge, the new genus should belong to Nuculanidae, and it is similar to *Nuculana* but differs from the latter in the internal structure of shell. The resilifer of the pit of *Nuculana* is more oblique and terminally produced than that of the present genus. Besides, the new genus bears a radial internal ridge, which is absent in *Nuculana*. The present genus resembles *Poroleda* and *Propeleda* in its rather elongate outline, slightly opisthogyrate umbo, and obtuse triangular resilifer. But the latter two forms have a nearly straight hinge line with longitudinal imbricating teeth, pallial lines with deeper sinus, and no radial internal ridges, and thus distinctly differ from the new genus. *Hilgardia, Costatoleda,* and *Lembulus* also have posterior umbonal ridges but are ornamented with diagonal costae, squamae, or nodes, or with wider and deeper posterior grooves. Their ornamentations greatly differ from that of the new genus [*sic*].

Type species.—*Qiongzhounia yongguinia* Lan in J. Chen, Liu, & Lan, 1983, p. 623, pl. 3,*14–21* (no holotype designated) by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, according to Lan in J. Chen, Liu, & Lan, 1983, p. 623): Shell medium, thin, inner shell layer porcelaneous; nuculaniform, equivalve, inequilateral; anterior end rounded, posteriorly elongate, and rostrate. Umbo low and small, slightly salient above hinge margin, slightly opisthogyrate, situated in anterior third of shell. Posterior umbonal carina low, rounded, and smooth, flank ornamented with regular concentric ridges, 10 ridges per millimeter; siphonal area only with weak growth lines, escutcheon elongate shuttle shaped, marked off from siphonal area by escutcheon ridge; lunule absent. Internal hinge margin elongate and narrow, dentition *Nuculana*-type, provided with fine and crowded taxodont teeth, an obtuse triangular resilifer under umbo interrupting taxodont teeth and dividing it into 2 branches, anterior branch short, with 14–16 teeth; posterior one long, with 16–20 teeth. Both adductor scars distinct,

rounded, and shallow, located below anterior and posterior ends of taxodont teeth respectively. A radial internal ridge running from near beak to posterior ventral angle, corresponding to umbonal carina on exterior of shell. Pallial line entire, no sinus.

Type locality.—Hainan Island.

Type occurrence.—Wanglougang Formation, Pliocene.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 61516, 61517.

Distribution of genus.—Pliocene; Guangdong, China (Lan in J. Chen, Liu, & Lan, 1983, p. 623).

Taxonomic position.—Veteranellidae (by original designation).

Revision suggestion.—Nuculanidae.

Genus SKYPHOCONCHA
Liu & Gu in Liu, 1988 (June), p. 241

[in Chinese with English description, p. 397]

Figure 3.8–3.11

Discussion and diagnosis.—Original diagnosis (Liu & Gu in Liu, 1988, p. 397): small to medium, rostrate in outline, with maximum length not more than 37 mm and maximum height through umbos; equivalve, inequilateral; short and round anteriorly, with anterodorsal margin arched; elongated and attenuated posteriorly, with posterodorsal margin descending rapidly from near umbos, then becoming horizontal, parallel to ventral margin for its posterior four-fifths; moderately to considerably inflated; no posteroumbonal ridge but anteroumbonal one exists; umbos prominent, large, discontinuous, strongly opisthogyrous, well incurved, protruding above hinge line, anterior to midlength; surface ornamented with fine to coarse concentric lines and fine radial lineations; no lunule; escutcheon well developed, wide, deeply sunken, limited by a radially marginal ridge on every side; external ligament, opisthodetic [prosodetic in original text]. Hinge plate wide, in particular the anterior part near umbos; dentition taxodont, anterior tooth row longer and having more teeth than posterior tooth row; two tooth rows almost merge beneath umbos, with two kinds of teeth on every row. Anterior tooth row with some 35 teeth, first 15 to 17 hindmost teeth being densely distributed, uniform in size, thin, long pillared, vertical, with low relief, and about 20 in front of them, gradually becoming short, robust, high, erect, forward chevronal blades; posterior tooth row with some 22 teeth, first 7 to 10 frontmost teeth being fine, short, vertical, pillarform, distributed densely, with low relief, and 12 to 15 teeth behind them becoming strong, coarse, erect chevronal blades afterward, with high relief; all teeth oriented with long axes perpendicular to shell dorsal margin; all sockets widened, deepening from near umbos toward anterior and posterior ends respectively. Umbonal cavity deep; inner surface smooth; anterior adductor scar large, shallow, long ellipsoid, with its long axis parallel to dorsal margin, placed under 8 to 10 frontmost teeth of anterior tooth row; posterior adductor scar small, deep, suborbicular, close to terminal end of posterior tooth row, small pedal scar isolated, located above anterior upper side, ellipsoid; pallial line simple, without pallial sinus [*sic*].

Type species.—Skyphoconcha beichuanensis Liu & Gu in Liu, 1988, p. 242, pl. 70,*5* (holotype); pl. 73,*8*,*12–14*; pl. 76,*13;* by original designation; by monotypy.

Original description of type species.—(Gu & Liu, 1988, p. 358): Nuculanids as long as 37 mm, with both commarginal and radial ornament present, shell highest in umbonal region, elongate, not attenuated posteriorly; posterodorsal and posteroventral shell margins subparallel, posterior tip turning dorsally; anterior and posterior shell margins broadly rounded; beaks opisthogyrate. Teeth taxodont, posterior tooth row sunken and forming an obtuse angle with obliquely inclined anterior tooth row; anterior teeth more numerous than posterior ones. Adductor scars isomyarian; anterior one, occurring below eighth to tenth tooth, is larger than posterior one, located at distal end of posterior tooth row; small, deep, pedal retractor scar occurring above posterior adductor scar. Opisthodetic external ligament. Pallial line simple and entire, no sinus [*sic*].

Type locality.—Ganxi, Beichuan, Sichuan, southwestern China.

Type occurrence.—Ganxi Formation, Emsian, Lower Devonian.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: LBV-851111 (holotype); LBV-851112–851115, 851117.

Distribution of genus.—Lower Devonian; Longmenshan, Sichuan, southwestern China (Liu & Gu in Liu, 1988, p. 241).

Taxonomic position.—Nuculidae (by original designation).

Revision suggestion.—Fang (1998, p. 185) suggested that *Skyphoconcha* is a junior synonym of *Pseudonuculana* Pojeta, Zhang, and Yang (1986, p. 63) and should be transferred to Nuculanidae (Gu & Liu, 1988; Pojeta, Zhang, & Yang, 1986).

See also.—Gu and Liu (1988, p. 358, 1988 [Dec]) described the same fossil material as *Scyphoconcha* Liu & Gu in Liu, 1988 (=*Skyphoconcha* Liu & Gu, 1988 [June]) but placed it in Nuculanidae.

Genus TEINONUCULANA
Zhang, in Zhang, Wang, & Zhou, 1977, p. 9

[in Chinese]

Figure 1.13, 3.6–3.7

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 9): shell medium to large, transversely elongate, inequilateral; anterior end rounded, gradually narrower posteriorly, posterior end narrow; umbo situated in anterior third of shell; surface ornamented with ripple-like oblique lines, forming an irregular reticulated ornamentation. Triangular resilifer under umbo, acline; in front and behind resilifer is a chevron taxodont series, not interrupted beneath umbo by resilifer; more teeth in posterior series. Adductor scars well developed, anterior one larger; internal septum rather short, extending downward about one-fifth shell height from umbo.

Type species.—Teinonuculana guangdongensis Zhang in Zhang, Wang, & Zhou, 1977, p. 10, pl. 1,*13* (holotype), *14–15;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 10): Shell medium to large, very inequilateral, transversely elongate, three times longer than high; umbo salient, situated in anterior third of shell; anterior end rounded, posterior slope slightly concave, posterior part very elongate, rather narrow, gradually becoming narrower posteriorly

into stick shape; a radial ridge extending from umbo to posterior end, but distinct only in elongate posterior part; surface ornamented with crowded, ripple-like oblique lines anterior to umbo, forming an irregular reticulated ornamentation; with crowded, ripple-like lines after umbo, inclined forward and backward, not as distinct as those in anterior part; triangular resilifer under umbo, acline; in front and behind resilifer is a chevron taxodont series, not interrupted beneath umbo by resilifer; more teeth in posterior series; adductor scars well developed, anterior one large, orbicular, located near anterodorsal margin; posterior one small, elliptical; internal septum rather short, extending downward about one-fifth shell height from umbo.

Type locality.—Hengli, Huiyang, Guangdong, China.

Type occurrence.—Jinji Formation, Lower Jurassic.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: IV55394 (holotype); IV55395, 55396.

Distribution of genus.—Lower Jurassic; Guangdong, China (Zhang in Zhang, Wang, & Zhou, 1977, p. 10).

Taxonomic position.—Nuculanidae (by original designation).

Revision suggestion.—Yin and McRoberts (2006) suggested that the type species of *Teinonuculana* exhibits diagnostic features (e.g., posteriorly elongated form, long and narrow rostrum, and taxodont dentition consisting of numerous chevron-shaped teeth and sockets) that are consistent with *Ryderia* and placed *Teinonuculana* in synonymy with the latter.

Genus VERTERANELLA Patte, 1926
Subgenus VERTERANELLA (LEDOIDES) Wen & Lan in Gu et al., 1976, p. 28

[in Chinese]

Figure 3.1–3.5

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Wen & Lan in Gu et al., 1976, p. 28): shell elongate *Nuculana*-form, posterior part long and narrow, with nearly pointed end. A series of taxodont teeth ranging at each side of resilifer, posterior series three times longer than anterior one. Surface ornamentation unusual: umbonal region only with concentric lines, remainder of shell covered by regular radial lines, intersected by concentric lines to form reticulated ornamentation on anterior part, but lacking concentric lines on posterior part; a series of slants developing near posterodorsal margin and crossing over radial lines to form chevron-shaped ornamentation with their points toward umbo. Anterior adductor scar rounded, posterior one strong and transversely elongate; without pallial sinus.

Type species.—*Verteranella (Ledoides) langnongensis* Wen & Lan in Gu et al., 1976, p. 29, pl. 19,*48*,*49* (holotype), *50–52;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Wen & Lan in Gu et al., 1976, p. 29): Posterior part of shell rostrate, length about 2.5 times as long as height; moderately inflated. Umbo situated in anterior fourth of shell; wide and shallow median sulcus extending from umbo to middle part of ventral margin. Umbonal region marked only with concentric lines, rest of disc surface covered by three kinds of ornament elements: radial lines fine and closely spaced; concentric lines only restricted to anterior part, but with posterior ends extending posteriorly in ontogenetic order; series of slants developing near posterodorsal margin and crossing over radial lines to form chevron-shaped ornamentation. Anterior taxodont series with about 24 small teeth, posterior taxodont series about 12, length of posterior taxodont series about 3 times as long as that of anterior one.

Type locality.—Langnong, Nielamu, Xizang (Tibet), China.

Type occurrence.—Qulonggongba Formation, Norian, Upper Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 24689 (holotype); 24688, 24690.

Distribution of subgenus.—Upper Triassic; southern Xizang (Tibet), China (Wen & Lan in Gu et al., 1976, p. 28).

Taxonomic position.—Nuculanidae (by original designation).

Note.—According to Chen, Wen, and Lan (in Wen et al., 1976, p. 23, pl. 3,*1–8*), subgenus *Verteranella (Ledoides)* and type species erected by Chen, Lan, and Wen.

Genus XIAOSHUICULANA
J. Chen in J. Chen, Liu, & Lan, 1983, p. 622

[in Chinese with English description, p. 626]

Figure 1.21–1.22, 3.12

Discussion and diagnosis.—Original diagnosis (J. Chen in Chen, Liu, & Lan, 1983, p. 626): shell small, nuculaniform, equivalve, strongly inequilateral, moderately inflated. Posterior umbonal ridge not distinct. Anterior part of shell shorter than posterior part. Surface strongly ornamented with 28–30 radial costae. Concentric lines present, weak and restricted only to ventral part. Interior ventral margin of shell serrated. Hinge with two series of small teeth ranging at each side of a triangular oblique resilifer. Muscle scars circular-ovate. Pallial line simple. The new genus is very similar to *Indoculane* Kanjilal and Singh (1973) from the Upper Jurassic of Cutch, India, in outline and in having radial ornamentation, but differs from latter in number of grouped costae. Present genus is ornamented with only one group of radial costae. In *Indoculana* there are two groups of costae, radial and concentric, that form reticular ornamentation. *Indoculana* has a distinct ridge running from umbo to posterior margin, which is absent in present genus. *Ledoides* Chen, Wen, and Lan (in Wen et al., 1976) is an Upper Triassic genus from Xizang, China, and resembles new genus in outline. It is ornamented with concentric costae on umbonal area, reticular sculptures on anterior part, and radial and oblique lines on posterior part of surface. Thus its ornamentation differs greatly from that of *Xiaoshuiculana* [*sic*].

Type species.—*Reticulana elegansa* Li & Li in Zhang, Wang, & Zhou, 1977, p. 9, pl. 1,*10–12* (no holotype has been designated yet) by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Li & Li in Zhang, Wang, & Zhou, 1977, p. 9): Shell small, nuculaniform, posteriorly elongate and constricted; subequilateral; moderately inflated; length slightly more than height; umbo incurved, slightly opisthogyrate, situated near center; anterodorsal margin nearly straight or slightly convex, posterodorsal concave;

posterior umbonal carina distinct; surface marked with reticulated ornament, radial costae evident, concentric lines weak; rounded triangular resilifer below umbo, with a series of taxodont teeth on each side, about 13 small teeth in anterior taxodont row, and about 10 in posterior; adductor scars rounded, posterior one deeper and evident; interior ventral margin crenulated.

Type locality.—Xiaoshui, Lechang, Guangdong, China.

Type occurrence.—Xiaoshui Formation, Upper Triassic.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China (lacking accession number).

Distribution of genus.—Upper Triassic; Guangdong, China (J. Chen in J. Chen, Liu, & Lan, 1983, p. 622).

Taxonomic position.—Veteranellidae (by original designation).

Revision suggestion.—Nuculanidae.

Subfamily VETERANELLINAE J. Chen, Liu, & Lan, 1983, p. 618

[in Chinese with English description, p. 626]

Discussion and diagnosis.—Original diagnosis (J. Chen, Liu, & Lan, 1983, p. 626): nuculaniform to ovate, inequilateral. Escutcheon and lunule present. Paleotaxodont with internal ligament. Surface ornamented with one or more groups of radial, concentric, and oblique costae or ridges as well as growth lines. Pallial line simple [*sic*].

Type occurrence.—?Silurian, Devonian–Holocene.

Taxonomic position.—Nuculanoidea: Nuculanidae (by original designation).

Revision suggestion.—Veteranellinae is a rejected name, suggested by Fang and Cope (2004, p. 1125).

Subclass AUTOLAMELLIBRANCHIATA Grobben, 1894
Superorder PTERIOMORPHIA Beurlen, 1944
Order PRAECARDIOIDA Newell, 1965
Superfamily PRAECARDIOIDEA Hoernes, 1884
Family PRAECARDIIDAE Hoernes, 1884
Genus FENTOUNIA Liu in Liu & Liang, 1983, p. 294

[in Chinese]

Figure 4.1–4.4

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Liu in Liu & Liang, 1983, p. 294): shell medium to somewhat large, thin, moderately inflated, subcircular or oblique oval; umbo gibbose, beak incurved, prosogyrate, situated anteriorly. Surface smooth or with concentric lines. External ligament, opisthodetic; interior unknown.

Type species.—Fentounia helicorostrata Liu in Liu & Liang, 1983, p. 294, pl. 103,*1* (holotype), *2*,*6*,*9;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Liu in Liu & Liang, 1983, p. 294): Shell medium, thin, moderately inflated, oblique oval; umbo gibbose and wide, beak strongly incurved, situated slightly anterior of midpoint of shell length. Surface ornamented with concentric lines. Parivincular ligament, opisthodetic; interior unknown.

Type locality.—Fentou, Nanjing, Jiangsu, eastern China.

Type occurrence.—Fentou Formation, middle Silurian.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 62861.

Distribution of genus.—middle Silurian; eastern China (Liu in Liu & Liang, 1983, p. 294).

Taxonomic position.—Praecardiidae (by original designation).

Family ANTIPLEURIDAE Neumayr, 1891
Genus ANTIPLEURA Barrande, 1881
Subgenus ANTIPLEURA (DAIGUIA) Guo, 1985a, p. 121

[in Chinese with English description, p. 264]

Figure 4.22–4.24

Discussion and diagnosis.—Original diagnosis (Guo, 1985a, p. 264): shell subrounded, subequilateral, inequivalve, with moderate convexity. Umbo slightly anterior to median, weakly prosogyrous at beak. Left valve obviously more convex with prominently overhanging umbo; right valve flat and slightly concave with obscure, low and small umbo. Surface ornamented with broad radial folds, broader and lower in right valve. Discriminated from *Antipleura* and *Dualina* by flat and slightly concave right valve and broad radial folds on shell surface [*sic*].

Type species.—Antipleura (Daiguia) mengziensis Guo, 1985a, p. 121, pl. 7,*6a–c* (holotype) by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1985a, p. 121): Shell subcircular in outline, length less than height; hinge margin nearly straight, only about two-thirds of greatest length of shell. Anterior, ventral, and posterior margins subrounded, anterodorsal and posterodorsal margins slightly extended; anterior auricle obscure, posterior one slightly distinct, depressed, and wide, subtriangular, with an obtuse posterodorsal angle of about 110°. Umbo slightly anterior in position, situated nearly one-half shell length back from anterior end; beak incurved and slightly prosogyre. Left valve rather inflated, with umbo rising above that of right valve; right valve rather flat, slightly concave, with small, subdued, and more anteriorly placed umbo. Surface ornamented with broad radial plicae, all being separated by same width interspaces; left valve with more plicae, about 10 in number, but posterodorsal area smooth and lacking plicae; right valve with fewer plicae, which are broader and weaker than those of left valve, umbonal, antero- and posterodorsal areas smooth and lacking plicae.

Type locality.—Daigu, Mengzi, Yunnan, southwestern China.

Type occurrence.—Daigu Group, Lower Devonian.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVY0089, holotype.

Distribution of subgenus.—Lower Devonian; Yunnan, southwestern China (Guo, 1985a, p. 121).

Taxonomic position.—Antipleuridae (by original designation).

Revision suggestion.—The only type specimen is probably a pterinopectinid rather than an antipleurid in view of its general outline and ornamentation, especially its auricles.

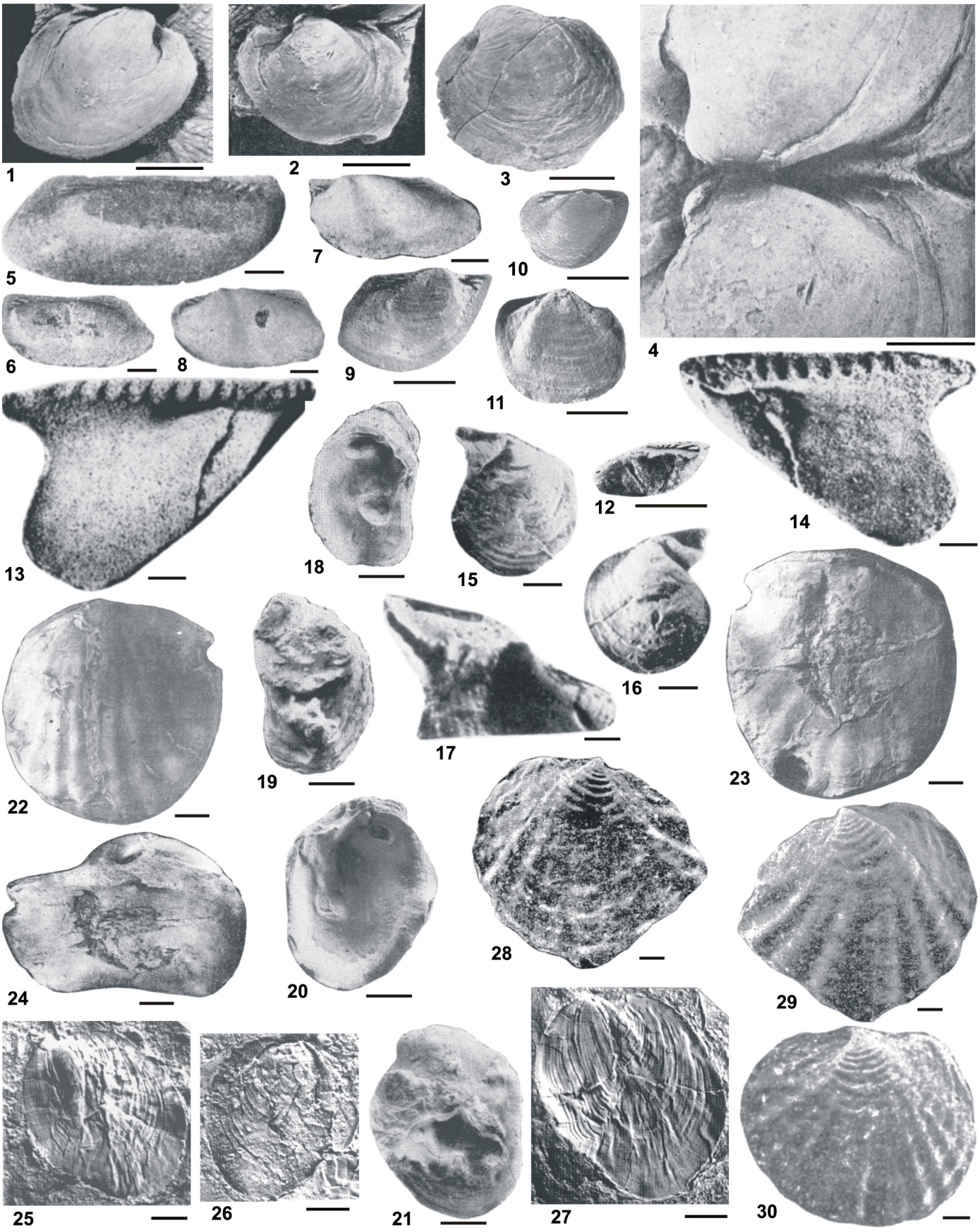

Figure 4. *For explanation, see facing page.*

Family BUTOVICELLIDAE Kriz, 1965
Genus TEWOELLA Ding & Li, 1987, p. 179

[in Chinese with English description, p. 182]

Figure 4.28–4.30

Discussion and diagnosis.—Original diagnosis (Ding & Li, 1987, p. 182): shell small to medium, circular or elliptical in outline; equivalve, inequilateral; slightly inflated. Beaks small and pointed, prosogyrate. Umbo subdued, lying at anterior half, one-third of whole shell length. Shell surface ornamented with radial ridges and concentric wrinkles, radial ridges beginning from below umbonal region; umbonal region only with concentric wrinkles, forming regular or irregular knobs or reticulate sculpture on surface of shell; lunule and escutcheon lacking; edentulous; muscle scar unknown. Judging from its ovoid-circular outline, equivalve, prosogyrate beaks, well-developed radial ridges, edentate and lack of lunule and escutcheon, the writers are inclined to refer the new genus to Praecardiidae in Praecardicea. In Praecardiidae, this genus resembles *Praecardium* but differs from the latter in lacking a denticle on the hinge margin, being less inflated, having a low flat umbo, radial ridges beginning from umbonal area, and concentric wrinkles intersected with radial ridges to form particular sculptures. *Buchiola* is similar but differs in having radial ridges beginning from umbonal region and having broad flat radial costae that are crossed by regularly spaced, upwardly arched growth lamellae [*sic*].

Type species.—*Tewoella xiawunaensis* Ding & Li, 1987, p. 179, pl. 125,*1–4*,*5a–c*,*6*,*7a–b*,*8*,*9a–c* (holotype) by original designation; by monotypy.

Original description of type species.—(translation from Chinese text, Ding & Li, 1987, p. 179): Shell small to medium, length about 15–30 mm, equivalve; weakly inflated, greatest convexity at middle-upper part of shell; subcircular to elliptical in outline, slightly longer than high, height of posterior part larger than that of anterior; anterior margin narrowly rounded, posterior one broadly arcuate, ventral margin circular-arcuate, dorsal one short and arcuate; posterodorsal part slightly depressed, showing crescent; umbo low and flat, slightly salient above hinge margin, situated near center or slightly anterior of center; beak small, prosogyrate; surface ornamented with broadly rounded radial ribs, originating from lower umbonal area, ~7–13 in number, the foremost one or two being curved upwardly. Umbonal area ornamented with fine and close concentric rings, radial ribs crossed and strengthened by concentric rings, commonly forming regular or irregular nodules at intersections and resulting in reticulate-like ornamentation; hinge teeth not seen, lacking lunule and escutcheon.

Type locality.—Dangduogou, Tewo, Gansu, northwestern China.

Type occurrence.—Bottom part of Dangduogou Formation, Emsian, Lower Devonian.

Repository of type material.—Xi'an Institute of Geology and Mineral Resources, Xi'an, Shaanxi, China; accession number: L321 (holotype); L314–320, 322.

Distribution of genus.—Lower Devonian; Gansu, northwestern China (Ding and Li, 1987, p. 179).

Taxonomic position.—Praecardiidae (by original designation).

Revision suggestion.—*Tewoella xiawunaensis* Ding & Li is very similar to growth stage II and stage III of *Butovicella gallemmu* Kriz (in Kriz & Serpagli, 1993, p. 342, pl. 2,*5–7*). The present genus probably is a junior synonym of *Butovicella* Kriz, suggested herein (family Butovicellidae Kriz, 1965).

Family LUNULACARDIIDAE Fischer, 1887
Subfamily PTEROCHAENIINAE Fang & Ding, 1993, p. 4

[in Chinese with English description, p. 10]

Discussion and diagnosis.—Original diagnosis (Fang & Ding, 1993, p. 10): shell small and tenuous, equivalve, inequilateral, opisthodetic, with prosogyre beaks; well-defined anterior ear separated from body of shell by a deep groove, flangelike or triangular in form; surface with concentric ornament, sometimes with fine internal costallae; large byssal gape present; internal features unknown. This subfamily differs from Lunulacardiinae in having a prominent anterior groove that separates the anterior ear from the

Figure 4. *1–4. Fentounia helicorostrata* Liu; *1,* holotype, right internal mold, scale bar 10 mm; *2,* paratype, left internal mold, scale bar 10 mm; *3,* paratype, left valve, scale bar 10 mm; *4,* paratype, dorsal part of conjoined valves, showing ligament area, scale bar 5 mm (adapted from Liu in Liu & Liang, 1983, pl. 103,*1,2,6,9*).——*5–8. Bapristodia serrata* Guo, scale bar 2 mm; *5,* holotype, right internal mold; *6–8,* paratype, left internal molds (adapted from Guo, 1988, pl. 7,*5–8*).——*9–12. Grammatodon (Lamellelodon) gucuoensis* Yao, scale bar 10 mm; *9,* holotype, right composite mold; *10,* paratype, right composite mold; *11,* paratype, left composite mold; *12,* paratype; right internal mold (adapted from Yao, 1994, pl. 10,*1,3,7,9*).——*13–14.* Holotype of *Yunshanoperna yunshanensis* J. Chen, scale bar 5 mm; *13,* right internal mold; *14,* latex cast of Fig. 4.13 (adapted from J. Chen in Gu, Chen, & Sha, 1984, pl. 11,*10,11*).——*15–17. Guangxiconcha hechiensis* Zhang, scale bar 1 mm; *15,* holotype; right valve; *16,* paratype, left valve; *17,* paratype, right external mold (adapted from Zhang in Zhang, Wang, & Zhou, 1977, pl. 193,*1–3*).——*18–21. Protostrea sinensis* (Hsu), scale bar 10 mm; *18–19,* holotype, right valve; *18,* interior view; *19,* right lateral view; *20–21,* paratype, left valve; *20,* interior view; *21,* left lateral view (adapted from Gu et al., 1976, pl. 40,*12,13,20,21*).——*22–24.* Holotype of *Antipleura (Daiguia) mengziensis* Guo, scale bar 10 mm; *22,* left lateral view; *23,* right lateral view; *24,* dorsal view (adapted from Guo, 1985a, pl. 7,*6a–c*).——*25–27. Nandania ovalis* Zhang, scale bar 2 mm; *25,* holotype, left composite mold; *26,* paratype, right composite mold; *27,* paratype, right external mold (adapted from Zhang, 1999, pl. 17,*11,4,9*).——*28–30. Tewoella xiawunaensis* Ding & Li, scale bar 2 mm; *28–29,* holotype, articulated shell; *28,* right lateral view; *29,* left lateral view; *30,* paratype, right composite mold (adapted from Ding & Li, 1987, pl. 125,*9b,9c,8*).

body of the shell, and in lacking the flattened lunule characteristic of the latter [*sic*].

Distribution of subfamily.—upper Silurian–Devonian; Asia, Europe, and North America.

Taxonomic position.—Lunulacardiidae (by original designation).

Genus PTEROCHAENIA Clarke, 1904
Subgenus PTEROCHAENIA (CLARKEA) Fang & Ding, 1993, p. 7

[in Chinese with English description, p. 11]

Discussion and diagnosis.—Original diagnosis (Fang & Ding, 1993, p. 11): shell small, arcuate or crescent, truncate anteriorly; byssal margin long, nearly straight, with anterior ear extending dorsoventrally, flange-formed [flangelike], obtusely truncated at end; posterior end not well differentiated; surface with concentric ornament, sometimes with internal costallae. *Clarkea* differs from *Pterochaenia* (*s.s.*) in being truncate anteriorly, with long and nearly straight byssal margin and dorsoventrally extended anterior ear [*sic*].

Type species.—Pterochaenia cashaquae Clarke, 1904, p. 254, pl. 4,*20–25*; by original designation.

Distribution of subgenus.—Middle Devonian–Upper Devonian; North America, Europe, and Asia (Fang & Ding, 1993, p. 5).

Taxonomic position.—Lunulacardiidae: Pterochaeniinae (by original designation).

Note.—See Clarke (1904) for figures and original diagnosis of type species.

Genus GUANGXICONCHA Zhang in Zhang, Wang, & Zhou, 1977, p. 492

[in Chinese]

Figure 4.15–4.17

Homonymy.—non Plicatounio (*Guangxiconcha*) Yao and Yu, 1986; =*Plicatounio* (*Guangxiplicatounio*) Fang, 2007a.

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 492): shell small, orbicular, moderately inflated, equivalve, inequilateral, infracrescent; umbo central; anterior auricle well developed, separated from disc by deep sulcus, extending anterodorsally, high over hinge margin, folded commonly, and hollow, conelike, commonly with a sulcus near its upper margin, sometimes flat (without sulcus); without posterior auricle; surface including auricles ornamented with commarginal lines. Interior structure unknown.

Type species.—Guangxiconcha hechiensis Zhang in Zhang, Wang, & Zhou, 1977, p. 492, pl. 193,*1* (holotype), *2–3;* by original designation.

Original description of type species.—(Translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 492): Shell small, orbicular, equivalve, inequilateral, infracrescent; umbo central; anterior auricle well developed, separated from disc by deep sulcus, extending anterodorsally, high over hinge margin, commonly folded, becoming hollow conelike, commonly with a sulcus near its upper margin, sometimes sulcus is indistinct; without posterior auricle; surface including auricles ornamented with commarginal lines.

Type locality.—Huima, Hechi, Guangxi, China.

Type occurrence.—Tangding Formation, Emsian, Lower Devonian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: IV55166 (holotype); IV55167, 55168.

Distribution of genus.—Lower Devonian; Guangxi, China (Zhang in Zhang, Wang, & Zhou, 1977, p. 492); Lower Devonian–Middle Devonian; Guangxi and Hunan, China (Zhang, 1999, p. 152).

Taxonomic position.—Lunulacardiidae (by original designation).

Revision suggestion.—Lunulacardiidae: Pterochaeniinae (Fang & Ding, 1993).

Family GUANGXICONCHIDAE Zhang, 1999, p. 151

[in Chinese with English description, p. 163]

Discussion and diagnosis.—Original diagnosis (Zhang, 1999, p. 163): small, equivalved, inequilateral, ovate, thin shelled with beak at or near anterior [deleted the word "and"—supposedly *lapsus calami*] of hinge; acline, prosocline, or opisthocline; byssal sinus evident; prominent sulcus separating anterior auricle from shell body, posterior auricle not clearly differentiated from remainder of shell; surface with commarginal lines and fine radial costellae, internal shell characters unknown. Guangxiconchidae differ from Lunulacardiidae and Ambonychiidae in their small size, thin shell, and prominent byssal sinus [read auricle sulcus] separating anterior auricle from shell body. Guangxiconchidae includes three genera: *Guangxiconcha* Zhang in Zhang, Wang, & Zhou, 1977; *Pterochaenia* Clarke, 1904; and *Opisthonia* (*gen. nov.*) [*sic*].

Type occurrence.—upper Silurian–Middle Devonian.

Taxonomic position.—Ambonychioidea (by original designation).

Revision suggestion.—The auricle sulcus in *Pterochaenia* and its allies, such as *Guangxiconcha*, is quite variable, thus it is unsuitable to consider auricle sulcus as an important diagnosis for their classification. Guangxiconchidae is a junior synonym of Pterochaeniinae Fang & Ding, 1993.

Genus NANDANIA Zhang, 1999, p. 149

[in Chinese with English description, p. 162]

Figure 4.25–4.27

Discussion and diagnosis.—Original diagnosis (Zhang, 1999, p. 162): equivalve, inequilateral, longitudinally ovate. Umbos rounded, not protruding above hinge margin, and occurring anterior to midlength of hinge. Extending from just in front of beak toward anteroventral margin; furrow at right angle to hinge line and deeper proximally. Anterior lobe (i.e., shell anterior to furrow) comprising about one-third of shell body and covered with commarginal lines; shell posterior to furrow with commarginal lines and widely spaced, fine radial lines. Internal shell features

unknown. *Nandania* is distinguished from other antipleurids by prominent radial furrow that divides shell into two parts with different ornament. *Silurina confortata* Barrande (1881, pl. 48,*IV*) is also longitudinally ovate, with subdued umbos, but it has a nasute ridge extending from umbo to anterior margin [*sic*].

Type species.—Nandania ovalis Zhang, 1999, p. 149, pl. 16,*13–15*; pl. 17,*1–10*,*11* (holotype), *12–14*.

Original description of type species.—(Zhang, 1999, p. 163): Small, thin shelled, dorsoventrally ovate, prosocline, equivalved, inequilateral. Holotype 10 mm high, 7 mm long. Umbos rounded, barely protruding above hinge line, and positioned anterior to hinge at midlength [just anterior of center on hinge margin]. Hinge line short; nearly straight posterior to umbo. Anterior and posterior margins broadly rounded. Radial furrow extending from anterior side of umbo to anteroventral margin; furrow deepest proximally and subdividing shell body into two parts: anterior part occupying one-third shell body and having commarginal lines; posterior part having fine and widely spaced radial lines, and crossed by commarginal lines. Anterior and posterior parts occasionally overlapping slightly owing to deformation [*sic*].

Original description of type species.—(Translation from Chinese text, Zhang, 1999, p. 149): 132 specimens, most of them being composite molds. Shell small and thin, longitudinally ovate, holotype 6 mm long and about 8 mm high. Infracrescent, equivalve, very inequilateral. Umbo blunt, situated at anterior of center, very near hinge margin. Hinge margin short and nearly straight posterior to umbo, about one-third of shell length. Anterior and posterior margins broadly rounded, subparallel to each other. An internal septum extending from anterior side of umbo to ventral margin, at right angle to hinge line, leaving a sulcuslike impression in internal molds, deepest proximally and becoming shallower ventrally, subdividing shell body into two parts: anterior part occupying one-third shell body, covered by commarginal lines; posterior part having fine and widely spaced radial lines, and crossed by commarginal lines. The left and right valves are often preserved together and partially overlap each other (pl. 17,*10–14*). External molds usually show ornament more clearly.

Type locality.—Luofu, Nandan, Guangxi, China.

Type occurrence.—Lower Member, Nabiao Formation, Dalejian, upper Lower Devonian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: 1358 (holotype); 1032, 1032-1, 1034, 1036, 1037, 1042, 1043-1, 1046, 1056, 1347, 1349, 1349-1, 1359, 1376, 1379, 1478-2.

Distribution of genus.—upper Lower Devonian; Guangxi, China (Zhang, 1999, p. 149).

Taxonomic position.—Antipleuridae (by original designation).

Revision suggestion.—The so-called radial ornament and "internal septum" or "radial furrow" are considered by Zhang (1999, p. 149) as the distinguishing features for the genus *Nandania* Zhang. However, there is no strong evidence for the existence of internal septum in *Nandania*. In addition, the so-called radial lines of *Nandania* are probably traces of an outer radially fibrous prismatic shell layer. Therefore the genus name *Nandania* is rejected herein. It seems that *Nandania* has closest affinity with *Pterochaenia* and *Guangxiconcha*, because they are morphologically similar to each other in being small and thin shelled, and especially in the presence of an anterior auricle. *Nandania* is probably a junior synonym of *Pterochaenia* Clarke, 1904.

Note.—We retranslate Zhang's (1999) Chinese description of the type species because his English description (p. 163) does not coincide with his Chinese description (p. 149). For example, we cannot find the words internal septum in his English description.

Genus OPISTHONIA Zhang, 1999, p. 155

[in Chinese with English description, p. 165]

Figure 5.1–5.3

Discussion and diagnosis.—Original diagnosis (Zhang, 1999, p. 165): small, thin shelled, markedly opisthocline, equivalved, strongly inequilateral, umbos rounded, slightly protruding above hinge line; prominent sulcus separating elliptical anterior auricle from shell body; anterior and posterior margins broadly rounded and subparallel; anteroventral margin strongly extended anteriorly, producing falcate outline of shell body; posterior auricle not obviously differentiated; commarginal lines on anterior auricle and shell body. *Opisthonia* differs from the other genera of Guangxiconchidae in having a markedly opisthocline, falcate shape. In addition, the elliptical anterior auricle differs from the narrow elongate auricle in *Pterochaenia* [sic].

Type species.—Opisthonia gracilia Zhang, 1999, p. 156, pl. 21,*1–4*,*5* (holotype), *6–7*; by monotypy.

Original description of type species.—(Zhang, 1999, p. 166): Equivalved, strongly inequilateral, obliquely ovate, very opisthocline, small, higher than long (10 mm height, 7–8 mm length), thin shelled; umbos rounded, slightly protruding above hinge line, and located at anterior end of hinge; hinge line arched; anterior auricle ovate, elongate, and separated from shell body by sulcus; anterior and posterior margins broadly rounded and subparallel; shell surface gently convex umbonally, planar distally; anteroventral margin strongly extended anteriorly, and forming a markedly opisthocline, falcate form of shell body; posterodorsal margin rounded; posterior auricle not differentiated; surface covered by fine and regular commarginal lines [*sic*].

Type locality.—Luofu, Nandan, Guangxi, China.

Type occurrence.—Upper member, Tangding Formation; Lower Member, Nabiao Formation, Zlichovian–Dalejian, upper Lower Devonian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: 1031 (holotype); 1029, 1030, 1039, 1041, 1345, 1380.

Distribution of genus.—upper Lower Devonian; Guangxi, China (Zhang, 1999, p. 156).

Taxonomic position.—Guangxiconchidae (by original designation).

Revision suggestion.—Junior synonym of *Pterochaenia* Clarke, 1904, suggested herein because they do not differ in any important respect.

Order MYTILOIDA Férussac, 1822
Superfamily MODIOLOPSOIDEA Fischer, 1887

[*nom. transl.* Fang & Morris, 1997, p. 52, *ex* Modiolopsidae Fischer, 1887 in 1880–1887, p. 989]

Family MODIOLODONTIDAE
Fang & Morris, 1997, p. 62 [in English]

Type genus.—*Modiolodon* Ulrich, 1894, p. 521, *non Modiolodon* Netscharew, 1894.

Discussion and diagnosis.—Original diagnosis (Fang & Morris, 1997, p. 62): equivalve, modioliform, inequilateral, with beaks near anterior end; dentition with a few small but distinct, radiating cardinal teeth mounted on a hinge plate, no laterals; ligament opisthodetic, simple or primitive, without nymph or any other projecting support structure; anisomyarian, anterior adductor scar smaller than posterior one [*sic*].

Type occurrence.—Ordovician–Devonian.

Taxonomic position.—Modiolopsoidea (by original designation).

Order ARCOIDA Stoliczka, 1870
Superfamily ARCOIDEA Lamarck, 1809
Family PARALLELODONTIDAE Dall, 1898
Genus BAPRISTODIA
Guo, 1988, p. 115

[in Chinese]

Figure 4.5–4.8, 6

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Guo, 1988, p. 115): shell small, subtrapeziform, equivalve, moderately inflated; hinge margin nearly straight, about three-quarters greatest length of shell; anterior margin semicircular, ventral margin broadly arcuate, posterior margin truncated; length more than ~2 times height; umbo low, wide, and blunt, beak slightly incurved and prosogyre, situated about one-third shell length back from anterior end. Both posterior and anterior umbonal carinae widely rounded and indistinct; median sulcus wide, shallow, and distinct, extending from umbo to ventral margin, with a corresponding ventral sinus at ventral margin. Surface covered by growth lines. Dentition consisting of short and forward-inclined anterior teeth, subumbonal pseudotaxodont teeth, and long and backward-inclined posterior teeth; all teeth serrated or transversely grooved, and converging ventrally. Adductor scars shallow and obscure.

Type species.—*Bapristodia serrata* Guo, 1988, p. 116, pl. 7,*5* (holotype), *6–8*; text-fig. 2; by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1988, p. 116): Shell small, subtrapeziform, inflated; hinge margin straight and long, about three-quarters greatest length of shell; anterior margin rounded, ventral margin broadly arcuate, posterior margin truncated; anterodorsal angle about at right angle, subrounded; posterodorsal part winglike, subangular, and flat, with an obtuse posterodorsal angle of 120°–140°; posteroventral angle well defined, extending posteriorly, subrounded; umbo wide and blunt, beak incurved and slightly prosogyrate, situated about one-third shell length back from anterior end. Both posterior and anterior umbonal carinae widely rounded and indistinct; median sulcus wide and shallow, extending from umbo to ventral margin, with a corresponding ventral sinus at ventral margin. Dentition arranged in a divergent pattern with center of radius toward middle of valves, 4 anterior teeth, short and lamellar, forward inclined, forming an oblique angle with anterior hinge margin; subumbonal pseudotaxodont teeth short and small, about 3 or 4; posterior teeth long and lamellar, about 5 or 6, subparallel to posterior hinge margin; all teeth serrated or transversely grooved, and converging ventrally. Adductor scars obscure.

Type locality.—Wuyin, Weishan, Yunnan, southwestern China.

Type occurrence.—Maichuqing Formation, upper Upper Triassic.

Figure 5. *1–3. Opisthonia gracilia* Zhang, scale bar 1 mm; *1,* holotype, right composite mold; *2,* paratype, right external mold; *3,* paratype, left composite mold (adapted from Zhang, 1999, pl. 21,*5,1,4*).——*4–7. Fasciculiptera guangxiensis* Zhang; *4,* holotype, right valve, scale bar 10 mm; *5,* paratype, right valve, scale bar 2 mm; *6,* paratype, left valve, scale bar 10 mm; *7,* paratype, ventral view, scale bar 10 mm (adapted from Zhang in Zhang, Wang, & Zhou, 1977, pl. 193,*8,7,9,17*).——*8–9.* Holotype of *Catella (Oceanopieris) elegans* Guo; *8,* internal mold of conjoined valves, scale bar 1 mm; *9,* latex cast of Fig. 5.8, scale bar 5 mm (adapted from Guo, 1988, pl. 4,*5a,5b*).——*10.* Holotype of *Hemimenion cuneatum* Guo, scale bar 10 mm; left valve (adapted from Guo, 1988, pl. 6,*4*).——*11–14. Xinshaophorus rhomboidalis* Ding; *11,* holotype, right lateral view, scale bar 10 mm; *12,* paratype, left lateral view, scale bar 10 mm; *13,* enlarged hinge of Fig. 5.12, scale bar 5 mm; *14,* paratype, left lateral view, scale bar 5 mm (adapted from Ding, 1982, pl. 162,*1,4a,4c,5*).——*15–18. Guichiella angulata* Li & Ding, scale bar 5 mm; *15,* holotype, left valve; *16,* paratype, right valve; *17,* paratype, right valve; *18,* paratype, left valve (adapted from Li & Ding, 1981, pl. 1,*26,23,24,25*).——*19–23. Kymatoceramus xuyangensis* Gu, scale bar 5 mm; *19,* holotype, left valve; *20,* enlarged dorsal part of Fig. 5.19 (adapted from Gu, Li, & Yu, 1997, pl. 39,*6,7*); *21,* paratype, left valve; *22,* paratype, right valve; *23,* paratype, right lateral view (adapted from Gu in Gu, Li, & Yu, 1997, pl. 8,*3–5*).——*24–26.* Holotype of *Xinshaophorus (Dalophonychia) lophoides* Guo & Liu, scale bar 10 mm; bivalved specimen; *24,* left lateral view; *25,* right lateral view; *26,* dorsal view (adapted from Guo, 1985a, pl. 5,*1a–c*).——*27–29. Pterohalobia productalata* Guo, scale bar 10 mm; *27,* holotype, right lateral view; *28,* external mold of Fig. 5.27; *29,* paratype, left lateral view (adapted from Guo, 1985a, pl. 16,*4a–b,7*).——*30. Nanlingella luojiaduensis* (Xiong), scale bar 10 mm; paratype, left composite mold (adapted from Xiong & Wang, 1980, pl. 1,*4*).

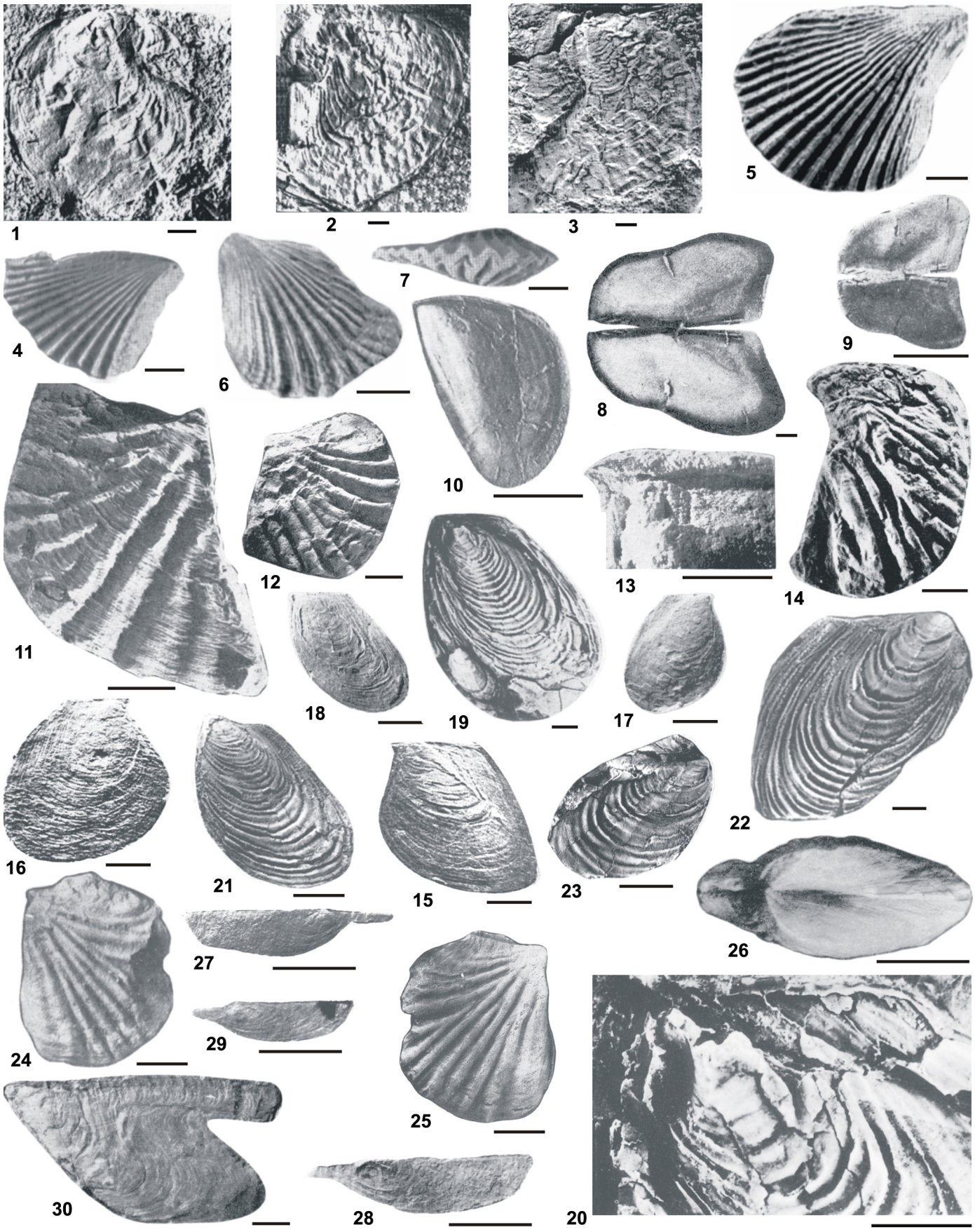

Figure 5. *For explanation, see facing page.*

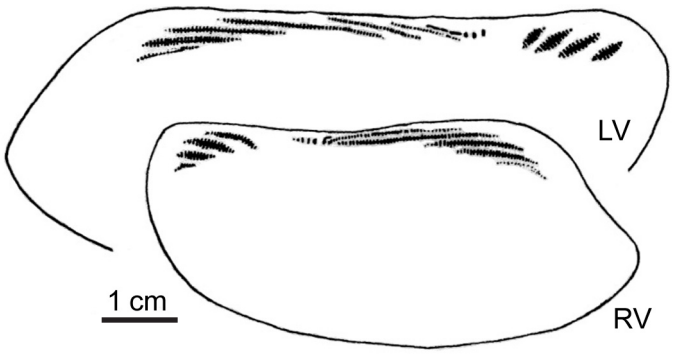

Figure 6. Diagrammatic drawing of hinge of *Bapristodia serrata* Guo (adapted from Guo, 1988, p. 116, text-fig. 2).

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0715 (holotype); IVy0716–0718.

Distribution of genus.—upper Upper Triassic; Western Yunnan, southwestern China (Guo, 1988, p. 116).

Taxonomic position.—Parallelodontidae (by original designation).

Genus CATELLA Healey, 1908
Subgenus CATELLA (OCEANOPIERIS) Guo, 1988, p. 115

[in Chinese]

Figure 5.8–5.9, 7

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Guo, 1988, p. 115): shell small, subtrapeziform, *Pteria*-like, equivalve, moderately inflated; anterior margin rounded, posterior margin truncated; median sulcus wide and shallow, extending from umbo to ventral margin, with corresponding ventral sinus at ventral margin; umbo low, beak slightly incurved and slightly prosogyrate, situated about one-third shell length back from anterior end. In front of median sulcus, shell contracted and narrowed; posterior umbonal carina well developed, widely rounded, extending from umbo to posteroventral margin, anterior umbonal carina rather wide, not well defined. Surface covered by growth lines and wrinkles. Teeth radiating out from a point well ventral of hinge margin, consisting of several short and forward-inclined anterior teeth, forming an oblique angle with hinge margin, as well as long and lamellar posterior teeth, subparallel to hinge margin. Adductor scars obscure.

Type species.—Catella (Oceanopieris) elegans Guo, 1988, p. 115, pl. *4,5* (holotype), *6–9*; text-fig. 1; by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1988, p. 115): Shell small, subtrapeziform, *Pteria*-like; hinge margin straight and long, about five-sixths greatest length of shell; umbo low, beak incurved and slightly prosogyrate, situated in anterior third to fourth of shell; anterior umbonal carina rather wide, not well defined; posterior one well developed, broad, and rounded, extending from umbo to posteroventral margin; median sulcus wide and shallow, extending from umbo to ventral margin, with a corresponding ventral sinus. In front of median sulcus, shell contracted and narrowed, subtriangular; anterior margin rounded, posterior margin truncated, anterodorsal end nearly at right angle, posterodorsal part winglike, subtriangular, and flat, with a posterodorsal angle of 110°–120°. Surface covered by growth lines and wrinkles. Anterior hinge margin with 5 short and forward-inclined anterior teeth, obliquely crossing hinge margin, among them, largest at middle, smallest at posterior; posterior hinge margin with 2 lamellar posterior teeth, rather long, subparallel to hinge margin. Adductor scars large, subcircular, not well defined.

Type locality.—Hetaoshu, Jianchuan, Yunnan, southwestern China.

Type occurrence.—Sanhedong Formation, Carnian, Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0675 (holotype); IVy0676–0679.

Distribution of subgenus.—lower Upper Triassic; western Yunnan, southwestern China (Guo, 1988, p. 115).

Taxonomic position.—Parallelodontidae (Grammatodontinae) (by original designation).

Revision suggestion.—Junior synonym of *Catella* Healey.

Genus CUCULLOPSIS Chao, 1927, p. 10

[in English]

Type species.—Cucullopsis quadrata Chao, 1927, p. 10, pl. 1,*11–13;* by original designation; by monotypy.

Type locality.—Lincheng coal field, Hebei, North China.

Type occurrence.—Houkou limestone, Taiyuan Formation, upper Carboniferous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology.

Distribution of genus.—upper Carboniferous; China (Gu et al., 1976, p. 124).

Taxonomic position.—Parallelodontidae (by original designation).

Note.—Original diagnosis and figure of holotype was included in *Treatise* (Cox et al., 1969 in 1969–1971, p. 258).

Genus GRAMMATODON Meek & Hayden, 1861
Subgenus GRAMMATODON (LAMELLELODON) Yao, 1994, p. 60

[in Chinese with English description, p. 63]

Figure 4.9–4.12

Discussion and diagnosis.—Original diagnosis (Yao, 1994, p. 63): small to comparatively large, slightly elongate, subtrapezoidal in outline, inequilateral or subequilateral; moderately inflated; umbo broad, round, located near anterior margin or anterior of median, distinctly salient above hinge margin; posterior umbonal carina present; sculpture distinctive, only with concentric ribs and growth lines; hinge plate relatively narrow, with 3–4 horizontal posterior pseudolaterals and 2 horizontal anterior pseudolaterals, which parallel hinge line and 4–5 oblique cardinals converging on a point beneath umbos; lacking interior ventral marginal crenulation and ventral sinus. *Grammatodon (Lamellelodon)* can be compared with *Grammatodon (Grammatodon)* and *G. (Grammatodon)* in sculpture,

dentition, and shape, but differs from the latter genera in main diagnostic features such as concentric ribs, having more rounded carina, and 2 horizontal anterior pseudolaterals [*sic*].

Type species.—Grammatodon (Lamellelodon) gucuoensis Yao, 1994, p. 61, pl. 10,*1* (holotype), *2–3,5,7,9,14*; by original designation.

Original description of type species.—(Yao, 1994, p. 63): Equivalved, inequilateral or subequilateral, small to large, obliquely subquadrate in outline; inflation moderate; umbos large, placed near anterior margin, and projected above hinge margin; long straight dorsal margin truncated anteriorly by sharp anterodorsal angle, approximating an acute angle; anterior margin sharply bent into convex ventral margin, like anterior part of a knife; posterior margin obliquely truncate, meeting ventral margin at a prominent, but rounded, posteroventral angle; posterior end distinctively larger than anterior in height; defined umbonal carina running from posterior side of umbos more or less directly to posteroventral angle; flanks of shell only ornamented by irregular concentric ribs and growth lines. Dentition: taxodont with 4–5 short, oblique cardinal teeth radiating upward from a point below umbo and 3–4 long, posterior pseudolaterals and 2 anterior pseudolaterals parallel to hinge margin [*sic*].

Type locality.—Gucuo village, southern Tibet, China.

Type occurrence.—Gucuo II Formation, Lower Cretaceous.

Repository of type material.—The Institute of Geology, Chinese Academy of Geological Sciences, Beijing; accession number: XG886-168 (holotype); XG886-10, 886-72, 886-96, 886-98, 886-129, 886-130.

Distribution of subgenus.—Berriasian, Lower Cretaceous; Xizang (Tibet), China (Yao, 1994, p. 63).

Taxonomic position.—Parallelodontidae (by original designation).

Order PTERIOIDA Newell, 1965
Suborder PTERIOIDINA Newell, 1965
Superfamily AMBONYCHIOIDEA Miller, 1877
Family AMBONYCHIIDAE Miller, 1877
Genus FASCICULIPTERA Zhang in Zhang, Wang, & Zhou, 1977, p. 493

[in Chinese]

Figure 5.4–5.7

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 493): equivalve, very inequilateral, retrocrescent, rounded-triangular to triangular in outline; umbo anterior, with small anterior lobe, without byssal gape; hinge margin long and straight, posterior auricle large, extending posteriorly; surface covered by thick and projecting costae, with triangular cross section, forming a zigzag (sawtoothed) ventral commissure; costae grouping into bunches, each bunch including 3–10 costae in number, the strongest one on center of bunches, those on both sides weaker; commarginal lines *Limipecten*-like, arching toward dorsal on costae and toward ventral in interspaces. Interior structure unknown.

Type species.—Fasciculiptera guangxiensis Zhang in Zhang, Wang, & Zhou, 1977, p. 493, pl. 193,*7,8* (holotype), *9,17;* by original designation; by monotypy.

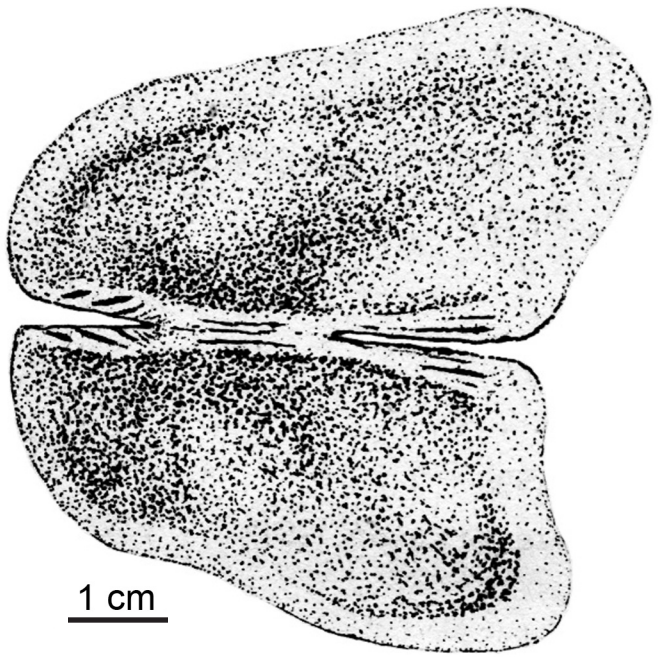

Figure 7. Diagrammatic drawing of holotype of *Catella (Oceanopieris) elegans* Guo, showing hinge (adapted from Guo, 1988, p. 116, text-fig. 1).

Original description of type species.—The original description of type species given by Zhang (in Zhang, Wang, & Zhou, 1977, p. 493) is the same as that of *Fasciculiptera* Zhang in Zhang, Wang, & Zhou, 1977.

Type locality.—Xiangzhou, Guangxi, China.

Type occurrence.—Donggangling Formation, Givetian, Middle Devonian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: IV55116 (holotype); IV55117, 55118, 55531.

Distribution of genus.—Middle Devonian; Guangxi, China (Zhang in Zhang, Wang, & Zhou, 1977, p. 493).

Taxonomic position.—Ambonychiidae (by original designation).

Genus XINSHAOPHORUS Ding, 1982, p. 233

[in Chinese]

Figure 5.11–5.14

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Ding, 1982, p. 233): shell medium to large, equivalve, inequilateral; both shape and convexity of shell variable; retrocrescent, infracrescent, or procrescent; umbo situated at anterior end, (beak) incurved and prosogyrate; greatest convexity generally at anterior of shell. Anterior margin concave below beak, with byssal notch; 2–3 small and oblique teeth under umbo near anterior margin in each valve. Surface ornamented with thick radial ribs arranged in two sets, one placed at posterodorsal part, commonly consisting of a median rib at middle of valve and its pinnate branching ribs, and the other at anteroventral part, each

rib always intersecting anterior and ventral margins; short rib near shell margin between two rib sets, or connected with other ribs.

Type species.—*Xinshaophorus rhomboidalis* Ding, 1982, p. 234, pl. 162,*1* (holotype), *2–5*; by original designation.

Original description of type species.—(Translation from Chinese text, Ding, 1982, p. 234): Shell medium to large, rhomboidal, or parallelogram; inequilateral; umbo situated at anterior end, beak incurved and prosogyrate; procrescent or slightly procrescent, with a trend expanding in anteroventral direction; greatest convexity generally at anterior of shell. Anterior margin concave below beak, with byssal notch that varies in shape and size; shape and size of incurved area varies from specimen to specimen; 2–3 small and oblique teeth under umbo near anterior margin in left valve, lacking lateral teeth. Surface ornamented with thick radial ribs arranged in two sets, one placed at posterodorsal part, with 5 ribs, commonly consisting of a median rib (sometimes not well developed) at middle of valve and its pinnate branching ribs toward posterior margin, and the other at anteroventral part, with 5 ribs, each rib always intersecting anterior and ventral margins; short rib near shell margin between two rib sets, or connected with median rib. Adductor scars and pallial line unknown.

Type locality.—Tiaoma, Changsha, Hunan, China.

Type occurrence.—Qiziqiao Formation, Givetian, Middle Devonian.

Repository of type material.—Regional Geological Survey Team of Hunan Province, China; accession number: HBI 151 (holotype); HBI 152–155.

Distribution of genus.—Middle Devonian; Hunan, China (Ding, 1982, p. 234).

Taxonomic position.—Ambonychiidae (by original designation).

Revision suggestion.—Junior synonym of *Follmannia* Drevermann.

Subgenus XINSHAOPHORUS (DALOPHONYCHIA) Guo, 1985a, p. 128

[in Chinese with English description, p. 264]

Figure 5.24–5.26

Discussion and diagnosis.—Original diagnosis (Guo, 1985a, p. 264): shell subrectangular, equivalve, moderately inflated. Hinge margin nearly rectilineal; anterior margin uprightly truncated; semicircular from ventral to posterior margin. Posterior dorsal part flat with broad wing. Umbo claw shaped, interiorly bent and slightly prosogyrous at beak, near front end. Anterior umbonal carina coarse, rounded, with narrow and rather steep anterior slope and broad and somewhat flat posterior slope. Byssal sinus obvious. Shell surface covered with coarse, pinnate plicae radiating toward ventral and posterior margins from umbo. *Dalophonychia subgen. nov.* is characterized by subrectangular outline and rounded anterior venter. *Dalophonychia* is similar to *Follmannia* in the plica-ornamentation, but differs in subrectangular outline and broad, flat posterior wing [*sic*].

Type species.—*Xinshaophorus (Dalophonychia) lophoides* Guo & Liu in Guo, 1985a, p. 128, pl. 5,*1* (holotype), *2*; by original designation.

Original description of type species.—(Translation from Chinese text, Guo, 1985a, p. 128): Shell subrectangular, equivalve, moderately inflated, greatest convexity at anterior part, decreasing gradually backward; slightly higher than long. Hinge margin nearly straight, about half shell length, nearly perpendicular to anterior margin; ventral and posterior margins subrounded; posterodorsal part somewhat winglike, broad and depressed. Umbo clawlike, with incurved beak, slightly prosogyrate, situated at anterior end. Anterior umbonal carina well developed, wide and rounded, subparallel to anterior margin, with narrow and steep anterior slope, posterior slope wide, gentle, and rather depressed; anterior margin with a sinus under umbo, byssal gape present. Surface ornamented with strong, wide, and rounded radial plicae; anteroventral part with 3 pair of bifurcating plicae in all, posterodorsal part with pinnate branching plicae.

Type locality.—Liukongqiao, Luxuan, Yunnan, southwestern China.

Type occurrence.—Qujing Formation, Givetian, Middle Devonian.

Repository of type material.—Yunnan Institute of Petroleum Geology, Kunming, Yunnan; accession number: 721289/38 (holotype); 721292/38.

Distribution of subgenus.—Middle Devonian; eastern Yunnan (Guo, 1985a, p. 128).

Taxonomic position.—Ambonychiidae (by original designation).

Revision suggestion: Junior synonym of *Follmannia* Drevermann.

Family MYALINIDAE Frech, 1891
Genus HEMIMENION
Guo, 1988, p. 117

[in Chinese]

Figure 5.10

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Guo, 1988, p. 117): shell cuneiform, semilunar, or subtriangular, slightly retrocrescent, shell thin, with less convexity; dorsal margin nearly straight or broadly arcuate, forming obtuse angle with posterior margin, anterior and posterior margins arcuate or semiorbicular, ventral one rounded; umbo located near anterior end; anterior umbonal carina broadly rounded, with steep and narrow anterior slope; poserior slope wide and gentle. Ligament area rather narrow, with several thick and distinct ligament grooves; adductor scars obscure, pallial line rather distinct.

Type species.—*Hemimenion cuneatum* Guo, 1988, p. 117, pl. 6,*4* (holotype); by original designation.

Original description of type species.—(Translation from Chinese text, Guo, 1988, p. 117): Shell cuneiform, or semilunar; dorsal and anterior margins broadly arcuate, posterior margin semicircular, ventral one rounded; umbo slightly pointed, with umbonal angle of slightly less than 90°, lying at anterior end; anterior umbonal carina broadly rounded, with steep and narrow anterior slope; posterior slope wide and gentle. Surface nearly smooth, with growth lines. Ligament area rather narrow, ligament grooves thick and distinct, subparallel to hinge margin; adductor scars obscure, pallial line rather distinct.

Type locality.—Shuitangzhai, Gejiu, Yunnan, southwestern China.

Type occurrence.—Gejiu Formation, Anisian, Middle Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0702 (holotype).

Distribution of genus.—lower Middle Triassic; Yunnan, southwestern China (Guo, 1988, p. 117).

Taxonomic position.—Myalinidae (by original designation).

Revision suggestion.—Junior synonym of *Aviculomyalina* Assamann, suggested herein.

Family INOCERAMIDAE Zittel, 1881 (Giebel, 1852)
Genus KYMATOCERAMUS Gu in Gu, Li, & Yu, 1997, p. 63

[in English]

Figure 5.19–5.23

Discussion and diagnosis.—Original diagnosis (Gu in Gu, Li, & Yu, 1997, p. 63): small to medium, subequivalve and obliquely oval. Feebly to moderately inflated. Slightly higher than long. Anterior ear small and indistinct, posterior ear large, subobtuse, triangular, and well differentiated. Small umbo anteriorly situated. Hinge line short and straight. Concentric plicate ribs bifurcating or even trifurcating and regularly spaced as a whole. Short, indistinct radial plicae appear medially on lower slope of concentric ribs and are cut off by them, mostly recognizable ventrally. Ligament area transversely narrow, with at least 8 ligament pits that are rather regularly distributed, barely higher than long and with longer interspaces. Both ligament pits and their interspaces undulate in lower margin of ligament area. Very narrow elongate area between row of ligament pits and hinge line. In ligament pits and their neighboring interspaces, as well as very narrow and elongate area between row of ligament pits and hinge line, there are minute and vertical parallel striations beside growth lines in pits [*sic*].

Type species.—Kymatoceramus xuyangensis Gu in Gu, Li, & Yu, 1997, p. 65, pl. 8,*3–5*; pl. 39,*6* (holotype), *7*; by original designation.

Original description of type species.—(Gu in Gu, Li, & Yu, 1997, p. 65): Small to barely medium. Subequivalve, weakly to moderately inflated, without conspicuous different inflations in two valves. Obliquely oval. Axial angle approximately 55°, apparently smaller in young stages. Slightly higher than long. Anterior margin broadly convex, posterior margin nearly straight to gently convex, dorsal margin short and straight (barely one-third valve length), ventral margin well rounded and merging into anterior margin more gradually than into posterior margin. Anterior ear small and steeply sloped (cat. nos. 81457, 81459). Very shallow marginal sinus seems present in lower anterior margin of anterior ear. Posterior ear large but vertically rather narrow, subobtuse, and triangular, almost flattened and well differentiated. Posterior ear angle about 135°. Umbo small, slightly inflated, and somewhat depressed, slightly projecting and overhanging above hinge line, situated near anterior extremity of this line. Umbonal angle about 81°. Maximum inflation located slightly below umbonal area and decreasing downward but rapidly steepened laterally. No carinate ridge. The apparent planeness [flatness] and even scarce concavity of valve surface show effect of deformation. Plicate ribs concentric with valve margin, bifurcating and trifurcating laterally, sharp to rounded and regularly spaced as a whole. On largest specimen, 25 ribs can be counted. Density of ribs decrease with ontogeny, usually 8–11 ribs per centimeter during adult stage, but more numerous ribs per centimeter during immature stage, with interspaces almost as wide as ribs. In at least one specimen (cat. no. 81457) there are very indistinct radial plicae, short and cut off by concentric ribs, on lower slopes of concentric ribs medially, mostly recognized on 6 concentric ribs in ventral part of valve. Judging from 2 adhered shell fragments on internel mold of holotype, shell is not very thick. Ligament area transversely narrow and scarcely concave, being largely uncovered only in one specimen (cat. no. 81458), taking up largest part of dorsal margin. A very narrow and elongate area presented irregularly between row of ligament pits and hinge line. At least 8 ligament pits can be discriminated on largest specimen with greatest width of about 0.6 mm, shorter than those of their interspaces. Pits are very slightly longer than high and regularly spaced as a whole along hinge line, and do not produce indentations, but do produce undulations of lower margin of ligament area (cat. no. 81458). In addition, of much interest is presence of very minute and parallel striations on both ligament pits and their interspaces, normally crossing over growth lines in ligament pits and barely visible under a hand lens. Apparently edentulous. Neither pallial line nor adductor scars can be discriminated. On surface of valve or molds there are minute ridges in form of a network of polygons, visible under a magnified lens. These polygons are gradually enlarged toward ventral direction [*sic*].

Type locality.—Qihulin hill, Hulin, Heilongjiang, northeastern China.

Type occurrence.—Yunshan Formation, Lower Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 81458 (holotype); 81457, 81459, 81460.

Distribution of genus.—Aptian, Cretaceous, but probably first appeared in Kimmeridgian, Upper Jurassic; east-northeastern China and probably northern Siberia (Gu in Gu, Li, & Yu, 1997, p. 65).

Taxonomic position.—Inoceramidae (by original designation).

Superfamily PTERIOIDEA Gray, 1847 (1820)
Family PTERINEIDAE Miller, 1877
Genus GUICHIELLA Li & Ding, 1981, p. 328

[in Chinese with English description, p. 329]

Figure 5.15–5.18

Discussion and diagnosis.—Original diagnosis (Li & Ding, 1981, p. 329): shell small, *Pteria*-form, equivalve, inequilateral, left valve slightly convex, right valve rather flattened; both ears undefined, anterior ear of right valve small, triangled, with an acute end, anterior sulcus deep and a rather deep byssal notch present; posterior ear large, flattened, marked off from main body by shallow furrow. Ligament area narrow, striated latitudinally, tooth undeveloped. Shell surface covered by concentric sculptures and weak radial costae [*sic*].

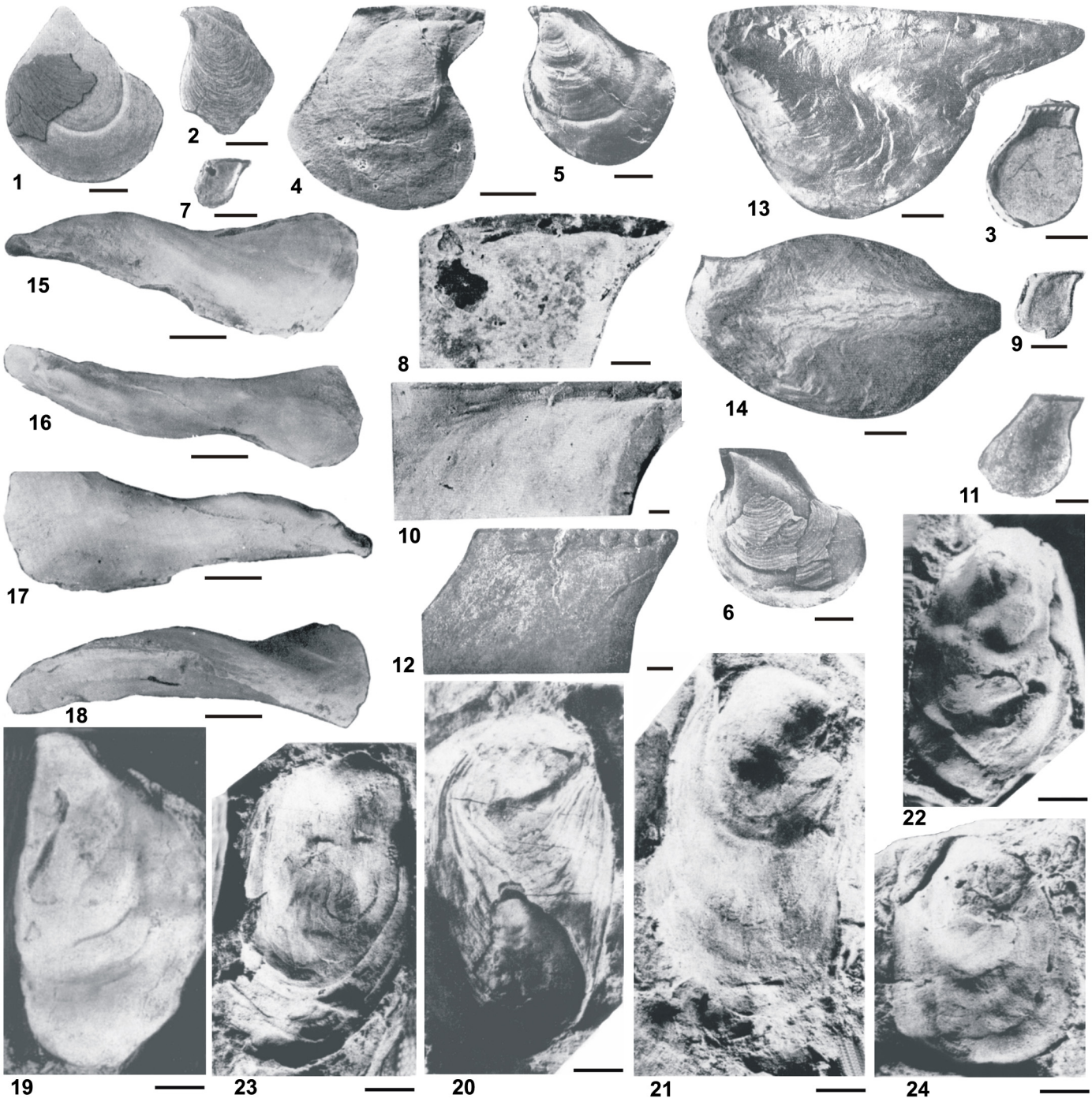

Figure 8. *1–12. Permoperna trapezoidalis* (Kayser). *1–2,* Kayser's type material, scale bar 10 mm; *1–2,* left lateral views (adapted from Kayser, 1883, pl. 21,*2,4*); *3,* interior view of Fig. 8.2, showing the so-called small teeth, scale bar 10 mm (adapted from Frech 1911, pl. 15,*1c*); *4,* holotype of *Waagenoperna (Permoperna) hayamii* Nakazawa & Newell, right internal mold, scale bar 5 mm (adapted from Nakazawa & Newell, 1968, pl. 3,*11*); *5,* plesiotype, left lateral view, adult specimen, scale bar 10 mm (adapted from Gu et al., 1976, pl. 11,*13*); *6,* plesiotype, left lateral view, adult specimen, scale bar 10 mm (adapted from Gu et al., 1976, pl. 11,*16*); *7–8,* plesiotype, right internal mold, infant specimen; *7,* lateral view, scale bar 5 mm; *8,* enlarged ligament area of Fig. 8.7, showing the *Bakevellia*-type hinge, scale bar 1 mm (adapted from Fang, 1982, pl. 1,*8a,8b*); *9–10,* plesiotype, right internal mold, early young specimen; *9,* lateral view, scale bar 10 mm; *10,* enlarged ligament area of Fig. 8.9, scale bar 1 mm (adapted from Fang, 1982, pl. 1,*1a,1b*); *11–12,* plesiotype, right internal mold, young specimen; *11,* lateral view, scale bar 5 mm; *12,* enlarged ligament area of Fig. 8.11, scale bar 1 mm (adapted from Fang, 1982, pl. 1,*2a,2b*).——*13–14. Nanlingella luojiaduensis* (Xiong), scale bar 10 mm; *13,* holotype [=*Bakevellia luojiaduensis* (Xiong) in Zhang, Wang, & Zhou, 1977, pl. 5,*20*], left composite mold; *14,* paratype, dorsal

(*Continued on facing page.*)

Type species.—Guichiella angulata Li & Ding, 1981, p. 328, pl. 1,*9–10*,*23–25*,*26* (holotype); by original designation.

Original description of type species.—(Translation from Chinese text, Li & Ding, 1981, p. 328): Shell small, *Pteria*-form, retrocrescent; hinge margin long and straight; umbo large and distinct, situated near anterior end, not protruding above hinge margin; umbonal angle about 50º–70º. Disc of left valve slightly convex, with small and distinct anterior auricle, triangular, with an acute end, separated from disc by deep umbonal sulcus; posterior auricle large, depressed, obliquely triangular, differentiated from disc by umbonal carina. Right valve flat, with small anterior auricle, triangular, byssal sinus distinct; posterior ear depressed, not well differentiated from disc. Anteroventral margin short, arcuate, ventral margin broadly arcuate, obliquely extending toward posteroventral margin, sometimes forming angular corner. Ligament area narrow, with 1–2 latitudinally striated grooves, but obscure. Surface covered by concentric lines or rings.

Type locality.—Panjiaqiao, Guichi, Anhui, eastern China.

Type occurrence.—Base of Second Member, Qinglong Formation, Smithian, Lower Triassic.

Repository of type material.—Nanjing Institute of Geology and Mineral Resources, Ministry of Land and Resources, Nanjing; accession number: H1218 (holotype); H1213, 1216, 1219, 1221, 1224.

Distribution of genus.—lower Olenekian, lower Triassic; Anhui and Jiangsu, eastern China (Li and Ding, 1981, p. 328); Dienerian–Smithian.

Taxonomic position.—Pterineidae (by original designation).

Revision suggestion.—Chen and Komatsu (2002, p. 442) suggested *Guichiella* is probably a subgenus of *Claraia* Bittner. But *Guichiella* has a duplivincular ligament rather than a chevron claraiid-type ligament, and it may be better to retain *Guichiella* within the Pterineidae for the present.

Family BAKEVELLIIDAE King, 1850
Genus PERMOPERNA Nakazawa & Newell, 1968

[in Chinese with English description, p. 551]

[*emend.* Fang, 1982, p. 548]

Figure 8.1–8.12

Revised diagnosis of genus.—(Fang, 1982, p. 551): Shell subtrapezoidal, inequilateral, inequivalve, with left valve slightly more inflated than right; slightly prosocline in postlarval stage, but strongly so in adult stage with lower (ventral) part of shell extending posteriorly; umbo weak, subdued, and prosogyrate with small and pointed beak; anterior ear very small, posterior wing slightly differentiated, broad and depressed; ligament area long and wide, becoming somewhat obscure at posterior end, having several narrow rectangular ligament pits; anterior and posterior teeth of *Bakevellia*-type in postlarval stage, anterior teeth commonly obsolete in young stage, posterior teeth lamellar, weak, 1 or 2 in number, still sometimes seen in adult stage, originating near the last but two ligament pit [count down to the third one] and running [extending] posteroventrally; pallial line entire, groove-like in internal mold; muscle scars unknown, surface marked with concentric lines [*sic*].

Type species.—Myalina trapezoidalis Kayser, 1883, p. 169, pl. 21,*1–4* (syntype) [=*Waagenoperna (Permoperna) hayamii* Nakazawa & Newell, 1968, p. 62, pl. 3,*9–11*]; subsequent designation, Fang, 1982; by monotypy.

Type locality.—Mingshan, Leping, Jiangxi, China.

Type occurrence.—Longtan Formation, Wuchiapingian, upper Permian.

Distribution of genus.—Permian; South China and Japan (Fang, 1982, p. 548).

Taxonomic position.—Isognomonidae (by original designation).

Revision suggestion: The presence of a small number of broad quadrate resilifers and a continuous pallial line in the type species rule out the interpretation of this genus as an isognomonid (Tëmkin, 2006). Fang (1982, p. 547; 2004b, p. 633) promoted this subgenus as an independent genus and placed it in Bakevelliidae because the type species passes through a *Bakevellia* stage during ontogeny, including *Bakevellia*-type hinge teeth.

Genus HOERNESIA Laube, 1866
Subgenus HOERNESIA (STROPHOPTERIA) Guo, 1985a, p. 145

[in Chinese with English description, p. 265]

Figure 8.15–8.18

Discussion and diagnosis.—Original diagnosis (Guo, 1985a, p. 265): shell knife shaped, elongate, strongly twisted toward right at front and left at rear, inequivalve. Umbo near anterior end. Hinge nearly straight. Anterior wing roundedly triangular without an obvious boundary from shell body; posterior wing broad, obtuse, and relatively flat. Left valve strongly convex, with relatively broad, overhanging umbonal region; right valve flat, with obscure, low umbo. Posterior (adductor) muscle scar rather large, situated at posterior dorsal part, right one being larger and deeper than left. Minute pedal scar small, subcircular, deep, located in front of posterior adductor scar, from which it is separated by a relatively long distance [far from posterior adductor scar]. Distinguished from *Hoernesia s.s.* in strongly twisted and elongate shell body [*sic*].

Type species.—Hoernesia (Strophopteria) spiralis Guo, 1985a, p. 145, pl. 13,*1a–d* (holotype) by original designation; by monotypy.

Figure 8—*Continued from facing page.*
view of articulated shell (adapted from Xiong & Wang, 1980, pl. 1,*1b,2*).——*15–18.* Holotype of *Hoernesia (Strophopteria) spiralis* Guo, scale bar 10 mm; *15,* left lateral view; *16,* dorsal view; *17,* right lateral view; *18,* ventral view (adapted from Guo, 1985a, pl. 13,*1a–d*).——*19–24. Laevostrea intermedia* Yao, scale bar 10 mm; *19,* holotype, left internal mold; *20,* paratype, right external mold; *21,* paratype, right external mold; *22–23,* paratype, right internal molds; *24,* paratype, left external mold (adapted from Men, Li, & Yao, 1984, pl. 1,*7,1,3,4–6*).

Original description of type species.—(Translation from Chinese text, Guo, 1985a, p. 145): Shell narrow and elongate, knife shaped in outline, inequivalve; strongly twisting toward right side at front and left side at rear of shell, both showing a twist of 180°; about three times longer than high; hinge margin nearly straight, slightly twisted, following shell body's twist. Anterior auricle small, rounded triangular, not well differentiated from disc; posterior auricle broad, flat, and obtuse; umbo well to anterior. Left valve rather convex, with its umbo rising above that of right valve, umbonal carina rounded, extended with a reversed S-form curve; right valve less convex, with subdued umbo. Posterior adductor scar large, elliptical in outline; the scar of right valve larger and deeper than that of left valve; pedal scar small, subcircular, located in front of posterior adductor scar, from which pedal scar of right valve is deeper and more distant than that of left valve; another small pedal scar in anteroventral of umbo, left one deeper than right one. Pallial line far from shell margin and composed of a series of small pits.

Type locality.—Peiyuan, Yongsheng, Yunnan, southwestern China.

Type occurrence.—Lamei Formation, Lower Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0148 (holotype).

Distribution of subgenus.—Lower Triassic; Yunnan (Guo, 1985a, p. 145).

Taxonomic position.—Bakevelliidae (by original designation).

Revision suggestion.—Hoernesia (Strophopteria) Guo, 1985a is better placed in synonymy with *Hoernesia* Laube.

Genus NANLINGELLA
Xiong & Wang, 1980, p. 23

[in Chinese]

Figure 5.30, 8.13–8.14

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Xiong & Wang, 1980, p. 23): shell medium to large (2–30 cm), *Pteria*-form, retrocrescent, equivalve, inequilateral, strongly inflated. Umbo pointed, protruding above hinge margin, situated at anterior end. Dorsal margin long and straight, equal to maximum shell length; anterior margin nearly straight; posterior margin arcuate, concave deeply; anterior auricle small or not well developed, semiorbicular, with distinct byssal notch in right valve, posterior auricle large, triangular, with deep posterior sulcus and acuminate end, extending greatly beyond posterior edge of disc. Posterior umbonal carina strong, with steep posterior slope. Ligament area wide, provided with more than 10 ligament pits, arranged from anterior end to posterior end along hinge margin, provided with horizontal lines. Irregular pseudotaxodonts extending from anterior end to middle of cardinal area. Posterior adductor scar large, transverse ovate. Pallial line simple. Surface with concentric lines.

Type species.—Bakevellia luojiaduensis (Xiong) in Zhang, Wang, & Zhou, 1977, p. 44, pl. 5,*20* [=*Nanlingella luojiaduensis* Xiong & Wang, 1980, p. 25, pl. 1,*1a–b* (holotype), *2–6* (SD).

Original description of type species.—(Translation from Chinese text, Xiong in Zhang, Wang, & Zhou, 1977, p. 44): Shell medium to large, trapeziform, retrocrescent, equivalve; strongly inflated, umbo pointed, protruding above hinge margin, situated at anterior end; dorsal margin long and straight; anterior auricle not well developed, posterior auricle large, pointed triangular, with deep posterior sulcus, extending greatly beyond posterior edge of disc; ligament area with more than 10 ligament pits, provided with horizontal lines; posterior umbonal carina strong, with steep posterior slope; surface with concentric lines.

Type locality.—Luojiadu, Lechang, Guangdong, China.

Type occurrence.—Niugudun Member, Hongweikeng Formation, Carnian, Upper Triassic.

Repository of type material.—Xi'an Institute of Coal Geology and Exploration, Academy of Coal Science of China, Xi'an, Shaanxi, China (no accession number).

Distribution of genus.—Upper Triassic; South China (Xiong & Wang, 1980, p. 25).

Taxonomic position.—Bakevelliidae (by original designation).

Revision suggestion.—Nanlingella is a junior synonym of *Bakevellia* King (J. Chen, 1982).

Note.—The type species name *Bakevellia luojiaduensis* (Xiong) first appeared in Zhang, Wang, & Zhou (1977, p. 44, pl. 5, fig. 20) as a manuscript name.

Family ISOGNOMONIDAE Woodring, 1925
Genus YUNSHANOPERNA
J. Chen in Gu, Chen, & Sha, 1984, p. 96

[in Chinese with English description, p. 198]

Figure 4.13–4.14

Discussion and diagnosis.—Original diagnosis (Chen in Gu, Chen, & Sha, 1984, p. 198): shell medium, nearly equivalve, like *Bakevellia* in shape but without anterior auricle, posterior wing pointed with a remarkable auricular sinus. Hinge length equivalent to shell length, with short prosocline tooth anteriorly. Ligament area broad, bearing a series of regularly arranged resilifers that are higher than long, almost perpendicular to hinge margin, with intervals narrower than resilifer, last one being near to posterior end of hinge margin. *Yunshanoperna* differs from *Bakevellia* and *Bakevelloides* in its more numerous resilifers, only one anterior tooth, and lack of both anterior auricle and posterior lamellar teeth. *Aguilerella* has resilifers in anterior to center part of ligament area beside 1–2 posterior lamellar teeth, posterior wing not pointed. *Waagenoperna* can be distinguished from new genus by its peculiar resilifers, obtuse posterior wing, and disappearence of anterior teeth in adult stages [*sic*].

Type species.—Yunshanoperna yunshanensis J. Chen in Gu, Chen, & Sha, 1984, p. 97, pl. 11,*9–10,11* (holotype); by original designation.

Original description of type species.—(Gu, Li, & Yu, 1997, p. 55): Medium, length, and height of type are 41.5 mm and 30.2 mm respectively. Moderately inflated, greatest inflation being located near umbonal region. Probably equivalve. Prosocline. Anterior margin oblique and nearly straight, ventral margin short and well rounded, merging toward likewise well rounded posteroventral angle, posterior margin strikingly inwardly sinuated and merging to alate and backward-pointed posterior wing, dorsal margin long and straight. No anterior ear. Umbos subterminal and faintly forward pointing but not protruding over dorsal margin. Broad but indistinct sulcus between posterior wing and proper shell. In

left internal mold, shell surface is ornamented with concentric ridges and striations. Ligament being rather broad, with about 15 regularly arranged ligament pits that are higher than long, gradually broadened backward. With an oblique, prosocline, and narrow anterior tooth and a slightly prosocline but nearly horizontal posterior denticle that originates from a point below 6th or 7th ligament pit. Byssal gape not so prominent. A large oval posterior adductor scar below posterior ligament pit and within auricular sinus. Pallial line entire [*sic*].

Type locality.—Qihulin, Hulin, Heilongjiang, northeastern China.

Type occurrence.—Upper part of Yunshan Formation, Lower Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 81471 (holotype); 81470, 81472.

Distribution of genus.—upper Lower Cretaceous; southern Heilongjiang, northeastern China (Gu, Li, & Yu, 1997, p. 55).

Taxonomic position.—Isognomonidae (by original designation).

Superfamily POSIDONIOIDEA Frech, 1909

[*emend.* Waller in Waller & Stanley, 2005, p. 16]

Family HALOBIIDAE Kittl, 1912
Genus PTEROHALOBIA Guo, 1985a, p. 156

[in Chinese with English description, p. 266]

Figure 5.27–5.29

Discussion and diagnosis.—Original diagnosis (Guo, 1985a, p. 266): shell elongate, ensiform, equivalve, highly inequilateral, weakly inflated, with straight and long hinge margin, arcuate from ventral to posterior margin. Anterior ear narrow and long, extended forward; posterior dorsal wing relatively flat, broad, subtriangular. Umbo small, slightly inflated, slightly extended above hinge margin, situated very anteriorly. Shell surface covered by concentric wrinkles and growth lines. Ligament groove long and slender. Edentulous. Somewhat similar to *Longidaonalla* in shell outline, but lacks radial ribs [*sic*].

Type species.—Pterohalobia productalata Guo, 1985a, p. 156, pl. 16,*4* (holotype), *5–7;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1985a, p. 156): Shell knifelike, ensiform, or crescent; shell thin, rather flat, with low convexity; hinge margin nearly straight, slightly shorter than shell length; anterior, ventral, and posterior margins merging into broad arc line. Anterior auricle narrow and long, extending forward, length nearly one-quarter shell length; posterior auricle broad and flat, subtriangular. Umbo small, rather inflated, slightly projecting above hinge margin, situated about one-third shell length from anterior end. Surface covered by growth lines, but indistinct on anterior part of shell, especially on umbo area with commarginal wrinkles, extending backward, almost vertically or obliquely crossing posterior hinge margin. Ligament area narrow, edentulous.

Type locality.—Pingzhai, Qiubei, Yunnan, southwestern China.

Type occurrence.—Baifeng Formation, Anisian, Middle Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0190 (holotype); IVy0191–0193.

Distribution of genus.—lower Middle Triassic; Yunnan, southwestern China (Guo, 1985a, p. 156).

Taxonomic position.—Posidoniidae (by original designation).

Revision suggestion.—The anterior auricle of the figures of the holotype were not appropriately clipped off by Guo (1985a, pl. 16, fig. 4b) and its ornamentation is very similar to that of *Daonella boeckhi* Mojsisovics. We are inclined to place *Pterohalobia* in synonymy with the halobiid genus *Daonella* Mojsisovics.

Suborder OSTREOIDINA Férussac, 1822
Superfamily OSTREOIDEA Wilkes, 1810
Family OSTREIDAE Wilkes, 1810
Genus LAEVOSTREA Men, Li, & Yao, 1984, p. 51

[in Chinese with English description, p. 53]

Figure 8.19–8.24

Discussion and diagnosis.—Original diagnosis (Men, Li, & Yao, 1984, p. 53): shell medium to large, mostly elongate orbicular, left valve more convex than right valve, umbonal cavity shallow. Adductor muscle imprint reniform. Internal margins of both valves smooth, without comata. Both valves covered with irregular concentric wrinkles and growth lines. Similar to *Ostrea* (*s.s.*) with smooth internal margins and adductor muscle imprint reniform but differs from latter in shape and ornament of shell; also closely resembles *Liostrea* from the Upper Triassic–Jurassic and classified into subfamily Gryphaeinae, in both valves covered with concentric wrinkles and growth lines, with shallow umbonal cavity and absence of chomata; but *Liostrea* differs from *Laevostrea* in having orbicular imprint of adductor muscle and near hinge margin [*sic*].

Type species.—Laevostrea intermedia (Yao) in Men, Li, & Yao, 1984, p. 51, pl. 1,*1–6,7* (holotype); by original designation.

Original description of type species.—(Gu, Li, & Yu, 1997, p. 142; slightly abridged): Medium (for genus); length, 22.5–62 mm (right valve) and 24–48 mm (left valve); height ~39–95 mm (right valve) and ~47 mm to 79 mm+ (left valve), thus much higher than long. Shell outline more or less linguiform, without auricles. Anterior and posterior margins much broadly curved and nearly symmetrical, ventral margin narrow to well rounded, umbonal region faintly slanted backward and trigonally projected or highly projected upward. Valve surface ornamented with concentric wrinkles, and growth lines without any radial elements. Ligament area trigonal and faintly slanted posteriorly, longer than high to higher than long [varying from longer than high to higher than long]. Resilifer apparently consisting of two types: one being large and shallow, occupying more than half of ligament area; the other, scarcely large to rather small, and occupying less than one-third of ligament area but all much higher than long and moderately deep. Basal line of resilifer slightly curved inwardly or slightly curved inwardly in forms with ligament area much higher than long. Left umbonal cavity shallow to slightly deep. Commissural shelf rather narrow to moderately broad, largely without distinct curbs. It was recorded that there are no chomata present, yet as mentioned above there are two left internal molds of catalog numbers 81643 and 81663 that do have catachomata on the upper peripheries of commissural

shelves. Adductor scar with an outline of reversed comma mark, its posterior extremity being tapered and pointed upward, located at nearly posterior middle as in holotype or below the middle height and slightly backward and nearer to ventral margin. Scar of insertion of Quenstedt muscle generally difficult to recognize due to state of preservation.

Type locality.—Qingnian reservoir, Mishan, Heilongjiang, northeastern China.

Type occurrence.—Yunshan Formation, Lower Cretaceous.

Repository of type material.—Changchun College of Geology, Changchun, Jilin, northeastern China; accession number: SN0144 (holotype); SN0010, 0025, 0104, 0153a.

Distribution of genus.—upper Lower Cretaceous; southeastern Heilongjiang, northeastern China (Gu, Li, & Yu, 1997, p. 142).

Taxonomic position.—Ostreidae (by original designation).

Note.—See Gu, Li, and Yu (1997, p. 141) for remarks about genus. They removed figure 2 of Men, Li, and Yao (1984, pl. 1) from type material of type species (Gu, Li, & Yu, 1997, p. 142).

Genus PALAEOSTREA
Grabau, 1936, p. 284
[in English]

Discussion and diagnosis.—Original diagnosis (Grabau, 1936, p. 284): primitive ostreiform shells consisting of a succession of lamellae as in modern oysters, each projecting a more or less pectiniform appearance but without ears. Position of musclular scars not ascertained [*sic*].

Type species.—Palaeostrea sinica Grabau, 1936, p. 285, pl. 28,*1* (holotype); by original designation.

Original description of type species.—(Grabau, 1936, p. 285): This new species is represented by a single possible left valve resting on the matrix and by a fragment of the umbonal portion of another individual. In general outline the valve has a productiform appearance with the beak essential in center. The umbonal region is elevated and somewhat compressed laterally so that the side slopes are somewhat concave. Though imperfect and worn, a scar of attachment appears to be indicated. The sides are very gently convex, diverging downward to the point of maximum length, which is close to the base, then rounding abruptly into the subtruncate basal margin. The maximum convexity of the valve is in the umbonal region a short distance from the beak and there the contour is a subregular arc. From this point of maximum convexity to the base, the shell becomes progressively flattened. At first the anterior margin slopes abruptly and steeply to the edge of the valve, while the posterior one is more rounded. By the time the greatest width is reached, however, the surface is entirely flat or even faintly concave in the center. The surface is smooth except for the fine growth lines and the stronger growth lamellae, which are subregularly spaced and have neither crinkled nor elevated margins. The fragment of the umbonal portion of another individual shows the beak to be irregular, strongly convex with irregular growth lines and wrinkles, and with the sides meeting in an acute angle. On the fractured end the shell is seen to be made up of numerous superposed, somewhat irregular lamellae, the entire mass reaching a thickness of 5.5 mm, at 10.5 mm from the beak. At this point the width is 13 mm. The very young stage (nepionic) with a length and width of 4.8 mm, shows scattered pustules over the surface [*sic*].

Type locality.—West of Chiatao, Ishanhsian (Yishan County), Kwangsi (Guangxi), China.

Type occurrence.—Maping Formation, lower Permian.

Repository of type material.—Nanjing Institute of Geology and Palaeontology (Cat. No. 2643, holotype).

Distribution of genus.—lower Permian; Guangxi, China (Grabau, 1936, p. 284).

Taxonomic position.—Ostreidae (by original designation).

Revision suggestion.—The genus name is rejected because the type material is wholly unidentifiable and probably not an oyster (Stenzel, 1971, p. N1051, N1170).

Genus KULUNOSTREA
Wei, 1984, p. 72
[in Chinese]

Discussion and diagnosis.—Original diagnosis (Translation from Chinese text, Wei, 1984, p. 72): shell not large, oval to erected oval, higher than length, both valves inflated, left valve slightly larger than right valve. Umbo small, pointed and tumid, slightly salient above ligament area, opisthogyrate in various degrees. Anterior margin broadly rounded, posterior margin with projecting flange. Surface ornamented with irregular growth lamellae, becoming thicker toward posteroventral margin, imbricate-like. Right valve thick, surface with imbricate-like growth lamellae. Inner cavity deep, the deepest at the upper margin of adductor scar, corresponding to the prominence of outer surface, umbonal cavity shallow; inner cavity of right valve shallower than left valve. Adductor scar lunelike, its upper margin slightly concave, posterior extremity slightly tapered and warped upward. Inner margin with a few crenulations.

Type species.—Kulunostrea yengisarica Wei, 1984, p. 73, pl. 35,*2* (holotype), 3–6; by original designation.

Original description of type species.—(Wei, 1984, p. 73): Same as for genus.

Type locality.—Yengisar, Shache, Yecheng, Xingjiang, northwestern China.

Type occurrence.—Wulagen Formation, late Middle Eocene.

Repository of type material.—Geological Survey Department of Bureau of Petroleum of Xinjiang Autonomous Region; accession number: XBB-0472 (holotype); 0473–0475.

Distribution of genus.—upper middle Eocene; western Tarim basin, Xinjiang, northwestern China.

Taxonomic position.—Ostreidae (by original designation).

Revision suggestion.—Wei's type species has been placed in the genus *Flemingostrea,* and the genus name *Kulunostrea* has been abandoned in Lan and Wei (1995, p. 118).

Genus PROTOSTREA
Chen in Gu et al., 1976, p. 243
[in Chinese]

Figure 4.18–4.21

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Chen in Gu et al., 1976, p. 243): shell oysterlike, inequivalve, right valve inflated commonly, left valve flat. Surface ornamented with irregular growth lamellae. Hinge edentulous,

resilifer in center, oblong, rather deep; dimyarian, anterior adductor small, ovate; posterior adductor large; integripalliate.

Type species.—*Ostrea sinensis* Hsu in Hsu & Chen, 1943, p. 136 (*in litteris*); by original designation; Chen in Gu et al., 1976 [=*Protostrea sinensis* (Hsu)] p. 243, pl. 40,*10–12,13* (holotype), *14–21*; by monotypy.

Original description of type species.—(Translation from Chinese text, Chen in Gu et al., 1976, p. 243): Shell medium; shape variable, commonly subtrapezoid, posteriorly elongate, posteroventral margin sometimes concave. Umbo low and small. Surface with irregular growth lamellae, but obscure around umbo.

Type locality.—Qingyan, Guiyang, Guizhou, southwestern China.

Type occurrence.—Qianyan Formation, Anisian, Middle Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 16063 (holotype); 16062, 16064–16067.

Distribution of genus.—Middle Triassic; Guizhou, southwestern China (Chen in Gu et al., 1976, p. 243).

Taxonomic position.—Ostreidae (by original designation).

Revision suggestion.—*Protostrea* most probably belongs to Dimyidae rather than to Ostreidae (Morris in Skelton & Benton, 1993, p. 250; Chen, Stiller, & Komatsu, 2006).

Note.—The species name *Ostrea sinensis* first appeared in Hsu (in Hsu & Chen, 1943, p. 136) as a manuscript name but without description or figure. Hsu's original manuscript for the systematic study of the Triassic bivalves of South China, including *Ostrea sinensis* Hsu, was lost in the Second World War.

Subfamily CRASSOSTREINAE Torigoe, 1981
Genus TALONOSTREA
Li & Qi, 1994, p. 168

[in Chinese]

Figure 12.30–12.33

Original diagnosis.—(Translation from Chinese text in Li & Qi, 1994, p. 168): Shell small in size, edentulous, midgut separated from crystalline style sac (fig. 14b), without gill fold and migration filaments (fig. 10c). Lateral sulcus of labial fold not evident (fig. 4c). Two atria mostly fused, pallial tentacles petal-like (fig. 11c). Adductor scar without special color, lacking gastric caecum.

Type species.—*Talonostrea talonata* Li & Qi, 1994, p. 168, pl. 6,*C, D* (no holotype designated), text-fig. 14b (OD); by monotypy.

Original description and discussion of type species.—(Translation from Chinese text, Li & Qi, 1994, p. 168): shell thin, both valves flat, talon like. Surface smooth in right valve, purplish red in color, mingled with one or two dark radial zones, no radial ribs, no scales, with 6–8 concavities along shell margin; left valve with small attachment scar, surface with 5–8 radial ribs, inner surface white or pale purple in color. Adductor scar situated near posteroventral margin, ligament pit small and deep.

Visceral ganglia with two lateral ganglia, two abdominal arteria (fig. 8a), margins between blood vessels of gill plate indistinct (fig. 10c). Cross section of main filaments fingerlike, digestive diverticula with 9 holes, 4 compound holes among them, relationship between gill and visceral mass is type II_4 (fig. 1c).

Zhang and Lou (1956) identified the species as *Ostrea pestigris*. But Harry (1985) and Morris (1985) have confirmed that *Ostrea pestigris* and *Ostrea paulucciae* are the same species, and *O. paulucciae* is a junior synonym of *O. pestigris*. Among the three known genera of Crassostreinae (Harry, 1985), *Striostrea* is large in size, with large comblike teeth and large attachment scar; *Saccastrea* is small in size, with comblike teeth, and its midgut is fused with crystalline style sac, with gastric caecum; *Crassostrea* is large in size, without comblike teeth, with scales on shell surface, and midgut fused with crystalline style sac, lacking gastric caecum. *Talonostrea talonata* is characteristically small in size, without comblike teeth and scales, attachment scar small, midgut separated from crystalline style sac, lacking gastric caecum and gill fold.

Type locality.—Jiaozhou Bay, Qingdao, Shandong, North China; water depth: 4 m. This species attaches on dead shells or small stones in the subtidal regions of protected bays in northern China.

Repository of type material.—Approximately 50 specimens are stored at the Institute of Oceanology, Chinese Academy of Sciences (Qingdao, Shandong, China); without accession number.

Age.—Holocene.

Taxonomic position.—Crassostreinae (by original designation).

Order PECTINOIDA Rafinesque, 1815
Superfamily PTERINOPECTINOIDEA Newell, 1938
Family PTERINOPECTINIDAE Newell, 1938
Genus CLARAIA Bittner, 1901
Subgenus CLARAIA (PTEROCLARAIA) Guo, 1985a, p. 150

[in Chinese with English description, p. 265]

Figure 9.16–9.17

Discussion and diagnosis.—Original diagnosis (Guo, 1985a, p. 265): shell subcircular, weakly inflated. Hinge margin long, nearly straight. Right anterior ear small, subrectangular. Posterior wing relatively broad and large, prominently extended backward and outstripping posterior margin, set off from body by obvious groove. Umbo low, near anterior margin. Left umbo slightly overtaking hinge margin; but not right umbo. Shell surface ornamented with fairly regular concentric folds, weaker in right than in left. *Pteroclaraia subgen. nov.* is distinguishable from *Claraia s.s., Pseudoclaraia,* and *Guichiella* in its well-developed posterior wing set off from shell body by obvious groove [*sic*].

Type species.—*Claraia (Pteroclaraia) protinalata* Guo, 1985a, p. 151, pl. 12,*3* (holotype), *4;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1985a, p. 151): Shell subcircular, shape variable due to secondary deformation. Hinge margin nearly straight, long, slightly shorter than length of shell, or longer than two-thirds length of shell. Umbo low, situated in anterior third of shell; beak of left valve salient slightly above hinge margin, right one not salient above hinge margin; greatest convexity under umbo. Right anterior auricle subrectangular, with small and shallow byssal notch,

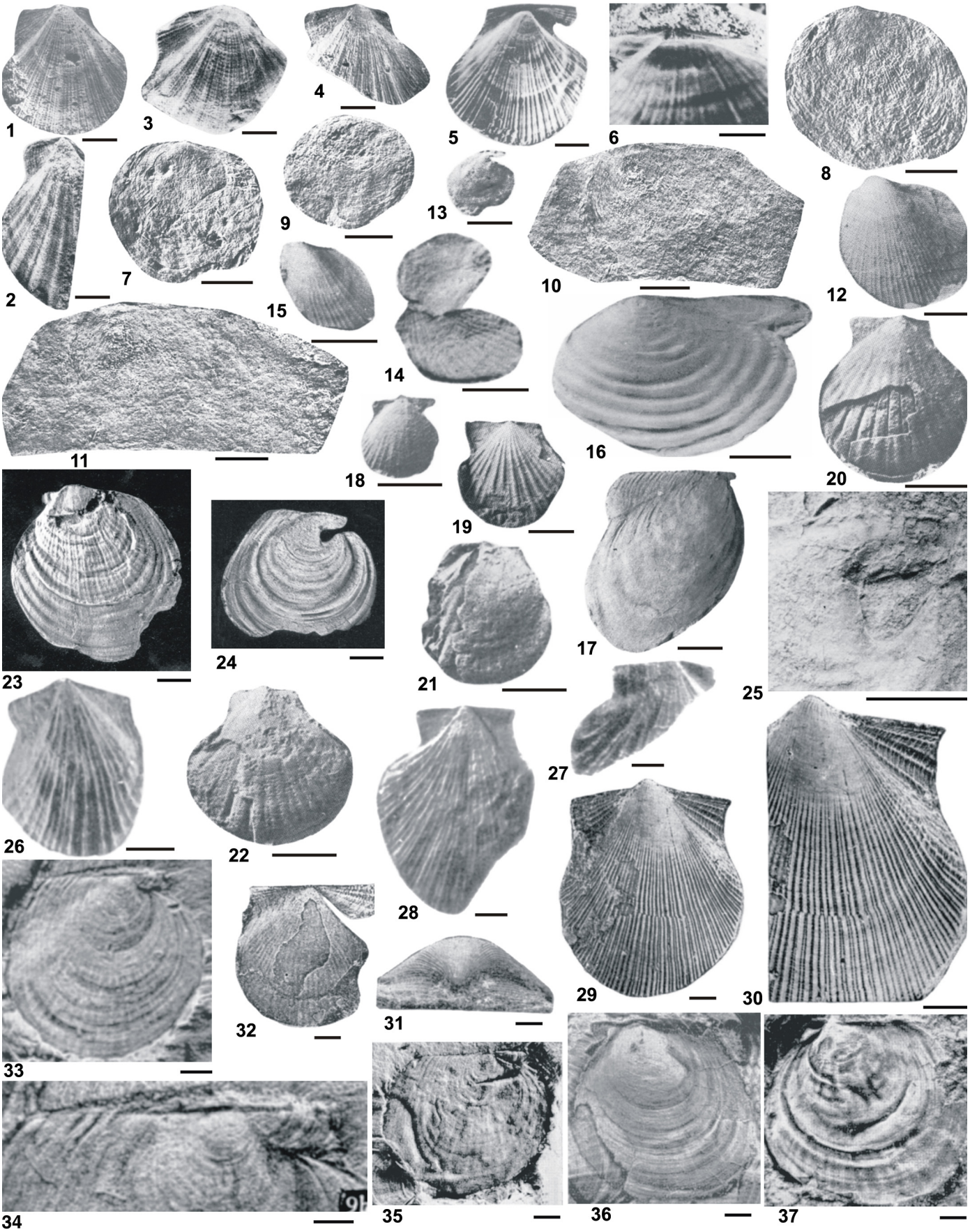

Figure 9. *For explanation, see facing page.*

cavelike; both posterior auricles well developed, depressed, extended backward, winglike, and rounded posteriorly, with a sinus under wing, separated from disc by narrow sulcus. Besides fine growth lines, surface ornamented with fairly regular and broadly rounded commarginal folds, confined to area from flank anterior to auricle sulcus; commarginal folds of right valve not well developed.

Type locality.—Yilang, Guangnan, Yunnan, southwestern China.

Type occurrence.—Ximatang Formation, Lower Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0136 (holotype); IVy0137.

Distribution of subgenus.—Lower Triassic; eastern Yunnan, southwestern China (Guo, 1985a, p. 151).

Taxonomic position.—Pterinopectinidae (by original designation).

Revision suggestion.—Suggested by Chen and Komatsu (2002, p. 439) as a junior synonym of *Claraia* Bittner. Type species of *Pteroclaraia*, *Claraia (Pteroclaraia) protinalata* Guo, appears to be identical with *Claraia anulata* Yin & Gan (in Gan & Yin, 1978, p. 334, pl. 114,*8–9,16*); the former should be considered a junior synonym of the latter.

Genus CLARAIOIDES Fang, 1993, p. 653

[in Chinese with English description, p. 660]

Figure 9.23–9.25

Discussion and diagnosis.—Original diagnosis (Fang, 1993, p. 660): shell small to moderate, prosocline, subcircular or elliptical in outline; inequivalve, with left valve moderately convex and right valve flat. Hinge margin nearly straight, slightly more than half of shell length; umbo about one-third to one-quarter of total length from anterior end. Posterior ear of both valves large, obtusely triangular; left anterior ear small, depressed, triangular, setting off from body with shallow auricle sulcus; right anterior ear conspicuous, small, tapered at end. Byssal notch wide and deep, distally constricted, with proximal end expanded downward into subcircular embayment bearing a thickened rim (byssal collar). Surface with concentric and radial ornament, or lacking; radial ornament, when present, usually weaker on right valve than on left valve. Hinge edentulous; ligament area narrow, with several pairs of chevrons as in *Pterinopecten*. The most striking feature lies in the subcircular byssal embayment in the right valve (lower valve), by which it may be readily distinguished from the comparable *Claraia* and *Pseudoclaraia*. In *Claraia*, the byssal notch is wide and horizontal, without internal expansion. The byssal notch of *Pseudoclaraia* is trumpetlike, internally constricted, and curved upward [*sic*].

Type species.—*Claraia primitiva* Yin, 1982, p. 343, pl. 29,*1* (paralectotype, left valve; holotype in the original text),*4*, and *6* (lectotype, right valve, designated herein; holotype in the original text), *2–3*, *5,7*; by original designation (Fang, 1993).

Original description of type species.—(Yin, 1982, p. 343): Opisthocline (possibly prosocline) with short hinge. Byssal notch deep, expanded into circle at proximal end. Left valve smooth in juvenile, with intercalated costae and concentric wrinkles in mature stage; right valve, concentric wrinkles, with or without obscure costae [*sic*].

Type locality.—Naquan, Fushui, Guangxi, China.

Type occurrence.—Heshan Formation, Changhsingian, upper Permian.

Repository of type material.—China University of Geosciences, Wuhan, Hubei, China; accession number: SC0036 (paralectotype, holotype in the original text), SC0045 (lectotype, holotype in the original text); paratypes: SC0038, 0039, 0051, 0097.

Distribution of genus.—Wuchiapingian and Changhsingian, upper Permian; South China and eastern Xizang (Tibet) (Fang, 1993, p. 654); upper Changhsingian; northwestern Caucasus Mountains (Kotlyar, Zakharov, & Polubotko, 2004).

Taxonomic position.—Pterinopectinidae (by original designation).

Note 1.—The double holotypes of the type species of this genus violate the Principle of Typification (ICZN, 1999), therefore, both

Figure 9. *1–4. Altaipecten multicostatus* Yang & Chen, scale bar 5 mm; *1,* holotype, left valve; *2–4,* paratype, left valves (adapted from Yang & Chen, 1985, pl. 2,*5–8*).——*5–6.* Holotype of *Binipecten yuani* Feng & Liu, scale bar 5 mm; *5,* right composite mold; *6,* latex cast of Fig. 9.5, showing the hinge (adapted from Feng & Liu, 1990, pl. 1,*5a,5b*).——*7–11. Peribositra baoqingensis* Chen; *7,* holotype, left lateral view, scale bar 10 mm; *8,* paratype, left lateral view, scale bar 5 mm; *9,* paratype, left lateral view, scale bar 10 mm; *10,* paratype, left external mold, scale bar 5 mm; *11,* paratype, left lateral view, scale bar 10 mm (adapted from Chen, 1981, pl. 10,*6–10*).——*12–15. Zandaia angusta* Yin & Nie, scale bar 5 mm; *12,* holotype, left valve; *13,* holotype, right valve; *14,* paratype, conjoined valves; *15,* paratype, left valve (adapted from Yin & Nie, 1990a, pl. 31,*11,14,13,2*).——*16–17. Claraia (Pteroclaraia) protinalata* Guo; *16,* holotype, left valve, scale bar 15 mm; *17,* paratype, right valve, scale bar 5 mm (adapted from Guo, 1985a, pl. 12,*3,4*).——*18–22. Costamussium zandaensis* Yin & Nie, scale bar 5 mm; *18,* holotype, right valve; *19,* holotype, left valve; *20,* paratype, left valve (adapted from Yin & Nie, 1990b, pl. 34,*15,17,23*); *21,* paratype, left valve; *22,* paratype, left valve (adapted from Yin & Nie, 1990b, pl. 35,*11,15*).——*23–25.* Holotypes of *Claraioides primitiva* (Yin), scale bar 5 mm; *23,* left valve; *24,* right valve; *25,* enlarged ligament area of Fig. 9.24, showing four pairs of chevron grooves visible radiating from beak (adapted from Yin, 1982, pl. 29,*1,4,6*).——*26–28. Tianshanopecten carboniferus* Feng, scale bar 5 mm; *26,* holotype, left valve; *27–28,* paratype, left valves (adapted from Feng, 1988, pl. 2,*1,2,7*).——*29–32. Qinghaipecten qinghaiensis* Sha, Chen, & Qi, scale bar 2 mm; *29–31,* holotype, left valve; *29,* left lateral view; *30,* local enlargement of Fig. 9.29; *31,* dorsal view (adapted from Sha, Chen, & Qi, 1991, pl. 2,*17a–c*); *32,* paratype, right valve (adapted from Sha, Chen, & Qi, 1991, pl. 3,*5*).——*33–37. Pseudoclaraia aurantiformis* Zhang; *33,* holotype, right composite mold, scale bar 2 mm; *34,* enlarged ligament area of Fig. 9.33, scale bar 1 mm; *35,* paratype, right valve, scale bar 2 mm; *36–37,* paratype, left valves, scale bar 2 mm (adapted from Zhang, 1980, pl. 2,*9a–b,13a,15,17*).

so-called holotypes become syntypes. The right valve specimen (asccession number: SC0045) is designated as the lectotype herein.

Note 2.—Newell and Boyd (1995, p. 27) included *Claraioides* in *Claraia* Bittner as a junior synonym. Yang et al. (2001) gave undue importance to the dentition for generic assignment in claraias and suggested that the shape and size of the byssal notch, as well as the shape of the anterior auricle could not be regarded as valid criteria for generic discrimination. Their conclusion received strong support from He et al. (2007). On the other hand, Kotlyar, Zakharov, and Polubotko (2004, p. 524) retained the name *Claraioides* for late Permian *Claraia*-like bivalves in order to segregate them from species of the *Pseudoclaraia-Claraia* lineage present during the Griesbachian. Regardless, we still accept it as a valid genus name because *Claraioides* has an unusually large, deep, internally and ventrally expanded byssal notch without exception, lacks *Claraia*-like attachment cicatrix, and did not survive the end-Permian biotic crisis. The byssal notch of *Claraia* is rather variable, but it is never internally expanded. In fact, there are two evolutionary lineages of different origins in the Permo-Triassic *Claraia* lineage: one (i.e., the *Pseudoclaraia-Claraia* lineage) might be originated from the cool-water Boreal realm, since *Claraia novosemelica* Lobanova, 1979 (=*Pseudoclaraia siberiensis* Zhang, 1980) from the Dzhulfian of Novaya Zemlya, Russia is the earliest member of the genus *Claraia* (including *Pseudoclaraia*) so far known, and the lineage did not occur in South China or the Tethyan realm until the latest Permian. The other (i.e., the *Claraioides* lineage) evidently originated from the lower Wuchiapingian of the warm-water Cathaysian province and is confined to the Permian Tethyan realm (Fang, 1985, 1993, 2003). The *Claraioides* lineage was wholly replaced by the *Pseudoclaraia-Claraia* lineage during the Permian-Triassic crisis. The byssal notch of *Claraia liuqiaoensis* He et al., 2007, is very wide and deep, and seemingly similar to that of the *Claraioides* lineage. However, its proximal end does not show any sign of expanding as in the *Claraioides* lineage. Therefore, it is improbable that the *Pseudoclaraia-Claraia* lineage evolved from the *Claraioides* lineage. The root of the *Pseudoclaraia-Claraia* lineage is in the cool-water Boreal realm. At present, the genus *Claraioides* contains the following eight species: *C. caucasicus* (Kulikov & Tkachuk, 1979), *C. primitivus* (Yin, 1982), *C. dianus* (Guo, 1985a), *C. praecursor* (Wu & Hong, 1991), *C. guizhouensis* (Fang, 1993), *C. zhiyunicus* (Gao, Yang, & Peng, 2004; note: *Claraia zhiyunicus* Yang, Gao, & Peng, 2001, is a *nomen nudum,* because they did not provide the diagnosis and description of this species.), *C. labensis* Kotlyar, Zakharov, & Polubotko (2004), and *C.* sp. (Gao, Yang, & Peng, 2004). It is a pity that He et al. (2007) only referred to three species of *Claraioides,* and they omitted some material of *Claraioides* when discussing the *Claraia-Claraioides* problem.

See also Yang et al. (2001), Fang (2003), Kotlyar, Zakharov, and Polubotko (2004), and He et al. (2007) for discussion of *Claraioides* Fang.

Genus PERIBOSITRA Chen, 1981, p. 54

[in Chinese with English description, p. 81]

Figure 9.7–9.11

Discussion and diagnosis.—Original diagnosis (Chen, 1981, p. 81): thin, orbicular shells with irregular concentric undulations and obsolescent radial ornamentations; slightly inequilateral, umbo low, shallow umbonal cavity; hinge margin usually short, rounded; posterior ventral marginal region usually curved inward, forming lobelike posterior margin. Left valve with narrow triangular ligament, cardinal area bearing triangular ligament pit on subcenter; hinge edentulous. Anisomyarian, anterior adductor scar relatively small, circular, deeply impressed; posterior adductor impression shallow but apparently much larger. This new genus is allied with *Bositra* de Gregorio, Jurassic (Europe), in its orbicular outline and ligament type, but distinguishable in having anisomyarian and lobelike posterior margin. It is similar to *Posidonia* Bronn, but exhibits alivincular ligament similar to that of *Pteria*. Resembles *Claraia* Bittner but differs in rounded hinge margin, ligament structure and adductor muscle scar form. In 1970, Nakazawa et al. illustrated some specimens from so-called mixed fauna at the Permian-Triassic boundary in Kashmir, as *Claraia stachei* Bittner, which was identified with the new form *Claraia bioni* Nakazawa by Nakazawa (1977; Nakazawa et al., 1975). Judging from Nakazawa's (in Nakazawa et al., 1970) illustrations, *Claraia bioni* may be congeneric with the present new species based on outline and rounded hinge margin, but muscle scars and ligament structure are not known in Kashmir form [*sic*].

Type species.—*Peribositra baoqingensis* Chen, 1981, p. 55, pl. 10,*6* (holotype), *7–10;* by original designation; by monotypy.

Original description of type species.—(Chen, 1981, p. 82): Shell relatively large (length 31–36 mm; height 30–34 mm); thin-shelled, orbicular outline; slightly inequilateral; posterior ventral margin region usually curved inward, posterior margin forming lobelike projection; umbo low, located near center of short and rounded hinge margin; shallow umbonal cavity, shell body ornamented with irregular concentric and weak radial costae, sculpture of costae most conspicuous toward center of shell surface and obsolescent toward both anterior and posterior ends. Characteristics of ligament and muscle scars are given in the diagnosis of the new genus [*sic*].

Type locality.—Xinhuai, Changxing, Zhejiang, eastern China.

Type occurrence.—Yinkeng Formation, uppermost Permian.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 53049 (holotype); 53047, 53048, 53050, 53051.

Distribution of genus.—uppermost Permian; Zhejiang, eastern China.

Taxonomic position.—Posidoniidae (by original designation).

Revision suggestion.—*Peribositra* is here placed in synonymy with *Claraia* according to Nakazawa (1992, p. 26), Fang (2004b, p. 611), and Waller and Stanley (2005, p. 20).

Genus PSEUDOCLARAIA Zhang Zuo-ming, 1980, p. 438

[in Chinese with English description, p. 443]

Figure 9.33–9.37

Discussion and diagnosis.—Original diagnosis (Zhang Zuo-ming, 1980, p. 443): shell small to moderate, prosocline, subcircular or subquadrate; inequivalve; left valve convex, right valve slightly convex or flat; hinge line long, about four-fifths shell length; left umbo high and very salient above hinge margin, right umbo subdued or slightly salient upward; both auricles large; posterior auricle large

and obtusely triangular, differentiated from shell proper in some species; left anterior auricle nearly triangular and convex; right anterior auricle rather large, semicircular; byssal notch trumpet shaped, constricted internally, curved upward and crossed with hinge margin; cicatrix small or distinct; edentulous; ligament area narrow and long, lacking resilifer but with several sets of chevron ridges and grooves; surface with concentric ornament or together with numerous intercalated radial ribs; auricular parts only with concentric lines; microstructures observed on cross section of prismatic layer subquadrate but irregular [*sic*].

Type species.—Pseudoclaraia aurantiformis Zhang Zuo-ming, 1980, p. 439, pl. 2,*6–8*,*9a–b* (holotype), *12–17*; by original designation.

Original description of type species.—(Translation from Chinese text, Zhang Zuo-ming, 1980, p. 439): description as for *Pseudoclaraia*.

Type locality.—Qinglong, Guizhou, southwestern China.

Type occurrence.—Base of Feixianguan Formation, Lowermost Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 55865 (holotype); 55862–55864, 55866–55871.

Distribution of genus.—upper Permian to Lower Triassic; South China, Himalaya region, Kashmir, Japan, Siberia, Canada (Zhang Zuo-ming, 1980, p. 439).

Taxonomic position.—Pterinopectinidae (by original designation).

Revision suggestion.—The findings of both *Claraia*-type and *Pseudoclaraia*-type byssal notches occurred in the same population of *Claraia wangi* (Patte) in the Meishan section of Changxing, China (Chen & Komatsu, 2002), and a transitional sequence from *Pseudoclaraia*-type to *Claraia*-type byssal notches occurred in the vertical succession of the regional populations of *C. wangi* (Patte) from the upper Griesbachian of the southern Pamir Mountains (Kotlyar, Zakharov, & Polubotko, 2004) suggest that the genus name *Pseudoclaraia* Zhang Zuo-ming, 1980, is a junior synonym of *Claraia* Bittner. It is probable that the *Pseudoclaraia-Claraia* lineage was originated from the Boreal realm, because *Claraia novosemelica* Lobanova, 1979 (=*Pseudoclaraia siberiensis* Zhang, 1980) from the Dzhulfian of Novaya Zemlya, Russia, is the earliest member of the genus *Claraia* so far known.

Superfamily AVICULOPECTINOIDEA Meek & Hayden, 1864
Family AVICULOPECTINIDAE Meek & Hayden, 1864

[=Etheripectinidae Newell & Boyd, 1995]

Genus ALTAIPECTEN Yang & Chen, 1985, p. 383

[in Chinese with English description, p. 386]

Figure 9.1–9.4

Discussion and diagnosis.—Original diagnosis (Yang & Chen, 1985, p. 386): shell medium, *Chlamys*-like, acline, inequivalve. Left valve more convex than right. Right anterior ear large, oblong, radially ornamented, with a deep byssal gape below. Posterior ear smaller than anterior . Surface of shell body ornamented with 10 or 12 rounded radial ridges on left valve, with 9 or 11 on right. Interspaces of ridges also round. Many radial costae occurring on ridges and the interspaces of ridges. Concentric lines across costae forming many tubercles at crossing points. Interior of shell with narrow radial riblets located correspondingly on each side of ridges on external surface. Hinge with a triangular resilifer [*sic*].

Type species.—Altaipecten multicostatus Yang & Chen, 1985, p. 384, pl. 2,*5* (holotype), *6–8*; by original designation.

Original description and discussion of type species.—(Translation from Chinese text, Yang and Chen, 1985, p. 384): Diagnosis as for genus; species can be compared with specimens of *Pecten (Aequipecten) keyserlingi* from Russian Timan region (Licharew, 1927), but Russian species is large (length 45 mm), with more radial plicae (12 on left valve and 11 on right), while present species is smaller (length 18.5 mm), with fewer plicae (10 on left valve) and stronger commarginal ornament.

Type locality.—Keramaili, Xinjiang, northwestern China.

Type occurrence.—Shiqiantan Formation, upper Carboniferous.

Repository of type material.—Regional Geological Survey Team of Xinjiang, China; accession number: XBA-479 (holotype); HBA-478, 480, 481.

Distribution of genus.—upper Carboniferous; China and Urals (Yang & Chen, 1985, p. 384).

Taxonomic position.—?Pectinidae (by original designation).

Revision suggestion.—Junior synonym of *Undopecten* Waterhouse, 1982, within the Aviculopectinidae suggested by Newell and Boyd (1995, p. 41).

Genus BINIPECTEN Feng & Liu, 1990, p. 128

[in Chinese]

Figure 9.5–9.6

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Feng & Liu, 1990, p. 128): shell small to medium, *Chlamys*-like form, retrocrescent, flat-convex or slightly convex; anterior and posterior auricles subequal; anterior auricle inflated, fanlike, upper part ornamented with costae, but smooth at lower part; posterior auricle depressed, triangular, with weak costellae; auricle sinus and byssal notch deep and rounded. Surface ornamented with radial costae and irregular concentric ridges; costae showing irregular bifurcation and commonly grouping into indistinct bunches. Interior characters as in the family Binipectinidae Feng & Liu (1990, p. 128).

Type species.—Binipecten yuani Feng & Liu, 1990, p. 128, pl. 1,*1–4*,*5a–e* (holotype); by original designation.

Original description of type species.—(Translation from Chinese text, Feng and Liu, 1990, p. 128): Shell small to medium, subrounded, retrocrescent, flat-convex or slightly convex; dorsal margin straight, shorter than greatest length of shell. Beak not protruding above hinge margin; anterior margin straight or slightly concave, posterior one straight. Right anterior auricle inflated, fanlike, upper part ornamented with 3–6 intercalate costae, but smooth at lower part; auricle sinus deep and rounded, byssal notch deep;

posterior auricle depressed, triangular, with obtuse posterodorsal angle, separated by steep slope from disc, ornamented with about 3 costallae. Surface ornamented with radial costae and concentric ridges; costae consisting of 3–4 successive ranks, showing irregular bifurcation and grouping into subbunches; disc with about 7 primary costae, rarely inserting a few intercalate costae on anterior part; concentric ridges developed or undeveloped. Posterior adductor scar distinct, large, ovate. Hinge stucture as in family Binipectinidae Feng & Liu (1990, p. 128).

Type locality.—Shuangjingzi, Qitai, Xinjiang, northwestern China.

Type occurrence.—Shiqiantan Formation, upper Carboniferous.

Repository of type material.—China University of Geosciences, Wuhan, Hubei Province; accession number: XT12001 (holotype); XT12045, 12047, 12066, 12234.

Distribution of genus.—upper Carboniferous; Junggar, Xinjiang, northwestern China; Urals, Russia (Feng & Liu, 1990, p. 128).

Taxonomic position.—Binipectinidae (by original designation).

Revision suggestion.—The genus name is rejected because of the misinterpretation of an *Aviculopecten*-type ligament in the type species. *Binipecten yuani* Feng & Liu has graded costae, showing irregular bifurcation and fasciculate pattern of costae in the right valve. This is reminiscent of *Heteropecten.* Unfortunately the type species is based only on the right valve. Just as Fang and Morris (1999) pointed out, it it unreasonable to define a new aviculopectinoid taxon without full knowledge of both valves.

Family BINIPECTINIDAE Feng & Liu, 1990, p. 128

[in Chinese]

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Feng & Liu, 1990, p. 128): right valve *Chlamys*-like form, retrocrescent, flat-convex or slightly convex; anterior and posterior auricles subequal, ornamented with radial costae, well-developed byssal notch; anterior byssal notch fanlike, posterior depressed, triangular. Surface ornamented with radial costae and concentric ridges, costae showing bifurcation. Ligament area narrowly triangular, very long, with two resilifers in center, ligament grooves parallel to dorsal margin on bourrelets. Posterior adductor scar distinct. Left valve unknown. upper Carboniferous.

Taxonomic position.—Pectinoidea (by original designation).

Revision suggestion.—Family name is rejected because of misinterpretation of an *Aviculopecten*-type ligament in the type species.

Genus NEOMORPHOTIS Yin & Yin, 1983, p. 154

[in Chinese]

Figure 10.19–10.22, 11

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Yin & Yin, 1983, p. 154): *Eumorphotis*-form, medium to gigantic, left valve inflated, right valve nearly flat. Auricles *Eumorphotis*-form, anterior auricle developed, separated from disc by auricle sulcus, byssal notch deep, surface of shell around byssal notch commonly sunken or depressed; posterior auricle winglike,

Figure 10. *1–7. Jianchuania problematica* (J. Chen); *1,* holotype, left valve, scale bar 1 mm; *2,* paratype, left internal mold, scale bar 5 mm; *3,* paratype, right lateral view, scale bar 5 mm; *4,* paratype, right lateral view, scale bar 1 mm; *5,* paratype, left valve, scale bar 5 mm (adapted from J. Chen in Ma et al., 1976, pl. 28,*11,1–4*); *6,* plesiotype, right lateral view, scale bar 5 mm; *7,* enlarged anterodorsal part of Fig. 10.6, showing anterior auricle, scale bar 1 mm (adapted from J. Chen & Chen, 1980, pl. 1,*8a,8b*).——*8–12. Paradoxipecten jiaheensis* Zhang; *8,* holotype, left valve, scale bar 10 mm; *9,* paratype, right valve, scale bar 10 mm; *10,* holotype, right valve, scale bar 10 mm (adapted from Zhang, 1981, pl. 1,*19,13,21*); *11–12,* topotypes, scale bar 1 mm; *11,* local enlargement of left external mold, showing ornament of left valve; *12,* local enlargement of right external mold, showing ornament of right valve (adapted from Fang, 1987, pl. 3,*13,14*).——*13–15.* Lectotype of *Junggaroconcha xinjiangensis* Yang & J. Chen, scale bar 5 mm; *13,* left lateral view; *14,* right lateral view; *15,* dorsal view (adapted from Yang & J. Chen, 1985, pl. 3,*8a–c*).——*16–18. Xinjiangopecten costatus* Yang, scale bar 5 mm; *16,* lectotype, right valve (adapted from Yang & J. Chen, 1985, pl. 3,*12* [not included in the figures of Yang, 1983]); *17,* paralectotype, left valve [adapted from Yang & J. Chen, 1985, pl. 3,*9* (=Yang, 1983, pl. 151,*18*)]; *18,* metatype, right valve (adapted from Yang & J. Chen, 1985, pl. 3,*14* [not included in figures of Yang, 1983]). ——*19–22. Neomorphotis gigantea* Yin & Yin; *19,* holotype, left internal mold, scale bar 20 mm; *20,* holotype, right internal mold, scale bar 20 mm; *21,* paratype, right interior view, scale bar 10 mm; *22,* paratype, left valve, scale bar 10 mm (adapted from Yin & Yin, 1983, pl. 18,*1,2,8,11*).——*23–24. Periclaraia circularis* Li & Ding, scale bar 2 mm; *23,* holotype, right valve; *24,* paratype, left valve (adapted from Li & Ding, 1981, pl. 1,*17,12*).——*25. Tianshanopecten carboniferus* Feng, scale bar 5 mm; paratype, left valve (adapted from Feng, 1988, pl. 2,*6*).——*26–32. Euchondrioides zhuzhouensis* Fang, scale bar 2 mm; *26,* holotype, left internal mold, showing internal costae; *27,* enlarged ligament area of Fig. 10.26; *28,* left external mold of Fig. 10.26, showing external costae, which are quite different from internal costae; *29,* paratype, right internal mold; *30,* paratype, left external mold; *31,* paratype, left lateral view; *32,* paratype, right external mold (adapted from Fang, 1987, pl. 5,*1a–c,2–3,5–6*).——*33–34.* Holotype of *Leptolima hunanensis* Zhang; *33,* internal mold of conjoined valves, scale bar 1 mm; *34,* enlarged dorsal part of Fig. 10.33, showing hinge, scale bar 5 mm (adapted from Zhang in Zhang, Wang, & Zhou, 1977, pl. 197,*23a,23b*).——*35–37.* Holotype of *Allobuchia apiculata* Yu, scale bar 2 mm; *35,* left lateral view; *36,* right external mold; *37,* right lateral view (adapted from Yu, 1983, pl. 2,*30a–c*).——*38–43. Endocostapecten inequicostata* (Yang & J. Chen), scale bar 5 mm; *38,* holotype, right valve; *39,* paratype, right valve (adapted from Yang & J. Chen, 1985, pl. 3,*5,4*); *40,* plesiotype, right lateral view; *41,* plesiotype, left lateral view; *42–43,* plesiotype, right lateral views (adapted from Feng, 1988, pl. 3,*11,16,19,26*).

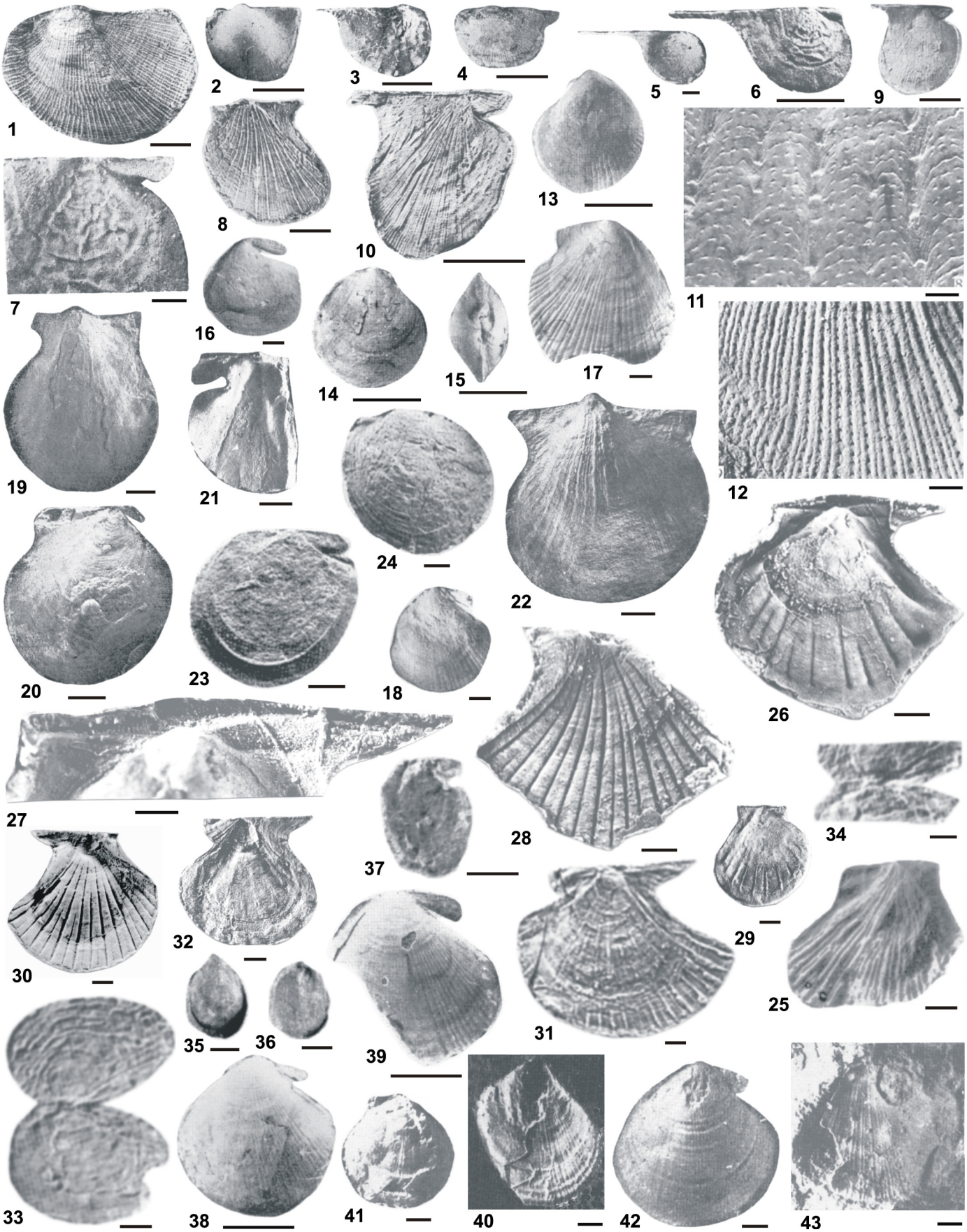

Figure 10. *For explanation, see facing page.*

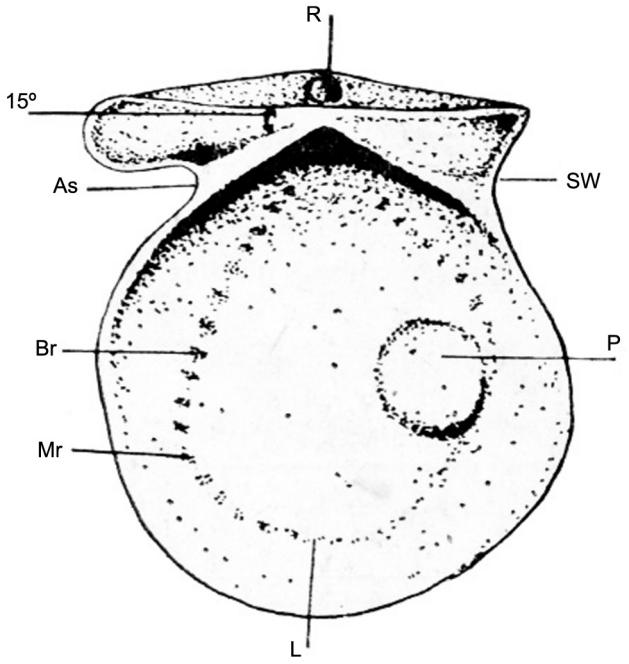

Figure 11. Diagrammatic drawing of internal structure of *Neomorphotis* (no scale), *As,* auricular sulcus; *Br,* byssal retractor; *L,* pallial line; *Mr,* pallial retractor muscles; *P,* adductor muscles; *R,* resilifer; *SW,* posterior auricle sulcus (adapted from Yin & Yin, 1983, p. 154, text-fig. 4-47).

not well differentiated from disc; surface covered by spinose and tubercular multicostate ornament of *Spondylus*-type. Ligament area broad, with high and wide median resilifer, interior structure same as that of *Prospondylus*.

Type species.—Neomorphotis gigantea Yin & Yin, 1983, p. 155, pl. 18,*1* (syntype, left valve, holotype in the original text), *2* (syntype, right valve, holotype in the original text), *3–11* (syntypes, paratypes in the original text); text-fig. 4-47 showing internal structure; by original designation.

Original description of type species.—(Translation from Chinese text, Yin & Yin, 1983, p. 155, slightly abridged): *Eumorphotis*-form, higher than long, in general 10 cm high, gigantic, shell thin (~1–1.5 mm thick). Left valve strongly inflated, convexity at two-thirds height of shell; beak point, salient above hinge margin, just anterior to center of hinge margin, not overhanging that of right valve; anterior auricle slightly inflated, with deep byssal sinus; posterior auricle winglike, with shallow byssal sulcus; surface covered by radial costae of 1 to 6 successive ranks and irregular growth lines, primary and secondary costae strong, about 30 in number, bearing crowded tubercles on their tops; with 5–10 (7–8 in general) costellae intercalated in interspaces. Right valve flat, beak not projecting above hinge margin, situated slightly anterior of center; anterior auricle inflated, with deep byssal notch; posterior auricle winglike, narrowly triangular, with byssal sulcus, not deep; surface covered by crowded and irregular growth lines, without radial lines. Ligament area rather high (5 mm high; 70 mm high in left valve), with a central resilifer that is roundly triangular. Interior of shell with evident pallial line, byssal retractor, radial muscles of mantle edge, and large adductor scar.

Type locality.—Qierma, Tianjun, Qinghai, northwestern China.

Type occurrence.—Qierma Member of Junzihe Formation, Anisian, Middle Triassic.

Repository of type material.—China University of Geosciences, Beijing; syntype accession number: Y813 (right valve, holotype in the original text); Y817 (left valve, holotype in the original text); Y814-816, 819, 820–823 (paratypes in the original text).

Distribution of genus.—upper Scythian–Anisian, ?Carnian, Triassic (Yin & Yin, 1983, p. 154).

Taxonomic position.—Aviculopectinidae (by original designation).

Revision suggestion.—The type species *Neomorphotis gigantea* Yin & Yin is a junior synonym of *Eumorphotis buhaheensis* Lu (in Zhang, Lu, & Wen, 1979, p. 257, pl. 71, fig. 13). Both species are from the same area and stratigraphic horizon.

Note.—The double holotypes of the type species of this genus violate the Principle of Typification (ICZN, 1999), therefore, both so-called holotypes become syntypes.

Genus PARADOXIPECTEN Zhang, 1981, p. 262

[in Chinese with English diagnosis, p. 264]

[*emend.* Fang, 1987, p. 373 (in Chinese with English diagnosis, p. 403)]

Figure 10.8–10.12

Discussion and diagnosis.—Original diagnosis (Zhang, 1981, p. 264): shell *Aviculopecten*-like, small-medium, prosocline. Hinge margin straight and long. Posterior auricle large and triangular. Right valve flat. Anterior auricle semicircular. Byssal notch deep. Radial costae closely arranged, bifurcated or sometimes intercalated. Concentric lines seen on entire valve, intersected with radial costae to form imbricated sculptures on surface of shell. Left valve intercalated, 2 to 3 orders. Costae of first order with blunt spines on ventral margin. Concentric lines fine. Cardinal crura extending to extremities, slightly curved upwardly in resilium [*sic*].

Revised diagnosis of genus.—(Fang, 1987, p. 403): Shell medium, inequivalve, inequilateral, left valve moderately inflated, right valve nearly flat; on left valve, incurved umbo projects slightly beyond hinge, on right valve very inconspicuous; byssal sinus in left anterior ear, deep byssal notch in right anterior ear; posterior ears usually acute. On left valve, ornament of radial costae of primary to several orders, increasing by intercalation, crossed by concentric lamellae that arch sharply toward the ventral side on primary and secondary costae; in interspaces of primary and secondary costae, concentric lamellae arch toward hinge; in addition, on costae, especially on tertiary costae or under, many short, pointed projections arch toward hinge. Right valve ornamented with numerous slender intercalated costae, much less differentiated than on left valve, crossed by concentric lamellae that arch dorsally in short, pointed projections. Resilifer shallow and indistinct. Intermediate in character between *Etheripecten* Waterhouse and *Limipecten* Girty. Ornament in left valve resembles that of *Etheripecten*, but latter has no short, pointed projections that arch dorsally on costae. In right valve, ornament obviously different from *Etheripecten*, but very similar to *Limipecten*. Differs from latter in having short, pointed projections that point dorsally on costae. In *Limipecten*,

concentric lamellar swing downward toward margin between costae in short, flattened, pointed projections [*sic*].

Type species.—Paradoxipecten jiaheensis Zhang, 1981, p. 263, pl. 1,*13*,*15–18*,*19* (holotype), *21* (holotype) by original designation (*non 26)*.

Original description of type species.—(Translation from Chinese text, Zhang, 1981, p. 263): Shell retrocrescent or infracrescent. In left valve, several fine radial costellae of regular rank intercalate between primary costae, several long spines on last primary costa; features of right valve as for genus *Paradoxipecten*.

Type locality.—Yuanjia, Jiahe, Hunan, China.

Type occurrence.—Upper member, Toeling Formation, early Wuchiapingian, upper Permian.

Repository of type material.—Institute of Geology, Chinese Academy of Geological Sciences, Beijing; accession number: holotypes: 1107 (left valve), 1130 (right valve); paratypes: 1108, 1121, 1123, 1131, 1132.

Distribution of genus.—Wuchiapingian, upper Permian; Hunan (Zhang, 1981, p. 263); upper Permian; southern China.

Taxonomic position.—Aviculopectinidae (by original designation).

Revision suggestion.—Newell and Boyd (1995, p. 34) listed *Paradoxipecten* Zhang as a junior synonym of *Heteropecten* Kegal & da Costa, 1951. It seems to us that their interpretation of *Heteropecten* is inappropriately broad. *Paradoxipecten* Zhang, 1981, *emend.* Fang, 1987 is herein accepted as valid.

Genus QINGHAIPECTEN
Sha, Chen, & Qi, 1991, p. 145

[in Chinese with English description, p. 157]

Figure 9.29–9.32

Discussion and diagnosis.—Original diagnosis (Sha, Chen, & Qi, 1991, p. 157): shell small or medium, roundly subquadrate or similar to shield-shaped, acline to feebly prosocline. Auricles subequal in length or posterior one slightly longer, terminal of posterior auricle more or less pointed, but anterior auricle obtuse. Left valve strongly convex and higher than long. Radial ornament of left valve strong, fine, and dense, arranged in 3 or 4 ranks, increasing by intercalation and bifurcation. The first 2 radials appear in early ontogeny, whereas last 2 radials are introduced later. First simply arranged radials appearing in area near beak. Initial intercalation and bifurcation starting from umbonal area and area near but below umbonal base respectively, whereas second intercalation and bifurcation not common and beginning in middle and ventral area respectively. Radials weak but fairly broad, flat, and dense on right valve, a few or probably most increasing by bifurcation near area of umbo and by intercalation in other areas. Concentric sculptures and growth lines fine and weak on left valve but undeveloped on right [*sic*].

Type species.—Qinghaipecten qinghaiensis Sha, Chen, & Qi, 1991, p. 146, pl. 2,*17a–c* (holotype); pl. 3,*1–11*; pl. 4,*1–2;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Sha, Chen, & Qi, 1991, p. 146; slightly abridged): Shell moderate in size, infracrescent to slightly retrocrescent. Dorsal margin nearly straight, anterior, posterior, and ventral margins rounded. Both auricles subequal or posterior auricle slightly longer, with pointed end, end of anterior auricle obtuse. Shell roundly subquadrate or subshield form inclusive of auricles. Left valve moderately inflated, slightly higher than long, maximum convexity located at middle-upper part of valve; umbonal angle about 40°–50°, umbo moderate in size, salient above hinge margin, situated near center or slightly anterior of center; beak not pointed, orthogyrate; surface ornamented with fine and crowded radial costae of three or four ranks, increasing in number with growth by intercalation and splitting; costae intersected by delicate and regular commarginal growth lines to form reticulated ornamentation, and forming nodules at intersections in auricles and two sides of auricle sulci. Right valve flat, height and length subequal or slightly longer than high; surface covered by wide and flat radial costae, probably increasing in number by bifurcation around umbo, but definitely by intercalation in adult stage, commarginal ornament not well developed; costae of auricles increasing in number by intercalation, intersected by regular and crowded concentric lines, with nodules at intersections in anterior auricle.

Type locality.—Bangtang, Yushu, Qinghai, northwestern China.

Type occurrence.—Mapingian, upper Carboniferous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 93559 (holotype); 93560–93572.

Distribution of genus.—upper Carboniferous; Junggar, Xinjiang, northwestern China (Sha, Chen, & Qi, 1991, p. 146).

Taxonomic position.—Aviculopectinidae (by original designation).

Revision suggestion.—Junior synonym of *Spyridopecten* Campbell & McKelvey, 1972, suggested herein because it has also large number of splitting costellae on both valves.

Genus TIANSHANOPECTEN
Feng, 1988, p. 632

[in Chinese with English description, p. 636]

Figure 9.26–9.28, 10.25

Discussion and diagnosis.—Original diagnosis (Feng, 1988, p. 636): shell of *Streblochondria*-form, medium, slightly opisthocline, weakly inflated. Body surface ornamented with numerous intercalated costae and concentric lines. Both ears nearly equal in length, triangular; anterior ear ornamented with radial and concentric lines, while posterior only with concentric lines. Cardinal area triangular; resilifer ovoid. Right valve unknown. Similar to *Guizhoupecten* Chen, 1962, in ornamentation of shell and outline of body, but differs in approximate equality of ears. *Guizhoupecten*? *tenuiconcentric* (Janischevsky) as reported by Astafieva-Urbaitis (1983) may belong to the genus [*sic*].

Type species.—Tianshanopecten carboniferus Feng, 1988, p. 632, pl. 2,*1* (holotype), *2,6–7;* by original designation; by monotypy.

Original description of type species.—(Feng, 1988, p. 636): Left valve medium, *Streblochondria*-form, weakly inflated and slightly opisthocline. Anterior ear ornamented with numerous radial, concentric lines, while posterior ear with only weakly concentric lines; both ears triangular, subequal in length (about 7 mm). Ornamentation of shell body consisting of intercalated coarse costae,

about 9 filae in first and second orders, and fine concentric lines, close and overlapping radial costae. Triangular cardinal area and ovoid resilifer clear [*sic*].

Type locality.—Qijiagou, southern margin of Junggar Basin, Xinjiang, northwestern China.

Type occurrence.—Qijiagou Formation, upper Carboniferous.

Repository of type material.—China University of Geosciences, Wuhan; accession number: XG07414 (holotype); XG07028, 07205, 07231.

Distribution of genus.—Carboniferous; China, Mongolia, and Russia (Feng, 1988, p. 632).

Taxonomic position.—Streblochondriidae (by original designation).

Revision suggestion.—*Tianshanopecten* is here placed in synonymy with *Heteropecten* Kegel & Costa, 1951, within the Aviculopectinidae.

Family STREBLOCHONDRIIDAE Newell, 1938

Genus JUNGGAROCONCHA Yang, 1983, p. 414

[in Chinese]

Figure 10.13–10.15

Discussion and diagnosis.—Original diagnosis (Yang & J. Chen, 1985, p. 386): shell small, subequivalve, opisthocline. Hinge line short and arched. Right anterior ear small, triangular, and convex, with deep byssal gape below. Ears sculptured with weak radial striae, posterior ears obsolete and very small. Surface of shell body ornamented with regular radial costae separated by narrow grooves. Costae growing interjectionally on left valve and bifurcately on right. Costae distinct on anterior part of surface in right valves; those on posterior part stronger than those on anterior part within left valves. Interior structure unknown. Similar to *Streblochondria* in outline of body and ears; resembles *Obliquipecten* in opisthocline outlines, but with an obsolete posterior ear and a small anterior ear, which separate it from the latter [*sic*].

Type species.—*Junggaroconcha xinjiangensis* Yang & Chen in Yang, 1983, p. 414, pl. 153,*4a–b* (lectotype, subsequent designation by Yang & Chen, 1985), *8*,*32*; by original designation.

Original description of type species.—(Translation from Chinese text, Yang & Chen, 1983, p. 414): Description as for genus.

Type locality.—Keramaili, Xinjiang, northwestern China.

Type occurrence.—Shiqiantan Formation, upper Carboniferous.

Repository of type material.—Regional Geological Survey Team of Xinjiang, China; accession number: HBA234 (holotype); HBA235, 236.

Distribution of genus.—Carboniferous; China and England (Yang & Chen, 1985, p. 383).

Taxonomic position.—Streblochondriidae (by original designation).

See also.—*Junggaroconcha gen. nov.* Yang & Chen, 1985, p. 382 (in Chinese with English description, p. 386).

Note.—Newell and Boyd (1995, p. 83) suggested that hinge characters and shell microstructure of *Junggaroconcha* have to be observed before validation of the name as a genus.

Genus XINJIANGOPECTEN Yang, 1983, p. 414

[in Chinese]

Figure 10.16–10.18

Discussion and diagnosis.—Original diagnosis (Yang & J. Chen, 1985, p. 385): shell small to medium, inequivalve, opisthocline. Left valve inflated; right valve weakly inflated. Hinge line straight, shorter than shell (length). Right anterior ears large and oblong in form, with narrow and deep byssal gape. Left anterior ears triangular, with distinct sinus below. Anterior ears with radial sculpture; posterior ears smooth and smaller than anterior ears. Middle and ventral parts of shell surface ornamented with numerous wide radial costae separated by narrow grooves. Costae growing interjectionally on left valve and bifurcately on right. Umbonal region nearly smooth. Hinge structure unknown. Similar to *Streblochondria* in outline of body and ears, but differs from latter in ornamentation. *Aviculopecten* can be easily distinguished from this genus by its prosocline outline. Permian genus *Guizhoupecten* also has an opisthocline outline and is closely related; differences are in ornamentation of umbonal region and shape of costae [*sic*].

Type species.—*Xinjiangopecten costatus* Yang, 1983, p. 415, pl. 151,*9–10*,*14–16*,*18–19* (no holotype designated) [=*Xinjiangopecten isocostus* Yang & Chen, 1985, p. 382, pl. 3,*9–11*,*12* (lectotype, subsequent designation, not included in figures of Yang, 1983), *13–15*; by original designation.

Original description of type species.—(Translation from Chinese text, Yang, 1983, p. 415): Shell medium, rounded triangular, left valve more inflated than right. Beak pointed, prosogyrate, protruding slightly above hinge margin, situated slightly anterior of center; umbonal cavity deep; hinge margin straight and long, about half as long as shell length, higher than long. Left valve rather inflated, with well-differentiated auricles; anterior auricle triangular, covered by strong concentric ridges and weak radial costae; costae and ridges of posterior auricle very weak; surface ornamented with *Palaeolima*-type radial costae, not very well graded, costae flat, uneven in width; interspaces also flat, 35–39 in number; costae weakened toward one-half height of shell and disappearing toward one-fourth height of shell, with only concentric ornament around umbo. Right valve somewhat flat, anterior auricle well differentiated from disc, covered by 3–4 radial costae; anterior umbonal slope flat, posterior umbonal slope steep; beak pointed and prosogyrate, protruding above hinge margin; surface ornamented with 35–38 radial costae, bifurcated indistinctly, concentric ridge weakly developed.

Type locality.—Hoboksar, Xinjiang, northwestern China.

Type occurrence.—Heishantou Formation, lower Carboniferous.

Repository of type material.—Regional Geological Survey Team of Xinjiang, China; accession number: XBA186 (lectotype); XBA185, 188–191, 471.

Distribution of genus.—lower Carboniferous; Asia and North America (Yang & J. Chen, 1985, p. 382).

Taxonomic position.—Streblochondriidae (by original designation).

Revision suggestion.—Newell and Boyd (1995) did not accept *Xinjiangopecten* as a valid genus. It is herein suggested that

Xinjiangopecten is a junior synonym of *Guizhoupecten* because they do not differ in any important respect.

Note.—Although the lectotype (XBA186) designated by Yang and Chen (1985) is not included in the original figures of Yang (1983), it is included in the original type material, on the basis of which Yang (1983) proposed the genus name *Xinjiangopecten*.

See also.—Yang and Chen, 1985, p. 381 (in Chinese with English description, p. 385) again proposed *Xinjiangopecten* as a new genus.

Genus GUIZHOUPECTEN Chen, 1962, p. 195

[in Chinese with English description, p. 201]

Type species.—*Guizhoupecten wangi* Chen, 1962, p. 196, pl. 1,*7a–b* (holotype), *8a–b*; by original designation.

Type locality.—Ganqiao (Kanchiao), Ziyun, Guizhou (Kueichow), southwestern China.

Type occurrence.—Ganqiao (Kanchiao) Member, Wuchiaping Formation, Wuchiapingian, upper Permian.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 11437 (holotype); 11438.

Distribution of genus.—middle and upper Permian; Laurasia (Newell & Boyd, 1995, p. 57).

Taxonomic position.—Streblochondriinae (by original designation).

Note.—It is unnecessary to give the original diagnosis and figure of the holotype because the genus was included in the *Treatise* by Cox et al., 1969 (p. 338, fig. C62,*2*).

Family EUCHONDRIIDAE Newell, 1938
Genus ENDOCOSTAPECTEN Feng, 1988, p. 634

[in Chinese with English description, p. 636]

Figure 10.38–10.43

Discussion and diagnosis.—Original diagnosis (Feng, 1988, p. 636): shell *Streblochondria*-form, small, opisthocline, subequivalve; hinge line short and straight; left valve more convex than right valve. Surface of shell body smooth or with concentric ridges. Anterior ear larger than posterior one; both left and right anterior ears ornamented with radial and concentric lines, posterior ears triangular. Irregular intercalated costae found on interior surface of shell body. Costae on anterior part of interior surface stronger than those on posterior part in right valve, whereas those on posterior part stronger than those on anterior part in left valve. Impressions formed by a series of narrow quadrated ligament pits and by a triangular resilifer found in ligament area [*sic*].

Type species.—*Junggaroconcha*? *inequicostata* Yang & J. Chen, 1985, p. 383, pl. 3,*4,5* (holotype); by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Feng, 1988, p. 634): Shell circular in outline, small, procrescent, umbo salient above hinge margin. Surface smooth, sometimes with regular or irregular radial costae; right anterior auricle narrow, tumid, extended horizontally or slightly downward, fan shaped, with narrow and deep byssal notch, covered by crowded radial costellae and concentric lines; left anterior auricle depressed, triangular; both posterior auricles small, obtusely triangular. Interior surface ornamented with narrow intercalated costae of uneven density, not originated from umbonal area, well developed at anterior part of right valve and posterior part of left valve, fading away posteriorly in right valve and anteriorly in left valve. Hinge with long, narrow, and triangular median resilifer and a series of transverse resilifers arranged in comblike appearance.

Type locality.—Beishan coal mine, Qitai, Xinjiang, northwestern China.

Type Occurrence.—Shiqiantai Formation, upper Carboniferous.

Repository of type material.—Regional Geological Survey Team of Xinjiang, China; accession number: XBA473 (holotype); XBA474.

Distribution of genus.—Carboniferous; China (Feng, 1988, p. 634).

Taxonomic position.—Euchondriidae (by original designation).

Revision suggestion.—The specimens described by Feng (1988) show only external radial ornament. Feng (1988) did not explain how to distinguish between external and internal costae in his specimens. Regardless, the existence of internal costae cannot yet be distinguished, and the genus name is therefore rejected.

Genus EUCHONDRIOIDES Fang, 1987, p. 380

[in Chinese with English description, p. 405]

Figure 10.26–10.32

Discussion and diagnosis.—Original diagnosis (Fang, 1987, p. 405): prosocline shells with a more or less prominent extension at posteroventral end; hinge margin shorter than shell length; left valve ornamented externally with relatively widely spaced intercalated costae of two or three orders [ranks], which are coarse and strong; right valve only with fine concentric fila; costae obscure and weak on auricles of both valves; interiors of both valves sculptured with intercalated radial ribs; in addition to relatively large median resilifer, series of narrow rectangular and transverse ligament pits occur in front and behind beaks, extending along hinge margin. Internal ribs are the most striking feature, by which it may be distinguished from the comparable *Euchondria* and *Crenipecten*. Furthermore, external costae in this genus coarse and strong, and number of costae less than those in comparable forms. *Parvamussium* Sacco, family Pectinidae, possesses internal ribs also, and differs chiefly from *Euchondrioides* in its hinge structure and general outline [*sic*].

Type species.—*Euchondrioides zhuzhouensis* Fang, 1987, p. 380. pl. 5,*1* (holotype), *2–6;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Fang, 1987, p. 380): Shell medium, suborbicular; both auricles well defined, posterior one larger, with acuminate end. Left valve ornamented externally with relatively widely spaced intercalated costae arranged in 2 or 3 ranks, separated by broad and flat interspaces, disc with about 8 primary costae; right valve only with fine concentric fila; radial ornament of auricles weaker. Interiors of both valves sculptured with intercalated radial costae arranged in 2 ranks, 12–16 in number near ventral margin.

Type locality.—Piaoshajing, Zhuzhou, Hunan, China.

Type occurrence.—Dangchong Formation, lower Maokouan, middle Permian.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 71681 (holotype); 71682–71686.

Distribution of genus.—Permian; South China (Fang, 1987, p. 380).

Taxonomic position.—Euchondriidae (by original designation).

Genus LEPTOLIMA Zhang in Zhang, Wang, & Zhou, 1977, p. 519

[in Chinese]

Figure 10.33–10.34

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 519): shell rather small, obliquely ovate, procrescent, not inflated, subequivalve; umbo situated centrally; anterior part of shell ornamented with radial costae, remainder of shell only with concentric lines; a series of transverse small teeth, both in front and behind umbo, small teeth parallel to each other, perpendicular to hinge margin; median resilifer not well preserved, adductor scars unknown.

Type species.—Leptolima hunanensis Zhang in Zhang, Wang, & Zhou, 1977, p. 520, pl. 197,*23a–b* (holotype) by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 520): Shell rather small, procrescent, obliquely ovate, not inflated; two auricles, neither well differentiated; umbo situated centrally; hinge margin rather long, anterior margin straight and oblique, posterior margin broadly arcuate; anterior part of shell ornamented with 6–7 broad and flat radial costae, with narrow interspaces; remainder of shell only with concentric lines; a series of transverse small teeth both in front and behind umbo, small teeth perpendicular to hinge margin; resilifer not well preserved.

Type locality.—Shamuchong, Linwu, Hunan, China.

Type occurrence.—Dalong (Talung) Formation, upper Permian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: IV55311 (holotype).

Distribution of genus.—upper Permian; Hunan, China (Zhang in Zhang, Wang, & Zhou, 1977, p. 520).

Taxonomic position.—Limidae (by original designation).

Revision suggestion: The only type specimen of *Leptolima hunanensis* Zhang is probably a *Crenipecten,* Euchondriidae, as suggested by Fang (2004b, p. 634), because this species is rather small in size, very like *Crenipecten* in shell outline, and shows a *Euchondria*-type pseudotaxodont hinge without a triangular cardinal area. It is very difficult to find any important differences between *L. hunanensis* and *Crenipecten.*

Superfamily PSEUDOMONOTOIDEA Newell, 1938
Family HUNANOPECTINIDAE Yin, 1985, p. 636

[in Chinese with English discussion on p. 638]

Synonymy.—Same family name proposed by Fang (1981, Master's thesis), which was formally published (Fang, 1987, p. 376, in Chinese with English description, p. 404).

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Yin, 1985, p. 636): retrocrescent to infracrescent pectiniform shells; left valve slightly more inflated than right valve; with distinct byssal notch; auricles not well differentiated from disc exclusive of right anterior auricle, not alate; possibly with narrow ligament area, only one cardinal crura each in front and behind internal resilifer respectively.

Revised diagnosis and discussion.—(Fang, 1987, p. 404): Small, commonly prosocline or nearly acline pectiniform shells; subequivalve, left valve more convex than right; deep byssal notch in right anterior auricle; surface marked with concentric fila or undulations, radial ornament obsolescent; ligament as in *Aviculopecten*, below ligament area, hinge with strong, lamellar isodont teeth, subparallel to the dorsal margin; monomyarian, with posterior adductor only. At present this family is represented by the single genus *Hunanopecten*. Zhang Ren-jie (in Zhang, Wang, & Zhou, 1977, p. 513) introduced *Hunanopecten* as a new genus of Aviculopectinidae with *H. exilis* Zhang as the type species. But all Aviculopectinidae are edentulous, therefore it is necessary to refer *Hunanopecten* to a new family, which is characterized by being subequivalve, both valves sculptured by concentric ornament; ligament as in *Aviculopecten*, but hinge with strong, lamellar isodont teeth. It is probable that *Hunanopecten* was derived from Aviculopectininae [*sic*].

Distribution of family.—Permian; South China (Fang, 1987, p. 376).

Taxonomic position.—Pectinoidea (by Yin's original designation).

Revision suggestion.—Fang (1981 [Master's thesis], 1987, 1989) suggested that the Hunanopectinidae should be placed in Aviculopectinoidea because of its aviculopectinid-type ligament. Newell and Boyd (1995) agreed with Fang's opinion on the nature of its external ligament but placed Hunanopectinidae in their new superfamily Pseudomonotoidea.

Genus HUNANOPECTEN Zhang in Zhang, Wang, & Zhou, 1977, p. 512

[in Chinese]

Figure 12.1–12.7

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 512): shell small to medium, ovate-orbicular, infracrescent or slightly retrocrescent, subequivalve, left valve more inflated than right valve, with deep byssal notch in right valve; surface of both valves including auricles ornamented with commarginal lines. Two lamellar teeth in front of and behind umbo in each valve, dorsal being subparallel to hinge margin, while ventral crosses hinge margin slightly obliquely, triangular resilifer under umbo, adductor scars unknown.

Type species.—Hunanopecten exilis Zhang in Zhang, Wang, & Zhou, 1977, p. 513, pl. 197,*13* (holotype), *14–20*; by original designation.

Original description of type species.—(Translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 512): Shell small, circular, height and length subequal or slightly longer than high; slightly inequivalve, left valve slightly more inflated than right; right valve infracrescent or slightly retrocrescent, left valve retrocrescent; umbo situated centrally, almost not salient above hinge margin; auricles subequal in left valve, not well differentiated from disc; right anterior auricle rather rounded, with deep and wide byssal notch,

width being slightly less than that of anterior auricle; surface of both valves including auricles ornamented with fine commarginal lines, lacking radial lines; two lamellar teeth in front of and behind umbo in each valve, triangular resilifer under umbo.

Type locality.—Duanpiqiao, Shaodong, Hunan, China.

Type occurrence.—Dalong (Talung) Formation, upper Permian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: IV55312 (holotype); IV55313-55316, 55318, 55321, 55323.

Distribution of genus.—upper Permian; South China (Zhang in Zhang, Wang, & Zhou, 1977, p. 512); Maokouan–Changhsingian, Permian; South China.

Taxonomic position.—Aviculopectinidae (by original designation).

Revision suggestion.—Aviculopectinoidea: Hunanopectinidae (Fang, 1989).

See also.—Fang (1987, 1989) for discussion on hinge of *Hunanopecten*.

Family LEPTOCHONDRIIDAE Newell & Boyd, 1995
Genus ORIENTOPECTEN Li, 1995, p. 361

[in Chinese with English description, p. 366]

Discussion and diagnosis.—Original diagnosis (Li, 1995, p. 366): shell small, oval, nearly equilateral, infracrescent or slightly prosocline in outline, higher than long. Dorsal margin short and straight; ears subequal, not clearly defined from main shell body, surface covered with numerous fine, radial costae of two orders; ligament area obtusely trigonal and narrow, provided with large, shuttle-like resilifer [*sic*].

Type species.—Orientopecten gujoensis Li, 1995, p. 361 (=*Leptochondria*? sp. a, Nakazawa & Newell, 1968, p. 73, pl. 6,*4–7*; no holotype has been designated yet); by original designation.

Distribution of genus.—upper Permian; China and Japan (Li, 1995, p. 361).

Taxonomic position.—Aviculopectinidae (by original designation).

Revision suggestion.—The genus name is rejected because the Japanese specimens are considerably deformed (Nakazawa & Newell, 1968, p. 73) and are indistinguishable from *Leptochondria* Bittner (family Leptochondriidae Newell & Boyd, 1995).

Note.—See Nakazawa and Newell (1968, p. 73, pl. 6,*4–7*) for figures and original description of type species.

Superfamily MONOTOIDEA Fischer, 1887
Family MONOTIDAE Fischer, 1887
Genus ZANDAIA Yin & Nie, 1990a, p. 106

[in Chinese with English description, p. 255]

Figure 9.12–9.15

Discussion and diagnosis.—Original diagnosis (Yin & Nie, 1990a, p. 255): left valve highly convex, right valve flat, prosocline, longitudinally ovate; beak at anterior third of shell; anterior narrow and steep, posterior wide and flat. Both auricles on left valve obtuse, anterior one small and posterior larger; no auricular sulcus between auricles and shell, growth lines between them not curved, and therefore, neither have typical auricles. Anterior auricle on right valve elongate with deep byssal notch, upper margin parallel to hinge line and lower margin inclining downward so it opens outward, posterior back shrunken. Left valve ornamented with costae and right valve with costae or smooth. The earliest report on the type was proposed by Bittner (1899), who identified it as *Pseudomonotis (?Avicula) himaica*. It is similar to the present specimens in shape and auricular features. This type was described from the Shal-shal section in the India Himalayan and Kumaun regions. It was associated with *Claraia decidens* and is uppermost Lower Triassic in age. The features, horizon, and locality of the above are identical with those of the present specimens, and therefore, the type should belong to *Zandaia*. Bittner questionably reported it without detailed discussion. Afterward, some authors in China referred it to *Claraia*, and Zhang Zhuoming described it as *Pseudoclaraia.* It is, however, different from both *Claraia* and *Pseudoclaraia,* according to the following characters: anterior auricle of left valve cannot be separated, anterior byssal notch of right valve identical with neither *Claraia* nor *Pseudoclaraia*, being wider with its upper margin parallel to hinge margin and lower margin open; left valve is strongly convex, and mostly has costae. Based on such features as oblique ovate shell, inequivalve, and shrinking auricles, the present genus is similar to genus *Otapiria*. It is, therefore, appropriate to refer it to subfamily Otapirinae (Waterhouse, 1982). The new genus differs from *Eumorphotis* by its shrinking auricles and from *Leptochondria* by its oblique and inequilateral shell [*sic*].

Type species.—Zandaia angusta Yin & Nie, 1990a, p. 106, pl. 31,*2,7,9–10,11* (syntype, left valve; holotype in the original text), *13,14* (syntype, right valve; holotype in the original text),*15,18* (syntypes, paratypes in the original text); by original designation.

Original description of type species.—(Yin & Nie, 1990a, p. 256): Shell longitudinal-ovate, height to width ratio 1.2 to 1.4. Left valve highly convex with convexity being about one-third to one-fourth of width, prosocline; beak of left valve at anterior one third, strongly curved and protruding above hinge margin; hinge margin straight and about two-thirds to three-fourths width; anterior narrow and posterior wide; both auricles on left valve rounded obtusely, anterior auricle very small and posterior auricle rather large, but both without auricular sulcus. Right valve almost flat, its anterior auricle elongate, byssal notch deep and wide; posterior flat and obtuse. Ornamentation: left valve, more than 30 costae spreading from beak and intercalated with secondary costae on adult shell, costae thin with wide intervals, those [costae] on auricles and concentric lines faint. Right valve without costae [*sic*].

Type locality.—Manzhongronggou, Zanda, Xizang (Tibet).

Type occurrence.—Danggongla Formation, upper Lower Triassic.

Repository of type material.—China University of Geosciences, Beijing; syntype accession number: 40406, 40408, 40409, 40414–40419.

Distribution of genus.—upper Lower Triassic; Himalayan region, China (Yin & Nie, 1990a, p. 106).

Taxonomic position.—Aviculopectinidae (by original designation).

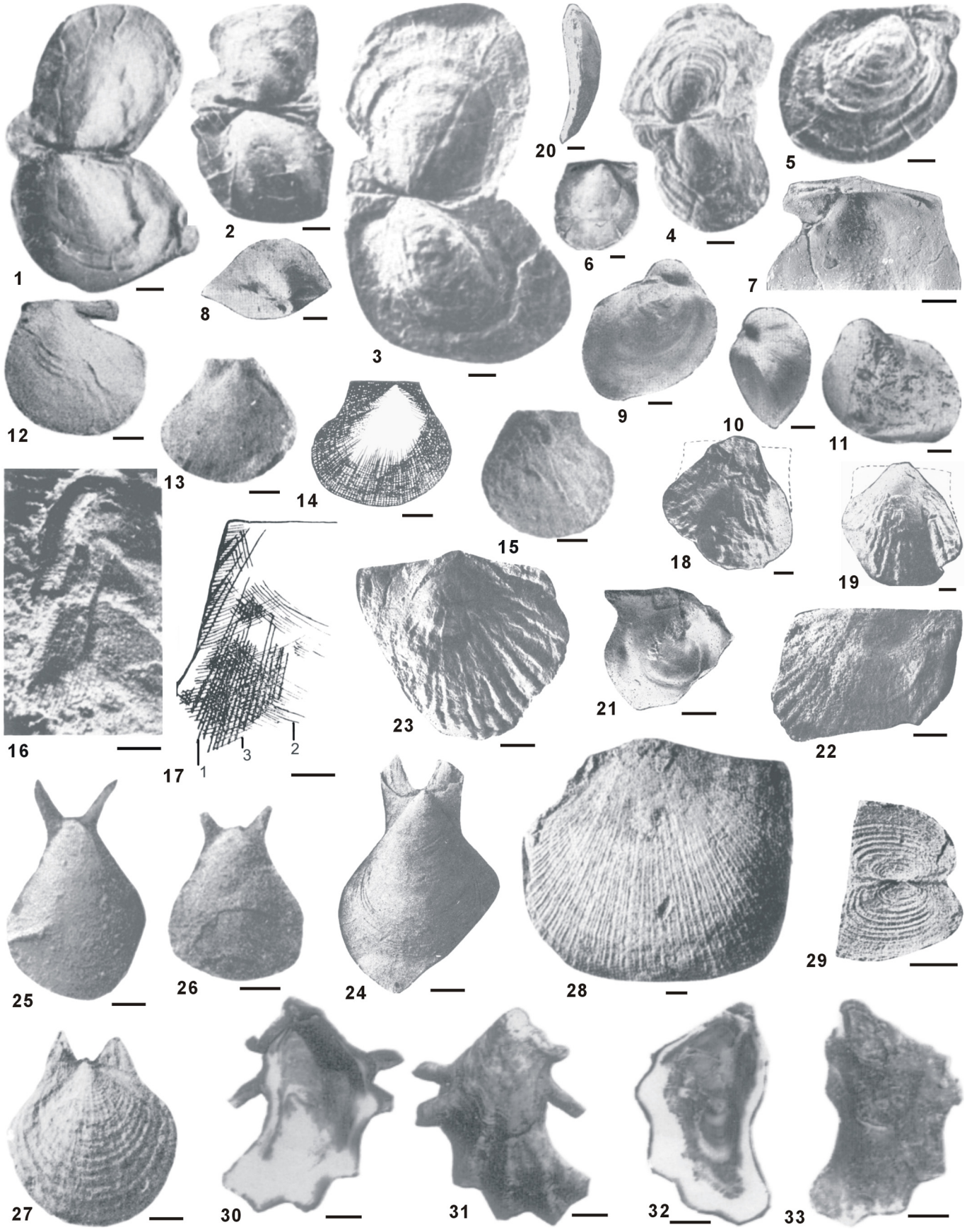

Figure 12. *For explanation, see facing page.*

Revision suggestion.—It is herein suggested that *Zandaia* is a junior synonym of *Praeotapiria* Kurushin, 1985.

Note.—The double holotypes of the type species of this genus violate the Principle of Typification (ICZN, 1999), therefore, both so-called holotypes become syntypes.

Family BUCHIIDAE Cox, 1953
Genus ALLOBUCHIA Yu, 1983, p. 43

[in Chinese with English description, p. 46]

Figure 10.35–10.37

Discussion and diagnosis.—Original diagnosis (Yu, 1983, p. 46): small to medium; acline ovate or linguiform in outline; higher than long; inequivalve; left valve larger than right valve; equilateral. Sculpture of closely arranged radial ridge and irregularly concentric ribs. Left valve moderately convex; posterior wings obscure; umbo sharply rounded, strongly protruded, slightly opisthogyrate, and strongly incurved. Right valve flat with umbo less protruded, posterior auricle not developed; anterior auricle well developed, round and large with concave, tonglike process, byssal notch broadly deep [*sic*].

Type species.—Allobuchia apiculata Yu, 1983, p. 43, pl. 2,*30a–d* (holotype), *31–33;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Yu, 1983, p. 43): Description as for genus; similar to *Otapiria limaeformis* Zakharov (1962, p. 25, pl.,*7–8,11,14*), Lower Jurassic, far eastern Russia, in outline, ornamentation, and convexity, but differs in its small size, subcentral and slightly opisthogyrate umbo, indistinct posterior auricle, and spoonlike and bigger right anterior auricle.

Type locality.—Chaoyangtun, Hulin, Heilongjiang, northeastern China.

Type occurrence.—Yunshan Formation, Lower Cretaceous.

Repository of type material.—Shenyang Institute of Geology and Mineral Resources, Shenyang, Liaoning, northeastern China; accession number: BH1557a (holotype); BH1558a-b, 1559, 1560.

Distribution of genus.—Lower Cretaceous; Heilongjiang, northeastern China.

Taxonomic position.—Buchiidae (by original designation).

Revision suggestion.—Junior synonym of *Aucellina* Prompeckj, as suggested by Gu, Li, and Yu (1997, p. 102).

Genus SICHUANIA
Chen in Gu et al., 1976, p. 151

[in Chinese]

Figure 12.8–12.11

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Chen in Gu et al., 1976, p. 151): shell obliquely ovate, inequivalve, left valve inflated, right valve rather flat, very inequilateral; umbo of left valve inflated, protruding highly over hinge margin and overhanging that of right valve, beak of left valve prosogyrate, with a triangular area under it. Surface covered by irregular and distinct growth wrinkles. Edentulous.

Type species.—Sichuania difformis Chen in Gu et al., 1976, p. 151, pl. 29,*10–11,15–17* (holotype), *12–14;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Chen in Gu et al., 1976, p. 151): Shell obliquely ovate, inequivalve, inequilateral. Umbo anterior in position; left valve inflated, with rounded and raised umbo, beak incurved and slightly prosogyrate, with triangular area under it. Right valve flat, umbo low and small. Hinge margin about as long as two-thirds shell length. Maximum convexity located at median of both valves. Surface ornamented with distinct and irregular commarginal growth wrinkles.

Type locality.—Yidun, Sichuan, southwestern China.

Figure 12. *1–7. Hunanopecten exilis* Zhang, scale bar 2 mm; *1,* holotype, internal mold of conjoined valves; *2–3,* paratype, internal molds of conjoined valves; *4,* paratype, external mold of conjoined valves; *5,* paratype, right composite mold (adapted from Zhang in Zhang, Wang, & Zhou, 1977, pl. 197,*13–15,17,18*); *6,* plesiotype, right internal mold; *7,* latex cast of Fig. 12.6, showing hinge (adapted from Fang, 1989, pl. 1,*11a,11c*).——*8–11.* Holotype of *Sichuania difformis* Chen, scale bar 5 mm; *8,* dorsal view; *9,* right lateral view; *10,* anterior view; *11,* left lateral view (adapted from Chen in Gu et al., 1976, pl. 29,*10,15–17*).——*12–17. Hunanonectes sanduensis* Fang; *12,* holotype, right composite mold, scale bar 5 mm; *13,* paratype, left valve (adapted from Fang, 1978, pl. 1,*7,9a*), scale bar 5 mm; *14,* drawing of Fig. 12.13, showing ornament of left valve; scale bar 5 mm (adapted from Fang, 1978, p. 461, text-fig. 1); *15,* paratype, left external mold, scale bar 5 mm; *16,* posterodorsal part of Fig. 12.15, scale bar 1 mm (adapted from Fang, 1978, pl. 1,*10a,10b*); *17,* diagrammatic drawing of Fig. 12.16, showing network pattern formed by radial costae (1), concentric striae (2), and so-called *Camptonectes* striations (3), scale bar 1 mm (adapted from Fang, 1978, p. 461, text-fig. 2).——*18–23. Newaagia (Latinewaagia) qilianensis* Yin & Yin, scale bar 10 mm; *18,* holotype, right valve; *19–20,* another holotype, articulated shell, left lateral view (*19*) and anterior view (*20*); *21,* paratype, left internal mold; *22,* paratype, right valve; *23,* paratype, left valve (adapted from Yin & Yin, 1983, pl. 20,*1,3a–b,2,5,8*).——*24.* Holotype of *Bupecten cornutus* Guo, scale bar 5 mm; right valve (adapted from Guo, 1988, pl. 6,*1*).——*25–26. Bupecten bulbus* Guo, scale bar 2 mm; *25,* holotype, left valve; *26,* paratype, left valve (adapted from Guo, 1988, pl. 6,*2,3*).——*27.* Holotype of *Bupecten (Linobupecten) reticularis* Guo, scale bar 2 mm; left valve (adapted from Guo, 1985a, pl. 23,*5*).——*28.* Holotype of *Halobia (Enormihalobia) intercalaria* Yin & Gan, scale bar 5 mm; left valve (adapted from Yin & Gan in Gan & Yin, 1978, pl. 118,*14*).——*29.* Holotype of *Parahalobia posidoniiformis* Yin & Hsu, scale bar 5 mm; conjoined valves (adapted from Yin & Hsu in Gu et al., 1976, pl. 39,*7*).——*30–33. Talonostrea tanolata* Li & Qi, scale bar 5 mm; *30–31,* holotype, left interior and left exterior; *32–33,* paratype, right interior and right exterior (adapted from Li & Qi, 1994, pl. 6,*C–D*).

Type occurrence.—Upper Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 24855 (holotype); 24856–24858.

Distribution of genus.—Upper Triassic; western Sichuan and northwestern Yunnan, southwestern China (Chen in Gu et al., 1976, p. 151).

Taxonomic position.—Buchiidae (by original designation).

Family OXYTOMIDAE Ichikawa, 1958
Genus JIANCHUANIA
J. Chen & Chen, 1980, p. 57

[in Chinese with English description, p. 59]

Figure 10.1–10.7

Discussion and diagnosis.—Original diagnosis (J. Chen & Chen, 1980, p. 59): shell small, suborbicular to ovate, acline, *Oxytoma*-like, bialate, strongly inequilateral, inequivalve. Left valve very inflated; umbo incurved and turned forward, rising above the right one and located at anterior part of hinge line; surface and both auricles ornamented predominantly by regular radial costae and weak concentric lines; anterior auricle obtusely triangular, separated from body with feeble groove and weak auricle sulcus; posterior wing pointed. Right valve flattened; umbo not rising over hinge line; surface with few concentric wrinkles; anterior crura present; posterior wing very elongate and spinose. Hinge plane edentulous, narrow, with slightly oblique triangular resilifer at center. Posterior muscle scar large, ovate-orbicular. Pallial line continuously simple; similar to *Pteria* in posterior wing, but differs from the latter in having an acline body, deep byssal notch, and edentulous hinge. Judging from its outline and its internal structure, this new genus undoubtedly belongs to the family Oxytomidae Ichikawa. This genus greatly resembles *Oxytoma* Meek in general outline and in anterior auricle, but differs from latter in having more flattened right valve and more first-order radial costae; differs from *Hypoxytoma* Ichikawa and *Meleagrinella* Whitfield chiefly in auricles. *Hypoxytoma* has a less deep auricular notch and shorter right posterior auricle than *Jianchuania*. The pallial line of *Hypoxytoma* is discontinous, and that of *Jianchuania* is continuous. *Meleagrinella* has no left anterior auricle [*sic*].

Type species.—*Pteria*? *problematica* J. Chen in Ma et al., 1976, p. 287, pl. 28,*1–9,11* (holotype); by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, J. Chen in Ma et al., 1976, p. 287): Shell small to medium, orbicular to ovate *Pteria*-form; inequivalve, infracrescent or nearly so; left valve inflated strongly, greatest convexity under umbo; surface covered by regular radial of two successive ranks; right valve rather flat, with weak concentric lines, without radials; hinge margin long and straight, umbo narrow and incurved, slightly salient above hinge margin, orthogyrate or slightly prosogyrate, situated about one-quarter of shell length back from anterior end; anterior auricle small, obtusely rounded, weakly gibbous, separated from disc by wide and shallow sulcus; byssal notch very shallow, auricular margin joining ventral margin with an arc; posterior auricle large and flat, much elongate, with a spinelike end, especially in right valve.

Type locality.—Jinding, Lanping, Yunnan, southwestern China.

Type occurrence.—Baijizhu Formation, Upper Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 26438 (holotype); 26433–26437, 26439–26442.

Distribution of genus.—Upper Triassic; Asia (J. Chen & Chen, 1980, p. 57).

Taxonomic position.—Oxytomidae (by original designation).

Family PROSPONDYLIDAE Ptchelincev, 1960

[=TERQUEMIIDAE Cox, 1964]

Genus NEWAAGIA Hertlein, 1952
Subgenus NEWAAGIA (LATINEWAAGIA)
Yin & Yin, 1983, p. 159

[in Chinese]

Figure 12.18–12.23, 13

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Yin & Yin, 1983, p. 159): irregular quadrate in outline, attached by umbo of right valve, or not attached in minority of specimens; right valve flat or weakly inflated, left valve convex; both auricles broad, not well differentiated from disc; ligament area rather high, with broadly triangular resilifer; surface covered by spinose radial ornament of *Spondylus*-type, stronger in left valve than in right valve.

Type species.—*Newaagia (Latinewaagia) qilianensis* Yin & Yin, 1983, p. 159, pl. 20,*1* (syntype, right valve, holotype in original text), *2*,*3a–b* (syntype, left valve, holotype in original text), *4–9* (syntypes, paratypes in original text)*;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Yin & Yin, 1983, p. 159): Shell gigantic, irregular quadrate; left valve pectiniform and rather inflated in young stage, surface with fine and crowded multicostate ornament of *Spondylus*-type; its convexity suddenly becoming flat toward end of juvenile stage (some individuals without flattening); sulcus extending from beak to posteroventral angle and becoming wider and deeper along with growing up, dorsally edged with a corresponding swell, also becoming more and more evident toward posteroventral angle; surface sculptured by 10–20 knobby radial plicae on middle and posterior parts, irregularly intercalated in two successive ranks, strongest plicae being in middle part of shell, weaker posteriorly, and anteriorly with fine radial costellae instead; lamellar growth lines developed on anterior, weaker posteriorly; anterior auricle angular, posterior one obtuse, both broad and not well differentiated from disc. Attached by umbo of right valve in young stage, with slightly concave attachment cicatrix, covered with growth lines or occasionally concentric plicae, some specimens without cicatrix; right valve of adult stage covered by radial plicae similar to those in left valve, plicae and interspaces of right valve corresponding to interspaces and plicae of left valve respectively, forming a wavy ventral commissure. Right valve concave or flat, ventral sinus at posterior ventral margin corresponding to concave surface of shell, with a protruding posteroventral part like an ear. Ornament weakening on dorsal part of shell. Ligament area of left valve 5

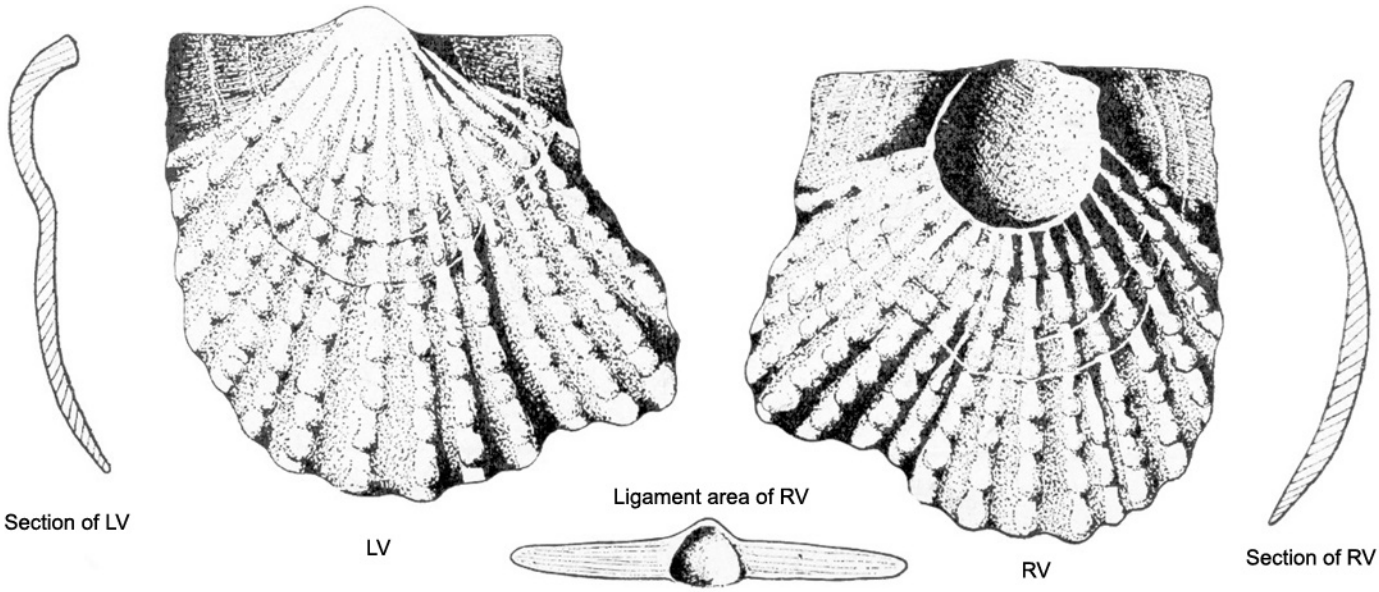

Figure 13. Diagrammatic drawing of *Newaagia (Latinewaagia) qilianensis* (no scale) (adapted from Yin & Yin, 1983, p. 160, text-fig. 4-48).

mm in height, covered by horizontal lines, with a triangular median resilifer, wide (about 10 mm) and shallow; pallial line deep, groovelike; shell about 3 mm thick.

Type locality.—North of Jiabolong, Tianjun, Qinghai, northwestern China.

Type occurrence.—Qierma Member of Junzihe Formation, Anisian, Middle Triassic.

Repository of type material.—China University of Geosciences, Beijing; syntype accession number: Y844 (right valve, holotype in the original text), Y845 (left valve, holotype in original text); Y842, 846, 847, 854, 855(paratypes in original text).

Distribution of subgenus.—Middle Triassic (Yin & Yin, 1983, p. 159).

Taxonomic position.—Terquemiidae (by original designation).

Revision suggestion.—*Latinewaagia* is presently regarded as a junior synonym of *Newaagia* Hertlein, because the two do not have any important differences.

Note.—The double holotypes of the type species of this genus violates the Principle of Typification (ICZN, 1999), therefore, both so-called holotypes become syntypes.

Superfamily HALOBIOIDEA Campbell, 1994
Family HALOBIIDAE Kittl, 1912
Genus PARAHALOBIA
Yin & Hsu in Gu et al., 1976, p. 224

[in Chinese]

Figure 12.29

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Yin & Hsu in Gu et al., 1976, p. 224): shell suboval, equivalve, slightly inequilateral. Beak low, not projecting above hinge margin, situated anteriorly. Surface ornamented with sublamellar concentric ornament, without radial costae. Anterior auricle narrow and distinct, separated from disc by shallow sulcus under auricle.

Type species.—*Parahalobia posidoniiformis* Yin & Hsu in Gu et al., 1976, p. 224, pl. 39,*7;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Gu et al., 1976, p. 224): Hinge margin short and straight, shorter than shell length. Surface covered by sublamellar concentric plicae, about 15 in number, 7 of them at middle part of valve very distinct.

Type locality.—Xiaomaheng, Qiubei Yunnan, southwestern China.

Type occurrence.—Ladinian, Middle Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology.

Distribution of genus.—Middle Triassic–Upper Triassic; southwestern China (Hsu, 1938, p. 113–116).

Taxonomic position.—Halobiidae.

Revision suggestion.—McRoberts (1993) considered *Parahalobia* a junior synonym of *Halobia* Bronn, 1830, but Campbell (1994) relegated *Parahalobia* to a subgenus of *Halobia*.

Note.—The name *Parahalobia* first appeared in Hsu (1938, p. 113) as a manuscript name but without description and figure. Hsu's original manuscript for the systematic study of the Triassic bivalves of South China was lost in the Second World War.

Superfamily PECTINOIDEA Wilkes, 1810
Family PECTINIDAE Wilkes, 1810
Genus COSTAMUSSIUM
Yin & Nie, 1990b, p. 168

[in Chinese with English description, p. 258]

Figure 9.18–9.22

Discussion and diagnosis.—Original diagnosis (Yin & Nie, 1990b, p. 258): bearing inner radial riblets in Pectinidae, riblets stretching almost to ventral margin. Right valve with byssal notch and auricular sulcus; prominent radial ornament (riblets

and ribs) occurring on both shells, increasing by intercalation or nonintercalation on left valve and by bifurcation on right valve. Inner riblets occur on both valves, streching nearly to ventral margin. Shell [shell surface in original text] small, byssal notch clear without opening. Left valve with striae or riblets, increasing by intercalation or nonintercalation. Radial riblets on right valve increasing by bifurcation [*sic*].

Type species.—*Costamussium zandaensis* Yin & Nie, 1990b, p. 168, pl. 34,*15* (syntype, right valve; holotype in original text), *16*,*17* (syntype, left valve; holotype in original text), *18–19*; pl. 35,*11–18* (syntypes, paratypes in original text); by original designation.

Original description of type species.—(Yin & Nie, 1990b, p. 260): Shell small, fan shaped, slightly higher than wide, medium convex, beak at middle and protruding slightly above hinge margin, ~0.7 times width. Anterior, posterior, and ventral margins uniformly arched. Left valve anterior auricle larger and about two times posterior, terminal in an angle of ~70°, with clear byssal sinus; posterior auricles small, at right angles or nearly obtuse angle, both auricles separated from shell by auricular sulcus. Left valve with 15–25 secondary riblets increasing by irregular intercalations. On right valve, ribs obscure at umbo and more than 20 on lower part of shell, being furcated near ventral margin. More than 10 inner radial ribs on inside of shell [*sic*].

Type locality.—Chagagou, Boling, Zanda, Xizang (Tibet).

Type occurrence.—Lower part of Youxiugou Formation, Middle Jurassic.

Repository of type material.—China University of Geosciences, Beijing; syntype accession number: 40477 (right valve; holotype in original text), 40329 (left valve; holotype in text); 40305, 40306-2, 40323, 40324, 40330–40332, 40336, 40473, 40475, 40439, 40476-2, 40479 (paratypes in original text).

Distribution of genus.—Middle Jurassic; Himalayan region, China (Yin & Nie, 1990b, p. 168).

Taxonomic position.—Pectinidae (by original designation).

Revision suggestion.—The genus name is rejected because the so-called inner radial ribs are in fact radial plicae. *Costamussium* probably is a junior synonym of the subgenus *Chlamys (Lyriochlamys)* Sobetski.

Note.—The double holotypes of the type species of this genus violate the Principle of Typification (ICZN, 1999), therefore, both so-called holotypes become syntypes.

Genus HUNANONECTES Fang, 1978, p. 461

[in Chinese with English description, p. 465]

Figure 12.12–12.17

Discussion and diagnosis.—Original diagnosis (Fang, 1978, p. 465): shell thin, nearly equivalve; left valve slightly more convex than right; opisthocline to prosocline, umbo small, sharp, and not rising above hinge line. Shell suborbicular or elliptical in outline; inequilateral, inclined to expand to anterior area; hinge margin nearly straight, slightly depressed in front of beak; auricles clearly defined, very unequal; posterior auricle (of both valves) narrow, trigonal, obtusely truncated at extremity, well defined from shell body by shallow groove; right anterior auricle protruded, linguiform, gradually widening toward anterior, separated from shell body by a deep auricular sulcus; byssal notch wide and profound; left anterior auricle triangular, large, forming an obtuse or acute angle with hinge margin owing to oblique shell body. Shell surface (except for right posterior auricle) ornamented by fine, closely spaced, concentric striae, radial costae and faint, flabellate, and punctate so-called *Camptonectes* striations, all interlaced to form delicate network pattern. Radial costae 80–90 near ventral margin, about 4 on right anterior auricle, but unseen on right posterior auricle. Radial costae more developed on left valve than on right, where only faint radial traces are visible. New subgenus should be grouped, in a broad sense, into the genus *Camptonectes* due to its flabellate outline, larger byssal notch, and so-called *Camptonectes* striations. On the basis of the surface ornamentation, Cox (1952) divided this genus into the following three groups: (1) lens group (*Camptonectes s.s.*): provided with fine flabellate, often punctate *Camptonectes* striations; (2) annulatus group: having erect concentric laminae at more or less regular intervals; (3) intertextus group (*Camptochlamys* Arkell): having lattice ornamentation. Accordingly, Hertlein (1969) referred the following three subgenera to *Camptonectes* (*s.l.*): *Camptonectes* (*s.s.*), *Boreionectes,* and *Camptochlamys*. Hayami (1957) put forward the fourth group for *Camptonectes* (*s.l.*), at least subgenerically, which is characterized by lacking entirely *Camptonectes* striations or any striking radial or concentric costae, by flabellate outline, and by being somewhat larger in length than height. Judging from its peculiar delicate network pattern and dissimilar ornamentations on the two valves, the subgenus is quite distinct from the above-mentioned four groups and all described genera of Pectinidae. It is worth notice that both *Camptonectes* striations and radial costae coexist in this subgenus. Therefore, in a certain sense, *Hunanonectes* may be a bridge between *Chlamys* and *Camptonectes.* If the *Camptonectes* striations are ignored, this subgenus may be easily refered to *Chlamys* [*sic*].

Type species.—*Hunanonectes sanduensis* Fang, 1978, p. 462, pl. 1,*7* (holotype), *8–13*; text-fig. 1–2; by original designation.

Original description of type species.—(Translation from Chinese text, Fang, 1978, p. 462): Shell elliptical, exclusive of auricles, inequilateral, procrescent, with expanded anterior part; longer than high; posterodorsal margin nearly straight, anterodorsal margin slightly concave, posterior and ventral margins and anterior margin convex; anterior margin of left anterior auricle joining hinge margin with an obtuse angle; umbonal angle ~110°; other characters as for genus.

Type locality.—Xintianmen, Yizhang, Hunan, China.

Type occurrence.—Xintianmen Formation, Lower Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology (shifted from Coal-Geology Exploring Company of Hunan in 1982, under the accession number 73616–73651; among them, 73630 is holotype.).

Distribution of genus.—Lower Jurassic; Guangdong and Hunan, China (Fang, 1978, p. 462).

Taxonomic position.—Pectinidae (by original designation).

Note.—All three species of *Hunanonectes* (*H. sanduensis, H. parachlamys,* and *H. yizhangensis)* should be regarded as conspecific because they show continuous variation.

Genus HALOBIA Bronn, 1830
Subgenus HALOBIA (ENORMIHALOBIA) Yin & Gan in Gan & Yin, 1978, p. 352

[in Chinese]

Figure 12.28

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Yin & Gan in Gan & Yin, 1978, p. 352): as *Halobia*, subcircular to rounded-quadrilateral in outline. Shell thin and flat, with anterior auricle. Surface ornamented with radial plicae. Subgenus has two characteristics: (1) radial plicae increasing by intercalation as in those of *Monotis*, with narrow plicae and wide interspaces, whereas radial plicae of *Halobia* increasing by bifurcation, with wide plicae and narrow interspaces; (2) anterior auricle remarkably shrinking back from anterior margin, with posteriorly concave growth lines to form byssal notch as pectinids, whereas anterior auricle of *Halobia* without or with only slight shrinking back from anterior margin.

Type species.—*Halobia (Enormihalobia) intercalaria* Yin & Gan in Gan & Yin, 1978, p. 353, pl. 118,*14* (holotype) by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Yin & Gan in Gan & Yin, 1978, p. 353): Shell very large, thin, and flat, rather inflated, rounded square in outline; beak situated slightly anterior of center; anterior auricle rather broad, shrinking greatly back from anterior margin, with distinct byssal sinus and auricle sulcus. Posterior hinge margin subparallel to ventral margin, and anterior margin subparallel to posterior margin. Surface ornamented with radial plicae and irregular, low, and broad concentric pleats; plicae narrow, edgelike, separated by rather broad interspaces, increasing by irregular intercalation; radial ornament denser in anterior part than in posterior part, attaining 11 every 10 mm in anterior and 8 every 10 mm in posterior respectively near ventral margin; anterior auricle mainly covered by growth lines.

Type locality.—Erqiao, Guiyang, Guizhou (Kueichow), southwestern China.

Type occurrence.—Sanqiao Formation, Upper Triassic.

Repository of type material.—Regional Geological Survey Team of Guizhou Province, China; accession number: GL060 (holotype).

Distribution of subgenus.—lower Upper Triassic; Guizhou, southwestern China (Yin & Gan in Gan & Yin, 1978, p. 353).

Taxonomic position.—Posidoniidae (by original designation).

Revision suggestion.—The only type specimen is probably a pectinid rather than a halobiid, because of its general outline, intercalated radial ornament, and pectinid-like auricles. Tentatively suggested herein as a junior synonym of *Antijanira* Bittner.

Genus PERICLARAIA Li & Ding, 1981, p. 327

[in Chinese with English description, p. 330]

[*emend.* J. Chen & Komatsu, 2002, p. 438 (in Chinese with English description, p. 442)]

Figure 10.23–10.24, 14

Discussion and diagnosis.—Original diagnosis (Li & Ding, 1981, p. 330): shell small, thin; rounded or subrounded in outline; acline

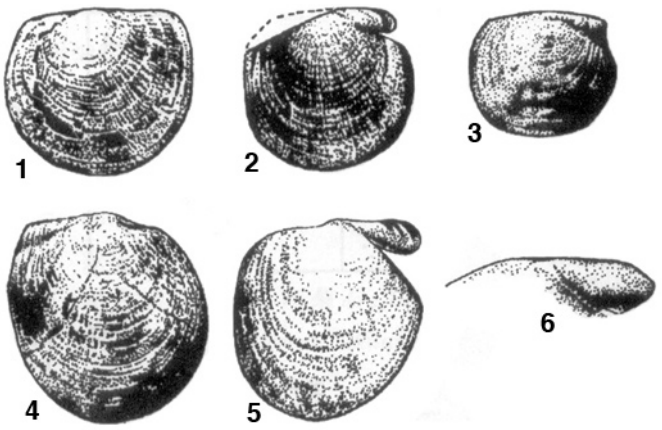

Figure 14. Chen and Komatsu's drawing of some of Li and Ding's type specimens of *Periclaraia circularis* Li & Ding, no scale; *1,* left valve, plesiotype; *2,* right valve, plesiotype; *3,* right valve, paratype (based on Li & Ding, 1981, pl. 1,*21–22,11*); *4,* left valve, plesiotype (based on Li et al., 1982, pl. 8,*13*); *5,* right valve, plesiotype (based on Li & Ding, 1981, pl. 1,20); *6,* right anterior auricle, showing ctanodium; plesiotype (based on Li & Lan, 1982, pl. 8,*9*) (adapted from Chen & Komatsu, 2002, p. 438, text-fig. 2).

or prosocline; hinge line long and straight, inequivalve, left valve rather convex, anterior ear small and defined, forming an arch; sulcus defined; posterior one undefined; right valve flattened, anterior ear large, triangular or oblong, with deep and narrow byssal notch below right anterior ear; ctenolium present, posterior ear undefined; shell surface ornamented by fine and angular concentric lines or radial costae [*sic*].

Revised diagnosis of genus.—(J. Chen & Komatsu, 2002, p. 442): Shell pectiniid, small to medium size, shell wall relatively thick; inequivalve, oval to subquadrate; smooth to weakly costellate; left valve moderately to strongly inflated, right valve flat to gently convex; right anterior ear variably developed with deep subauricular notch; left ear poorly differentiated; ctenolium present [*sic*].

Type species.—*Periclaraia circularis* Li & Ding, 1981, p. 327, pl. 1,*11–16,17* (holotype), *18*; by original designation.

Original description of type species.—(Translation from Chinese text, Li & Ding, 1981, p. 327): Shell small, subcircular, slightly retrocrescent; hinge margin long and straight, subequal to shell length; umbo broad, situated just anterior of center of hinge margin, slightly protruding above hinge margin; right valve flat, anterior auricle well developed, rectangular, with deep, narrow, and long byssal notch, obliquely extending to beak, ctenolium present, posterior auricle indistinct; left valve slightly inflated, anterior auricle defined, archlike, separated from disc by distinct sulcus, posterior auricle not well developed; surface with fine concentric lines.

Type locality.—Majiashan Chaoxian Anhui, eastern China.

Type occurrence.—Third Member, Qinglong Formation, ?uppermost Lower Triassic.

Repository of type material.—Nanjing Institute of Geology and Mineral Resources, Nanjing; accession number: H1234 (holotype); H1226, 1227, 1231, 1236–1238, 1240.

Distribution of genus.—upper Lower Triassic; Anhui, eastern China (Li & Ding, 1981, p. 327); recently, J. Chen and Komatsu (2002, p. 439) reported *Periclaraia* as ranging from the end of ?Lower Triassic to Anisian, Middle Triassic based on faunal correlation.

Taxonomic position: Pectinidae (by original designation).

Revision suggestion.—Li and Ding (1981) distinguished the three species *Periclaraia circularis* Li & Ding, 1981, *P. reticulata* Li & Ding, 1981 (pl. 1,*21–22*), and *P. chaoxianensis* Li & Ding, 1981 (pl. 1,*19–20*), but J. Chen and Komatsu (2002) regarded them as conspecific.

Family ENTOLIIDAE Teppner, 1922
Genus BUPECTEN
Guo, 1988, p. 118

[in Chinese]

Figure 12.24

Discussion and diagnosis.—Original diagnosis (Guo, 1985a, p. 266): shell subcircular, subovate, equilateral, nearly equally convex in 2 valves, symmetrical in 2 sides of front and rear, with straight and short hinge margin, having 2 oxhorn-shaped auricles protruding high above hinge axis and defined by sulci from rest of shell. Auricles on left valve wider and higher than those on right. Umbo nearly situated at median, extending slightly above hinge margin. Surface covered with concentric growth lines. Ligament area narrow; resilifer subtrigonal. *Bupecten* differs from *Entolium* in 2 accuminated and high, shooting [projecting] auricles, which are at least 2 times as high as those of *Pernopecten* [*sic*].

Type species.—Bupecten cornutus Guo, 1988, p. 118, pl. 6,*1* (holotype); text-fig. 3a; by original designation.

Original description of type species.—(Translation from Chinese text, Guo, 1988, p. 118): Shell subcircular, subovate, infracrescent, equilateral and symmetrical. Auricles well differentiated from disc by umbonal sulci, protruding high over hinge margin like a pair of ox horns. Auricles on left valve wider and higher than those on right, width at base nearly half that of hinge margin; auricles on right valve narrower, width only half that of left valve. Umbo slightly pointed, situated centrally, salient slightly above hinge margin, umbonal angle nearly at 90°. Surface nearly smooth, with growth lines only. Ligament area narrow; resilifer subtrigonal.

Type locality.—Dongguachong, Qiubei, Yunnan, southwestern China.

Type occurrence.—Falang Formation, Ladinian, Middle Triassic–lower Carnian, lower Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0699 (holotype); accession numbers for *Bupecten bulbus* Guo: IVy0700, 0701.

Distribution of genus.—upper Middle and lower Upper Triassic; Asia and Europe (Guo, 1988, p. 118).

Taxonomic position.—Entoliidae (by original designation).

Revision suggestion.—The so-called oxhornlike auricles seem to be artificially processed and polished up. It is presently suggested that *Bupecten* is a junior synonym of *Entolium* Meek.

Note.—Bupecten first appeared as a manuscript genus name in Guo (1985a, p. 159, with English description, p. 266); *Bupecten cornutus* Guo was designated as type species, which was not available in 1985 as a manuscript species name. However, Guo (1985a) named, described, and figured one new subgenus *Bupecten (Linobupecten)* Guo and one new species *B. (L.) reticularis* Guo under the name *Bupecten* Guo. Guo (1988) made *Bupecten* available with description of type species *Bupecten cornutus* Guo. According to Article 23 of the ICZN, *Linobupecten* Guo, 1985a should be the earliest valid genus name between them, thus *Bupecten* becomes a subgenus of *Linobupecten* Guo, 1985a. If *Linobupecten* Guo, 1985a, and *Bupecten* Guo, 1988, are regarded as congeneric, *Linobupecten* has priority. In addition, there is no right valve available in Guo's type material of *Bupecten cornutus* Guo, though Guo described the character of auricles of right valve. But another species *Bupecten bubulus* Guo (Fig. 12.25–12.26 in Guo, 1988, p. 118, pl. 6,*2*,*3*) has only right valves.

Subgenus BUPECTEN (LINOBUPECTEN) Guo, 1985a, p. 159

[in Chinese with English description, p. 267]

Figure 12.27

Discussion and diagnosis.—Original diagnosis of subgenus (Guo, 1985a, p. 267): shell subcircular, equilateral, symmetrical in 2 sides of front and rear. Umbo nearly located at median; beak extended slightly above hinge margin. 2 ears protruding high above hinge axis like 2 ox horns. Surface covered with concentric costae and radial ribs to form netting ornamentation. Differs from *Bupecten s.s.* in netting [netlike] ornamentation and relatively low auricles [*sic*].

Type species.—Bupecten (Linobupecten) reticularis Guo, 1985a, p. 160, pl. 23,*5* (holotype) by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1985a, p. 160): Shell subcircular, height and length subequal exclusive of auricles; infracrescent, equilateral; weakly inflated. Umbo small and narrow, situated centrally; beak salient slightly above hinge margin. Auricles of left valve form equilateral triangle, depressed, protruding high over hinge margin like a pair of ox horns. Front and rear parts of disc with two sulci respectively, obliquely extending to antero- and posteroventral margins respectively from umbo; upper pair of sulci shallower, bounding auricles and disc; lower pair of sulci slightly deeper. Surface covered with rounded concentric ridges and radial costae, ridges becoming broader and stronger toward ventral margin; costae subrounded, distinct near umbonal area, but becoming weaker toward ventral margin; crossing of costae and ridges produces a reticulated ornamentation.

Type locality.—Dehua, Pu'er, Yunnan, southwestern China.

Type occurrence.—Taozishu Formation, Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0287 (holotype).

Distribution of subgenus.—Upper Triassic; Yunnan, southwestern China (Guo, 1985a, p. 160).

Taxonomic position.—Entoliidae (by original designation).

Revision suggestion.—Linobupecten is presently regarded as a junior synonym of *Entolioides*. As mentioned above, *Linobupecten* Guo, 1985a has priority as a valid genus name over *Bupecten* Guo, 1988.

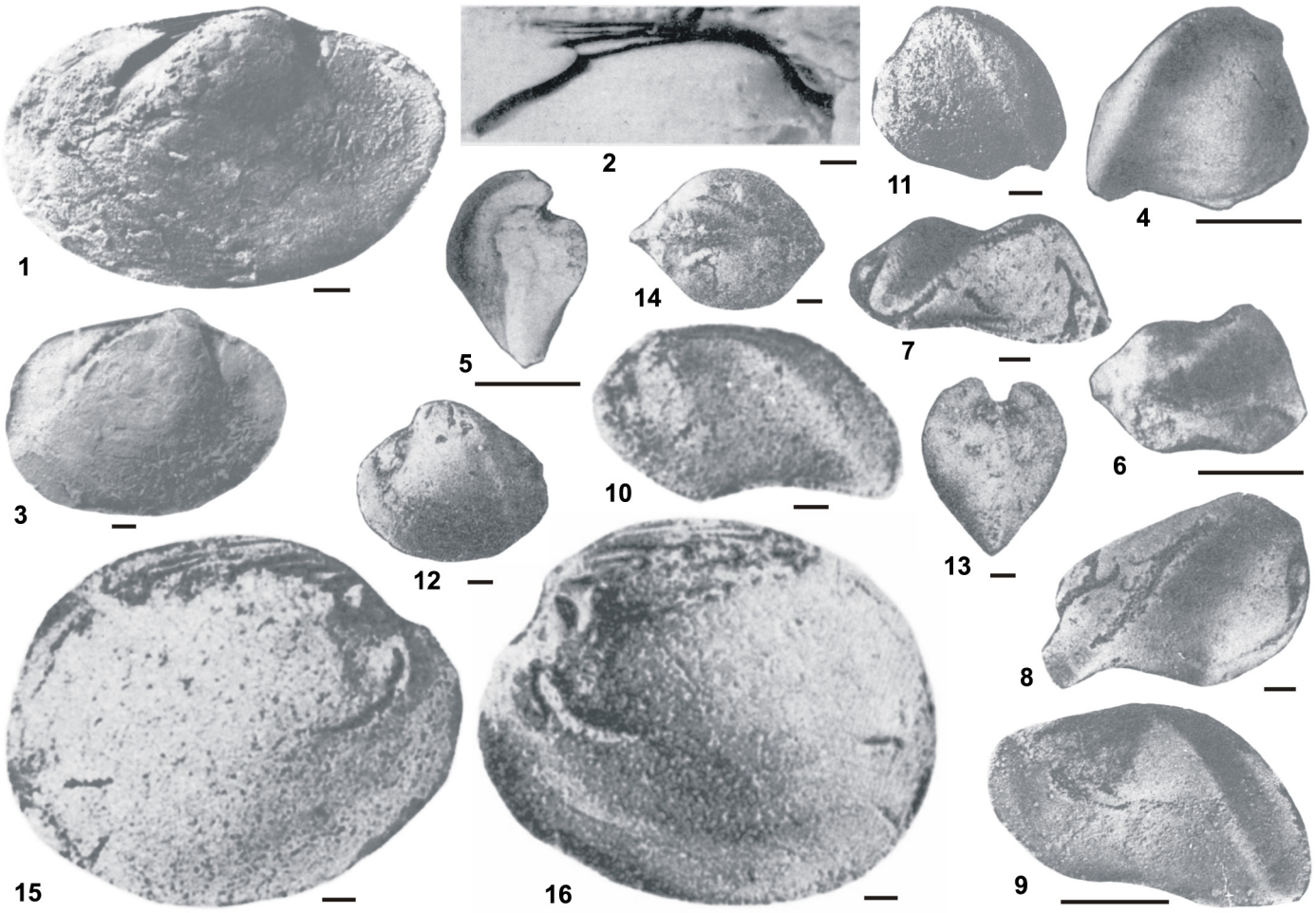

Figure 15. *1–3. Taselasmodum deccusatum* Guo; *1–2,* holotype, right internal mold, scale bar 10 mm; *1,* right lateral view; *2,* enlarged hinge of Fig. 15.1, scale bar 5 mm; *3,* paratype, right internal mold, scale bar 5 mm (adapted from Guo, 1985a, pl. 1,*1a,1b,2*).——*4–10. Baidiostraca aberrans* Guo; *4–6,* holotype, internal mold of articulated shell, scale bar 10 mm; *4,* right lateral view; *5,* anterior view; *6,* dorsal view; *7-8,* paratype, internal mold of right valve, scale bar 2 mm; *7,* dorsal view; *8,* right lateral view; *9,* paratype, left internal mold, scale bar 10 mm; *10,* paratype, left internal mold, scale bar 1 mm (adapted from Guo, 1988, pl. 1,*1b–c,1e,4a–b,5–6*).——*11–14. Mangbuina prima* Guo, scale bar 10 mm; *11,* holotype, left internal mold; *12–14,* paratype, an articulated shell core; *12,* left lateral view; *13,* anterior view; *14,* dorsal view (adapted from Guo, 1988, pl. 1,*7,8a–c*).——*15–16.* Holotype of *Zadimerodia fastigiata* Guo, scale bar 2 mm; *15,* right internal mold; *16,* latex cast of Fig. 15.15 (adapted from Guo, 1988, pl. 2,*3a,3b*).

Superorder HETEROCONCHIA Hertwig, 1895
Order ACTINODONTOIDA Douvillé, 1912
Superfamily CYCLOCONCHOIDEA Ulrich, 1894
Family CYCLOCONCHIDAE Ulrich, 1894
Genus BAIDIOSTRACA Guo, 1988, p. 126

[in Chinese]

Figure 15.4–15.10

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1988, p. 126): shell medium, subtriangular in outline, moderately inflated, inequivalve, inequilateral; evident posteroventral angle; anterior margin rounded, posterodorsal and posteroventral margins arcuate; umbo broadly rounded, gibbose, located near anterior, with prosogyrate and slightly incurved beak; anterior umbonal carina widely rounded, becoming obscure near ventral margin; posterior umbonal carina very strong, tall, and erect, running from umbo to posteroventral angle; flank between them low lying (i.e., median sulcus), with a corresponding ventral sinus at ventral margin. Right valve strongly inflated, with gibbose and salient umbo rising above hinge margin and subdued umbo of left valve. Anterior tooth (3a) of right valve small, tubercular, posterior tooth (3b) lamellar; anterior tooth (4a) and center tooth (2) of left valve small, tubercular, posterior tooth (4b) long. Anterior adductor scar slightly deeper, with narrow and short myophoric buttress [a conjecture]; posterior one not well defined.

Type species.—Baidiostraca aberrans Guo, 1988, p. 127, pl. 1,*1* (holotype), *2–6;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1988, p. 127): Shell subtriangular in outline, inflated, inequivalve, inequilateral; anterior margin subrounded, posterodorsal and posterior margins broadly rounded; umbo large, rounded, and gibbose, located at approximately anterior quarter of valve, with prosogyrate and slightly incurved beak; anterior umbonal carina widely rounded, becoming obscure toward posterobasal end; posterior umbonal carina very strong, tall, and erect, running from umbo to posteroventral extremity; median sulcus between them wide and shallow, with corresponding ventral sinus at ventral margin. Right valve large, more inflated, with gibbose and salient umbo rising above subdued umbo of left valve; right anterior tooth small, tubercular, right posterior tooth long, slender, and oblique; left anterior and center teeth weak, tubercular, posterior tooth long and oblique. Anterior adductor scar subcircular, slightly deeper, with narrow and short myophoric buttress; posterior one large, poorly defined.

Type locality.—Hanpoling, Zhenqiong, eastern Yunnan, southwestern China.

Type occurrence.—Hongshiya Formation, Floian, Lower Ordovician.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0645 (holotype); IVy0646–0650.

Distribution of genus.—Lower Ordovician; eastern Yunnan, southwestern China (Guo, 1988, p. 126).

Taxonomic position.—Myophoriidae (by original designation).

Revision suggestion.—According to Fang (personal observation, November 2005), *Baidiostraca* should be included in Cycloconchoidea because it has a much reduced actinodont dentition similar to Redoniidae, rather than a myophorid dentition as Guo (1988) described. Its dentition differs from all actinodonts hitherto described, and moreover, its strongly inequivalved nature is unusual among cycloconchoids. The development of strong posterior and anterior umbonal carinae and the low-lying median sulcus is also a peculiar character for cycloconchoids. Fang and Cope (2008) proposed a new family for this unusual genus, which has close affinity with Redoniidae and which may be derived from the latter.

Genus MANGBUINA
Guo, 1988, p. 120
[in Chinese]

Figure 15.11–15.14

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1988, p. 120): shell subtriangular in outline, equivalve, subequilateral. Anterior margin rounded, posterodorsal and posterior margins broadly rounded, with evident posteroventral angle. Umbo large, rounded, and gibbose, situated anterior of center of hinge margin, with prosogyrate and slightly incurved beak. Umbonal carina well developed, strong, running from umbo to posteroventral extremity, bounded anteriorly by wide trough, with a corresponding ventral sinus at ventral margin; surface smooth apart from faint growth lines; posterior actinodont teeth long and slender, anterior teeth unknown; anterior adductor scar subcircular, deeper, posterior one poorly defined.

Revised diagnosis of genus.—(Fang & Cope, 2008, p. 298): Equivalved prosogyrate subtriangular cycloconchid, subequilateral, with evident posterior umbonal carina. Dentition consists of subumbonal teeth and three slender posterior lamellar teeth radiating out from beneath umbo; lacking anterior teeth [*sic*].

Type species.—Mangbuina prima Guo, 1988, p. 120, pl. 1,*7* (holotype), *8–11*); text-figs. 4a–b by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1988, p. 120): Shell subtriangular in outline, anterior margin rounded, posterodorsal and posterior margins broadly rounded, with rectangular posteroventral extremity; umbo large, rounded, and gibbose, situated anterior of center of hinge margin, with prosogyrate and slightly incurved beak; umbonal carina well developed, strong, running from umbo to posteroventral extremity, bounded anteriorly by wide and shallow trough, with corresponding ventral sinus at ventral margin; surface smooth apart from faint growth lines; posterior part of hinge consisting of 4 or 5 actinodont teeth, long and slender; anterior adductor scar subcircular, deeper, with an embryonic myophoric buttress at its posterior; posterior scar poorly defined.

Type locality.—Mangbu, Zhenqiong, East Yunnan, southwestern China.

Type occurrence.—Hongshiya Formation, Floian, Lower Ordovician.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0651 (holotype); IVy0652–0655.

Distribution of genus.—Lower Ordovician; eastern Yunnan, southwestern China (Guo, 1988, p. 120).

Taxonomic position.—Cycloconchoidea: Zadimerodiidae (by original designation).

Revision suggestion.—Cycloconchidae (Fang and Cope, 2004); genus distinguished from other cycloconchids in having reduced actinodont dentition, without anterior teeth, coupled with a peculiar, trigonally suboval shell. Guo (1988, p. 121, text-fig. 4b) described four or five posterior teeth in the type species *M. prima* Guo, but reexamination of the type material confirms only three posterior lamellar teeth and the existence of subumbonal teeth. Unfortunately, the incurved umbo obscures the true nature of the subumbonal teeth.

Genus TASELASMODUM
Guo, 1985a, p. 172
[in Chinese]

[*emend.* Fang & Cope, 2004, p. 1141 (in English)]

Figure 15.1–15.3

Homonymy.—non Taselasmodum Guo, 1988, p. 119.

Discussion and diagnosis.—Original diagnosis (Fang & Cope, 2004, p. 1141, translation from Chinese text, Guo, 1985a, p. 172): shell of medium size, suboval or elliptical in outline; inequilateral, equivalve. Anterior part of shell shorter and narrower than posterior. Umbo situated near center or anterior of valve. Hinge plate with teeth ventrally radiating from beneath umbo. Two anterior cardinal teeth in each valve, short and lamellar, slightly opisthocline. Posterior teeth long and lamellar, one extending

toward posteroventral part of valve and becoming stronger, so it looks like a septum [*sic*].

Revised diagnosis of genus.—(Fang & Cope, 2004, p. 1141): Elliptical prosogyrate actinodont with two lamellar posterior and two short anterior teeth in each valve. Anterior and posterior internal ridges fused with anterior and posterior myophoric buttresses respectively and join beneath umbo. A large posterior possible pedal retractor is attached tightly to posterior end of hinge plate very close behind posterior lamellar teeth [*sic*].

Type species.—*Taselasmodum deccusatum* Guo, 1985a, p. 172, pl. 1,*1* (holotype), *2* (by subsequent designation of Fang & Cope, 2004, p. 1141) [*non Taselasmodum septatum* Guo, *sp. nov.* in Guo, 1988, p. 120, pl. 2,*1*,*2* (holotype), by original designation in Guo, 1985a and later designation in Guo, 1988; but according to Article 69.3 of the ICZN (1999), Guo's designations are invalid.]

Original description of type species.—(Translation from Chinese text, Guo, 1985a, p. 172): Elongate elliptical shell outline, with height-length ratio of 0.66; anterior part of shell is narrower than posterior, anterior margin subcircular, posterior margin rounded; dorsal and ventral margins broadly arcuate; umbo wide, only slightly salient above hinge margin, situated just anterior of center on hinge margin; posterior umbonal carina widely rounded, not well definded, disappearing toward posteroventral. Two cardinal teeth anterior of umbo in each valve, short, strong, and lamellar, slightly opisthocline; five posterior teeth, long and lamellar, radiating from umbo toward posterior, one extending toward posteroventral part of valve and becoming stronger, so looks like a septum. Anterior adductor scar slightly deeper, with a myophoric buttress at posterior; posterior one larger and shallower.

Type locality.—Songlinzhai, Weixin, Yunnan, southwestern China.

Type occurrence.—Meitan Formation, Floian, Lower Ordovician to upper Arenig, Middle Ordovician.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0656 (holotype); IVy0657.

Distribution of genus.—Lower Ordovician–Middle Ordovician; Yunnan, southwestern China (Guo, 1985a, p. 172).

Taxonomic position.—Cycloconchoidea: Zadimerodiidae (by original designation).

Revision suggestion.—Cycloconchidae (Fang & Cope, 2004). Fang and Cope (2008) proposed a new subfamily Taselasmodinae within Cycloconchidae to accommodate *Taselasmodum* Guo, 1985a, and *Zhenxiongella* Fang and Cope, 2008, which differ from other cycloconchids in their possession of anterior and posterior internal septa, especially in their very strong and posteroventrally extended posterior internal septum. In addition, development of a rather large pedal retractor scar at the posterior of hinge plate is a unique character among cycloconchoids.

Note.—Guo (1985a, p. 172) proposed *Taselasmodum* and designated it as a manuscript name; he further named the manuscript species *Taselasmodum septatum* as the type species. According to the ICZN Code (1999), both of these names are *nomina nuda* because descriptions and figures of the species and genus were not been published. In the same work Guo (1985a, p. 172–173, pl. 1,*1–2*) described and figured a new species that he named *Taselasmodum decussatum*. Because this is a valid description and figure, Fang and Cope (2004) interpret this as validating *Taselasmodum* Guo, 1985a, with *T. decussatum* Guo, 1985a, as the type species by monotypy.

Family NYASSIDAE Hall, 1885

[=Tanaodontidae Liu in Gu et al., 1976, p. 30; Zadimerodiidae Guo, 1988, p. 119]

Genus ZADIMERODIA Guo, 1988, p. 119

[in Chinese]

Figure 15.15–15.16

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1988, p. 119): shell subcircular in outline, inequilateral, moderately inflated; shell shorter anteriorly, with rounded anterior margin; shell longer posteriorly, with rounded posterior margin; dorsal and ventral margins broadly arcuate; umbo low, rounded, located about one-fourth from anterior end; teeth with radial arrangement from umbo, two subtrigonal anterior cardinal teeth in each valve; posterior teeth lamellar, long, subparallel to posterior hinge margin; anterior adductor scar well defined, subcircular, with a myophoric buttress at posterior; posterior scar poorly defined.

Revised diagnosis of genus.—(Fang & Cope, 2008, p. 305): Subcircular prosogyrate actinodont with two subumbonal teeth and five to six elongate lamellar posterior teeth mounted on a continuous and stout hinge plate [*sic*].

Type species.—*Zadimerodia fastigiata* Guo, 1988, p. 119, pl. 2,*3a–b* (holotype) by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1988, p. 119): Shell subcircular in outline; shell shorter anteriorly, with rounded anterior margin; shell longer posteriorly, with rounded posterior margin; dorsal and ventral margins broadly arcuated; umbo low, slightly directed forward, located at approximately anterior quarter of valve; hinge consisting of two cardinal teeth in each valve below umbo, those in right valve stronger, subtrigonal; anterior one bigger and stronger than posterior one in left valve, and corresponding socket located between two cardinal teeth of right valve; posterior teeth number 5 or 6, radial from umbo, lamellar and long, subparallel to posterior hinge margin; anterior adductor scar well defined, deep, with a myophoric buttress at its posterior; posterior scar poorly defined.

Type locality.—Hanpoling, Zhenqiong, Yunnan, southwestern China.

Type occurrence.—Hongshiya Formation, Floian, Lower Ordovician.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0658 (holotype).

Distribution of genus.—Lower Ordovician; eastern Yunnan, southwestern China (Guo, 1988, p. 119).

Taxonomic position.—Cycloconchoidea: Zadimerodiidae (by original designation).

Revision suggestion.—*Zadimerodia* is similar to *Copidens* Pojeta & Gilbert-Tomlinson, differing only in details of hinge teeth

according to personal observation by Fang (November 2005) of Guo's type material deposited in The Geological Museum of China, Beijing. Fang (2006) relegated *Zadimerodia* to a subgenus of *Copidens* Pojeta and Gilbert-Tomlinson. However, the teeth of *Copidens* are not divisible into pseudocardinal and pseudolateral elements, whereas two subtrigonal subumbonal teeth are recognizable under the umbo in *Zadimerodia*. In addition, *Zadimerodia* is anisomyarian, whereas two adductors are subequal in *Copidens*. Thus, it may be better to restore *Zadimerodia* as an independent genus in the Nyassidae.

Family ZADIMERODIIDAE Guo, 1988, p. 119

[in Chinese]

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Guo, 1988, p. 119): shell subcircular, subovate, elliptical, subtrigonal in outline, equivalve, subequivalve to inequivalve; umbo center or anterior, sometimes with posterior umbonal carina; surface sculpture of growth lines; hinge plate provided with anterior cardinal and posterior actinodont teeth, showing radial arrangement from umbo, anterior cardinal teeth subtrigonal or bladelike.

Type occurrence.—Lower Ordovician.

Taxonomic position.—Cycloconchoidea (by original designation).

Revision suggestion.—Thanks to the work of Bailey (1983), we have a clearer understanding of the characters of the poorly known genus *Nyassa* Hall and Whitfield, 1869. Carter, Campbell, and Campbell (2000, 2006) restored the family name Nyassidae Hall, 1885, which includes the type genus and the genus *Tanaodon* Kirk, 1927. Fang presently suggests that *Copidens* Pojeta & Gilbert-Tomlinson, 1977, and *Zadimerodia* Guo, 1988, should also be included in Nyassidae, which forms a unique lineage in Cycloconchoidea, because these four genera share the following important features: (1) continuous actinodont dentition mounted on wide and stout hinge plate, without any edentulous interval separating pseudocardinal and pseudolateral elements; (2) gradual increase in length of teeth posteriorly, thus it is difficult to separate pseudocardinals and pseudolaterals; (3) all teeth radiate out posteriorly from beneath umbo, subparallel to posterior hinge margin; (4) lack of anterior pseudolaterals; (5) inequilateral, with umbo anterior; (6) anterior adductor scar on a thickened myophoric buttress, in close proximity to hinge plate. In sum, Zadimerodiidae is a junior subjective synonym of Nyassidae Hall, 1885.

Note.—The family name Zadimerodiidae first appeared in Guo (1985a, p. 172) as a manuscript family name without description and discussion, nor was the type genus *Zadimerodia* Guo (1988) available at the time. Only one species, *Taselasmodum deccusatum* Guo, 1985a, under the family name Zadimerodiidae Guo (MS.) was named, described, and figured. The genus *Taselasmodum* Guo, 1985a, with *T. deccusatum* Guo, 1985a, as type species, has been regarded as valid (Fang & Cope, 2004, p. 1141). Thus, the family name Zadimerodiidae Guo should be regarded as an invalid name.

Family TANAODONTIDAE Liu in Gu et al., 1976, p. 30

[in Chinese]

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Liu in Gu et al., 1976, p. 30): shell thick and large, retrocrescent; equivalve, inequilateral, with lunule and escutcheon; hinge plate wide and strong, with actinodont dentition and opisthodetic ligament.

Type occurrence.—Middle Devonian.

Taxonomic position.—Lyrodesmatoidea (by original designation).

Revision suggestion.—Carter, Campbell, and Campbell (2000) place *Tanaodon* within the family Nyassidae, thus Tanaodontidae becomes a junior subjective synonym of Nyassidae. See also revision suggestion for Zadimerodiidae (above).

Order TRIGONIOIDA Dall, 1889
Superfamily TRIGONIOIDEA Larmarck, 1819
Family TRIGONIIDAE Lamarck, 1819
Genus LUXITRIGONIA Guo, 1985a, p. 206

[in Chinese with English description, p. 270]

Figure 16.5–16.7

Discussion and diagnosis.—Original diagnosis (Guo, 1985a, p. 270): shell subrectangular. Umbo prominent, incurved and opisthogyrate at beak, slightly anterior to median; posterior umbonal carina well developed, edged, crenulated. Flank covered by coarse and strong concentric costae, with tubercula radiating from umbo; each tuberculum elongate at lower end to form tail shape; area transversely ridged without tubercula. Differs from *Ibotrigonia* and *Myophorella* by tail-shaped tubercula and area with coarse and strong transverse costae. In addition to type species, *Myophorella amdoensis* Wen also belongs to new genus [*sic*].

Type species.—*Luxitrigonia menggaensis* Guo, 1985a, p. 206, pl. 38,*1* (holotype), *2–4;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1985a, p. 206): Shell subrectangular, slightly longer than high. Anterior margin semicircular, ventral margin arcuate, posterior margin nearly truncated. Posteroventral angle evident, about at right angle; posterodorsal angle broadly obtuse, subrounded. Umbo small, slightly pointed, beak incurved, slightly opisthogyrate, situated nearly two-fifths shell length back from anterior end. Posterior umbonal carina keel-like, sawtoothed. Flank covered by strong and thick concentric ridges, about 12, with tubercles on tops, extending anteriorly and obliquely joining anterior and ventral margins in order, extending posteriorly and turning to dorsal when intersecting posterior carina, finally joining posterodorsal margin; tubercles on ridge tops elongate downward to form interrupted radial costae. Corselet with a median sulcus extending from umbo to posterior margin, narrow and shallow, concentric ridges without tubercles.

Type locality.—Mengga, Luxi, Yunnan, southwestern China.

Type occurrence.—Longhai Formation, Middle Jurassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0442 (holotype); IVy0443–0445.

Distribution of genus.—Middle Jurassic; western Yunnan, southwestern China; Qinghai, northwestern China (Guo, 1985a, p. 206).

Taxonomic position.—Trigoniidae (by original designation).

Revision suggestion.—Type species *Luxitrigonia menggaensis* Guo, 1985a is probably a junior synonym of *Myophorella? amdoensis* Wen (in Zhang, Lu, & Wen, 1979, p. 279, pl. 80,*1a–b*). None of the figures of *L. menggaensis* Guo were correctly cut out by the original author. The genus name is not accepted herein because preservation is poor and interiors are not preserved.

Genus SICHUANTRIGONIA Gou, 1993, p. 18

[in Chinese with English description, p. 24]

Figure 16.1–16.4

Discussion and diagnosis.—Original diagnosis (Gou, 1993, p. 24): shell rhombic to vertical-ovate, medium to large. Umbo sharply narrow, prosogyrate. Beak incurved. Shell height greater than or equivalent to shell length. A costal-ridgelike outer ridge present in posterior part of shell, stretching out from ventral margin; anterior part of outer ridge with wide and deep trough. Flank with many tuberculate ornaments. Siphonal area large, triangular, with one to two inner ridges developed on surface. Dental formula of left valve: 4a, 2, 4b, with 2 median cardinal teeth and wide, large, and bifurcate. Similar to *Trigonia (Kumatrigonia)* Tamura in shell shape, but in latter, the posterior umbonal ridge is strongly inflated and appears tuberculate, the concentric ridge is prominently fine, close, and there are no prominent tubercula on shell surface. Similar to *Gruenewaldia decussata* (Munster) (Newell & Boyd, 1975, p. 148–149, fig. 87–88) in shell shape and surface ornamentation, but latter differs in Myophoriidae-type dental formula. In shell shape and character of siphonal area, species quite distinct from all described Jurassic and Cretaceous genera of Trigoniidae with tuberculate ornament [*sic*].

Type species.—*Sichuantrigonia verrucosa* Gou, 1993, p. 18, pl. 1,*40*,*41* (holotype), *42–45;* by original designation; by monotypy.

Original description of type species.—(Gou, 1993, p. 25): Shell vertically ovate to rhombic, medium to large, 32–42 mm in length, 37–45 mm in height (higher than long). Beak incurved. A costal-ridgelike outer ridge present; proturberances extending to ventral margin; anterior part of outer ridge with wide and deep trough extending from beak toward umbo to ventral margin. Flank surface marked with regularly concentrated tubercula with less concentric lines in anterior part of umbo. Siphonal area large, triangular, developed with one to two inner ridges and marked by faint tubercula on surface. Escutcheon large; lunule small. Left valve possessing broadly trigonal median cardinal teeth and anteroposterior cardinal teeth [*sic*].

Type locality.—Maantang, Jiangyou, Sichuan, southwestern China.

Type occurrence.—Upper Member, Hanwang Formation, Upper Triassic.

Repository of type material.—Chengdu Institute of Technology, Chengdu, Sichuan, China; accession number: 40 (holotype); 39, 41–44.

Distribution of genus.—Upper Triassic; China (Gou, 1993, p. 18).

Taxonomic position.—Trigoniidae (by original designation).

Revision suggestion.—This genus is herein placed in synonymy with *Acanomyphoria* Guo, 1985a, because the ornament is very similar.

Genus TRIGONIA Bruguière, 1789
Subgenus TRIGONIA (PROTRIGONIA) Guo, 1985a, p. 204

[in Chinese with English description, p. 269]

Figure 16.8–16.17

Discussion and diagnosis.—Original diagnosis for subgenus (Guo, 1985a, p. 269): shell small or medium for genus, subtriangular, equivalve, subequilateral, inflated, semicircular from anterior to ventral margins, truncated or slightly curved forward at posterior margin. Umbo prominent, incurved, and prosogyrous ["opisthogyrate" in Chinese text, p. 204] at beak, slightly anterior to median; posterior umbonal carina well developed, with obscure antecarinal depression and correspondent weak sinus. Flank covered with growth lines or weak concentric slender ridges. Area ornamented by weak radial costae. Lunule small; escutcheon smooth, broadly lanceolate. Hinge teeth radiating from umbo, with slender transverse crenulations. In left valve, median tooth strong, coarse, bifid; anterior one shortly lamellar, opisthocline; posterior one slender and weak. In right valve, anterior one opisthocline, posterior one prosocline, joined at the upper end. Anterior adductor scar rather deep, strongly impressed, bordered by buttress; posterior one faint. Distinguished from *Trigonia s.s.* by small and nearly smooth shell and relatively weak teeth. Perhaps *Trigonia s.s.* evolved from *Protrigonia subgen. nov.* [*sic*].

Type species.—*Trigonia (Protrigonia) yunnanensis* Guo, 1985a, p. 204, pl. 29,*1a–c* (holotype), *2–4*; by original designation.

Original description of type species.—(Translation from Chinese text, Guo, 1985a, p. 204): Shell small, subtriangular. Length and height subequal. Anterior and ventral margins semicircular, posterior margin obliquely truncated or slightly concave. Posteroventral angle about at right angle or smaller than 90°; posterodorsal angle broadly obtuse. Umbo narrow and prominent, beak incurved and slightly opisthogyrate, situated slightly anterior of midpoint of shell length. Posterior umbonal carina well developed, keel-like, acute, extending from umbo to posteroventral angle. Flank nearly smooth, sometimes with a few narrow and fine concentric ridges on anterior part of flank. Corselet perpendicular to flank, ornamented with a thicker, inner rib, keel-like; a few radial costae in different thicknesses emerging between posterior carina and inner rib. Lunule deep, escutcheon wider, smooth, bordered by inner rib. Center tooth of left valve large and thick, bifid, with transverse microcrenulations on its dorsal side; anterior tooth inclined backward, short, and lamellar, with transverse microcrenulations on ventral side; posterior tooth weak, narrow, and slender, inclined

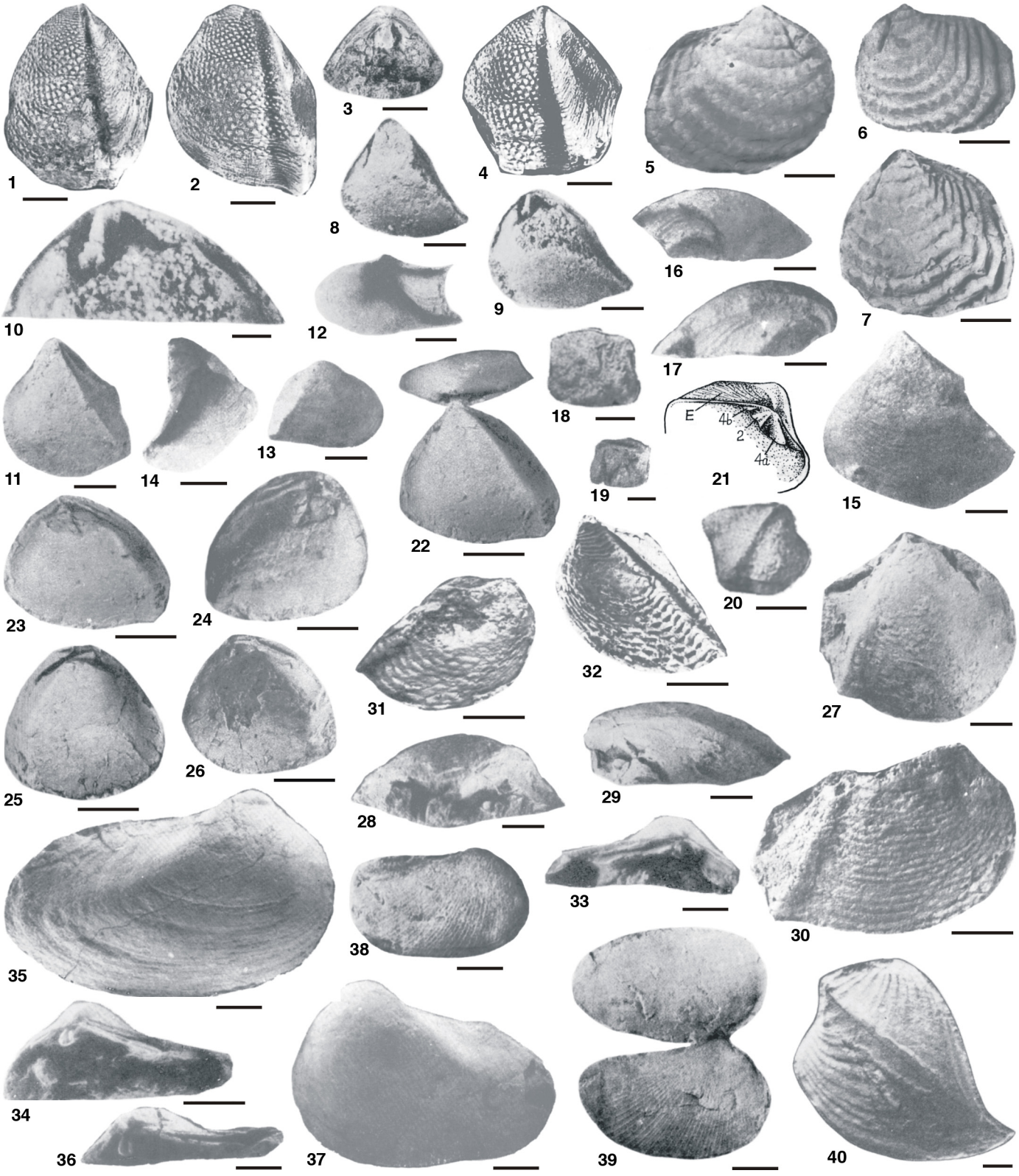

Figure 16. *For explanation, see facing page.*

forward. Anterior tooth of right valve inclined backward, short, and lamellar, with transverse microcrenulations on both sides; posterior tooth inclined forward, short and lamellar, with transverse microcrenulations on ventral side, dorsal ends of both teeth slightly connected with each other. Anterior adductor scar slightly deep, posterior one shallow and obscure. Buttress narrow.

Type locality.—North of Weixi town, Yunnan, southwestern China.

Type occurrence.—Maichuqing Formation, upper Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0345 (holotype); IVy0346–0348.

Distribution of subgenus.—Upper Triassic; Yunnan, southwestern China; Alps, Europe (Guo, 1985a, p. 204).

Taxonomic position.—Trigoniidae (by original designation).

Note.—Guo (1985a, p. 269) wrongly translated opisthogyrate in Chinese text (p. 204) as prosogyrous in his English summary. Therefore, opisthogyrate subgenus *Trigonia (Modestella)* Hautmann (2001, p. 120) is a junior synonym of subgenus *Trigonia (Protrigonia)* Guo, 1985a.

Family MYOPHORIIDAE Bronn, 1849
Genus ACANOMYPHORIA Guo, 1985a, p. 203

[in Chinese with English description, p. 269]

Figure 16.27–16.32

Discussion and diagnosis.—Original diagnosis (Guo, 1985a, p. 269): shell subtriangular, equivalve, subequilateral, inflated, semicircular at anterior margin, arcuated at ventral margin, prosoclinely truncated at posterior margin. Umbo rounded, somewhat protruded, slightly anterior to median; posterior umbonal carina well developed, reaching posteroventral angle, with tubercula on tops, with antecarinal depression and corresponding posteroventral sinus. Flank covered by concentric costae with thorn-shaped tubercula on tops; bases of tubercula elongate along concentric costae. Area slightly depressed, tranversely ridged with relatively regular and slender costae. Hinge similar to that in Costatoria. Distinguished from *Elegantinia* or *Gruenewaldia* in concentric costae with thorn-shaped tubercula [*sic*].

Type species.—Acanomyphoria tuberosa Guo, 1985a, p. 203, pl. 30,*1a–c* (holotype), *2–5;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1985a, p. 203): Shell subtriangular, subtrapezoidal; length and height subequal; inflated; anterior and ventral margins semicircular, posterior margin obliquely truncated, forming a distinct posteroventral angle with ventral margin, nearly 90º; posterodorsal angle broad and obtuse. Umbo subrounded, somewhat protruded, beak small, incurved, situated slightly anterior of midpoint of shell length; posterior umbonal carina thick, keel-like, extending from umbo to posteroventral angle, with tubercles on its top, bounded anteriorly by wide and distinct trough, somewhat deep, with a corresponding ventral sinus anterior to posteroventral angle. Flank wide and inflated, covered by concentric costae, with thorny tubercles on their tops, arranged along costae and slightly elongate; tubercles becoming obscure around umbo, concentric costae becoming more regular. Corselet slightly concave, covered by slender, crowded and regular concentric costae, with median ridge extending from umbo to posterior margin; escutcheon with more slender concentric costae, bordered by escutcheon ridge. Hinge teeth similar to those in *Costatoria*, rather thick and strong; two sides of median tooth and posterior side of anterior tooth with transverse grooves and ridges (microcrenulations) in left valve, two sides of anterior tooth and anterior side of posterior tooth with transverse microcrenulations, sides of other teeth smooth.

Figure 16. *1–4. Sichuantrigonia verrucosa* Gou, scale bar 10 mm; *1,* holotype, left valve; *2–3,* paratype, left valve; *2,* left lateral view; *3,* left interior view; *4,* left valve (adapted from Gou, 1993, pl. 1,*41,43a–b,44*).——*5–7. Luxitrigonia menggaensis* Guo, scale bar 5 mm; *5,* holotype, right valve; *6–7,* paratype, left valves (adapted from Guo, 1985a, pl. 38,*1,3,4*).——*8–17. Trigonia (Protrigonia) yunnanensis* Guo; *8–10,* holotype, left internal mold; *8,* left lateral view, scale bar 5 mm; *9,* umbo removed from Fig. 16.8, showing hinge, scale bar 5 mm; *10,* enlarged hinge of Fig. 16.9, scale bar 1 mm; *11,* paratype, left internal mold, scale bar 5 mm; *12,* paratype, right external mold, scale bar 5 mm; *13,* cast of Fig. 16.12, scale bar 5 mm; *14,* paratype, left external mold, scale bar 10 mm; *15–17,* cast of Fig. 16.14, scale bar 5 mm; *15,* left lateral view; *16,* dorsal view; *17,* posterior view (adapted from Guo, 1985a, pl. 29,*1b,1a,1c,2,3a–b,4a–d*).——*18–21. Quadratia quadrata* Yin, scale bar 5 mm; *18–19,* holotype, left valve; *18,* left lateral view; *19,* left interior view; *20,* another holotype, right valve (adapted from Yin in Gan & Yin, 1978, pl. 123,*3a–b,2*); *21,* diagrammatic drawing, showing hinge (no scale) (adapted from Yin, 1974, p. 25, text-fig. 3).——*22–26.* Holotype of *Trionychodia bella* Guo, scale bar 5 mm; *22,* left lateral view of conjoined valves; *23,* left internal mold; *24,* latex cast of Fig. 16.23; *25,* right internal mold; *26,* latex cast of Fig. 16.25 (adapted from Guo, 1988, pl. 3,*1a–e*).——*27–32. Acanomyphoria tuberosa* Guo, scale bar 5 mm; *27–29,* holotype, right internal mold; *27,* right lateral view; *28,* dorsal view; *29,* posterior view; *30,* paratype, right lateral view; *31,* paratype, right lateral view; *32,* exterior mold of Fig. 16.31 (adapted from Guo, 1985a, pl. 30,*1a–c,2,5a–b*).——*33–37. Yangella cuneatiformis* Liu & Gu, scale bar 10 mm; *33–34,* holotype; *33,* left interior; *34,* right interior; *35,* paratype, left valve; *36–37,* paratype, right valve; *36,* right lateral view; *37,* interior view (adapted from Liu & Gu in Liu, 1988, pl. 77,*2a–b,10,3a–b*).——*38–39. Pholadella (Qiaojiaia) usitata* Guo & Hu, scale bar 5 mm; *38,* holotype, right valve; *39,* paratype, lateral view of conjoined valves (adapted from Guo, 1985a, pl. 8,*4,5*).——*40.* Holotype of *Rhenania (Dianorhenania) yunnanensis* Guo, scale bar 1 mm; incomplete external mold (adapted from Guo, 1985a, pl. 2,*17*).

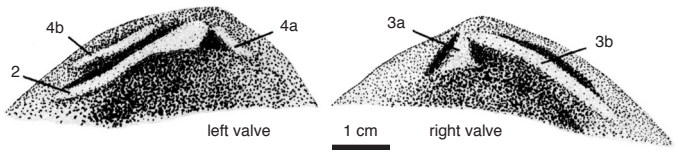

Figure 17. Diagrammatic drawing of holotype of *Trionychodia bella* Guo, showing hinge (adapted from Guo, 1988, p. 127, text-fig. 7).

Anterior adductor scar distinct, rather deep, with developed and backward-inclined buttress.

Type locality.—Guanfangnabang, Pu'er, Yunnan, southwestern China.

Type occurrence.—Weiyuanjiang Formation, Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0355 (holotype); IVy0356–0359.

Distribution of genus.—Upper Triassic; Yunnan, southwestern China (Guo, 1985a, p. 203).

Taxonomic position.—Myophoriidae (by original designation).

Note.—*Sichuantrigonia* Gou, 1993 (see p. 53 herein) is a junior synonym of the present genus.

Genus QUADRATIA
Yin in Gan & Yin, 1978, p. 375

[in Chinese]

Figure 16.18–16.21

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Yin in Gan & Yin, 1978, p. 375): shell small to medium, quadrilateral. Except for slightly rounded anteroventral angle, other three angles at right angle, all four margins nearly straight. Posterior umbonal carina keel-like, bordered anteriorly by a sulcus, quadrilateral flank forming a diagonal line, separating flank from concave posterior area. Escutcheon deep, wide, and long, bordered by acute ridge extending from umbo to posterodorsal angle. Cardinals 2 and 4a of left valve evident, turbercular, slightly inclined forward, with a large socket (3a) between them. 4b obscure due to solution loss. Right valve must have larger 3a and smaller 3b.

Type species.—*Quadratia quadrata* Yin in Gan & Yin, 1978, p. 375, pl. 123,*2-4* [=*Quadratia quadrata* Yin, 1974, p. 25, pl. 1,*3* (syntype, holotype in original text, right valve), *4a–c* (syntype, holotype in original text, left valve), *5* (syntype, paratype in original text); text-fig. 3] [type species by original designation by Yin, 1974, and subsequent designation by Yin in Gan & Yin, 1978, p. 375]; by monotypy.

Original description of type species.—(Translation from Chinese text, Yin in Gan & Yin, 1978, p. 375): Description as for *Quadratia*.

Type locality.—Qingyan, Guiyang, Guizhou, southwestern China.

Type occurrence.—Qingyan Formation, Anisian, Middle Triassic.

Repository of type material.—China University of Geosciences; syntype accession number: 00103 (holotype in original text, right valve), 00104 (holotype in original text, left valve); 00105 (paratype in original text).

Distribution of genus.—Middle Triassic; Guizhou, southwestern China (Yin in Gan & Yin, 1978, p. 375).

Taxonomic position.—Myophoriidae (by original designation).

Note 1.—This genus is not very well established and all the material is poor. The genus name *Quadratia* first appeared in Yin, 1974 (restricted publication, all the figures are poor).

Note 2.—The double holotypes of the type species of this genus violate the Principle of Typification (ICZN, 1999), therefore, both so-called holotypes become syntypes.

Genus TRIONYCHODIA
Guo, 1988, p. 127

[in Chinese]

Figure 16.22–16.26, 17

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1988, p. 127): shell subtriangular, equivalve, subequilateral, moderately inflated. Anterior margin rounded, posterior margin truncated, ventral margin arcuate. Posteroventral angle evident. Umbo broadly rounded, slightly projected, situated slightly anterior of midpoint of shell length. Posterior umbonal carina well developed, acute. Surface covered by growth lines. Hinge teeth well developed. Three in left valve, anterior tooth (4a) short and lamellar, inclined backward; posterior tooth (4b) lamellar, longer; center tooth (2) long and lamellar, extending backward along dorsal margin and expanding into subtriangular shape under umbo. Right valve having two cardinals, anterior tooth (3a) short and lamellar, inclined backward; posterior tooth (3b) strong, lamellar, inclined forward. Adductor scars shallow and obscure.

Type species.—*Trionychodia bella* Guo, 1988, p. 127, pl. 3,*1a–e* (holotype), *2*; text-fig. 7; by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1988, p. 127): Shell subtriangular, longer slightly than high, equivalve, subequilateral, moderately inflated. Anterior margin rounded, ventral margin arcuate, posterodorsal, and posterior margins broadly rounded. Posteroventral angle evident, nearly at right angle. Umbo large, obtusely rounded, slightly projected, situated slightly anterior of midpoint of shell length. Posterior umbonal carina well developed, keel-like, acute, extending from umbo to posteroventral angle. Surface covered by growth lines. In left valve, anterior tooth (4a) weak, inclined backward; center tooth (2) strong, extending backward along dorsal margin and expanding into subtriangular shape under umbo; posterior tooth (4b) lamellar, narrow, and fine, situated above center tooth. In right valve, anterior tooth (3a) strong, subtriangular; posterior tooth (3b) lamellar, subparallel to posterodorsal margin. Adductor scars shallow and obscure.

Type locality.—Daigu, Mengzi, Yunnan, southwestern China.

Type occurrence.—Pojiao Formation, upper Lower Devonian.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0662 (holotype); IVy0663.

Distribution of genus.—upper Lower Devonian; eastern Yunnan, southwestern China (Guo, 1988, p. 127).

Taxonomic position.—Myophoriidae (by original designation).

Revision suggestion.—*Trionychodia* is here placed in synonymy with *Yangella* Liu & Gu in Liu, 1988.

See also.—Liu (1988, p. 257) and Gu and Liu (1988, p. 359) for the description of *Yangella* Liu & Gu in Liu, 1988.

Genus YANGELLA Liu & Gu in Liu, 1988 (June), p. 257

[in Chinese with English description, p. 400]

Figure 16.33–16.37

Discussion and diagnosis.—Original diagnosis (Gu & Liu, 1988 [December], p. 359): medium to large-sized myophorids, as long as 70 mm. Ornament commarginal; best developed around umbo and toward ventral margin. Shell highest above beak; moderately attenuated posteroventrally; broadly rounded anteriorly and ventrally. Beak orthogyrate. Ligament opisthodetic, external. Two or three teeth on right valve; anterior tooth triangular, perpendicular to hinge margin and with median groove; two posterior teeth laminar and subparallel to hinge margin. Four teeth on left valve; anterior tooth small and wedge shaped; median tooth triangular and bifurcate; two posterior teeth laminar, subparallel to hinge margin, lower one connected to median tooth. All teeth radiate from umbo. Pallial line simple, entire. Anterior adductor muscle scar deep, small, oval, above which is a small pedal muscle scar. Posterior adductor scar larger, shallow, and subcircular, with vague, long-oval pedal retractor scar above. The shell outline of *Yangella* is most like that of Mesozoic myophorid *Heminajas* Neumayr, but *Yangella* has concentric lines and ridges, a very strong posterior umbonal ridge, and two posterior laminar teeth on each valve, whereas *Heminajas* has just one thin and elongate posterior tooth on each valve [*sic*].

Type species.—*Yangella cuneatiformis* Liu & Gu in Liu, 1988, p. 258, pl. 77,*2a–b* (holotype), *3a–b*,*8*,*10*; by original designation.

Original description of type species.—(Gu & Liu, December 1988, p. 359): Large shell, wedge shaped; anterior end broadly rounded; posterior end elongate and tapered. Umbonal ridge prominent, especially dorsally. Shell margin broadly angulate posteroventrally. Beak small, prosogyrate, erect, and incurved. Ornament consists of concentric lines and ridges that are stronger ventrally than dorsally. Lunule and escutcheon weak. Ligament opisthodetic, external. Dentition and muscle scars same as for genus. Pallial line entire [*sic*].

Type locality.—Ganxi, Beichuan, Sichuan, southwestern China.

Type occurrence.—Ganxi Formation, Emsian, Lower Devonian.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: LBV-851287 (holotype); LBV-851288–851290.

Distribution of genus.—Lower Devonian; Longmenshan, Sichuan, southwestern China (Liu & Gu in Liu, 1988, p. 258).

Taxonomic position.—Myophoriidae (by original designation).

See also.—*Trionychodia* Guo, 1988 (p. 56 herein).

Note.—Gu and Liu [1988, p. 359; published in December, whereas Liu and Gu (in Liu, 1988, published in June) again proposed *Yangella* as a new genus.

Family SINODORIDAE Pojeta & Zhang, 1984

[*emend*. Johnston & Zhang, 1998, p. 365]

Genus PHOLADELLA Hall, 1869 Subgenus PHOLADELLA (QIAOJIAIA) Guo, 1985a, p. 226

[in Chinese with English description, p. 271]

Figure 16.38–16.39

Discussion and diagnosis.—Original diagnosis of subgenus (Guo, 1985a, p. 271): shell elongate, elliptical, equivalve, inequilateral, moderately inflated, semicircular at anterior margin, arcuate at ventral margin, subrounded at posterior end, without lateral sulcus and ventral sinus, but with broad, shallow, obscure groove on posterodorsal part. Umbo obtuse and relatively large, subrounded, protruding above hinge margin, situated anteriorly; posterior umbonal carina weakly developed. Surface marked by radial costae but without concentric costae or undulations. *Qiaojiaia subgen. nov.* differs from *Pholadella s.s.* in lack of concentric undulations and lateral sulcus as well as ventral sinus [*sic*].

Type species.—*Pholadella (Qiaojiaia) usitata* Guo & Hu in Guo, 1985a, p. 226, pl. 8,*4* (holotype), *5;* by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo & Hu in Guo, 1985a, p. 226): Shell elongate elliptical. Height about two-thirds length. Anterior margin semiorbicular, ventral margin arcuate, posterior margin subrounded. Anterior part broader, slightly contracted, and tapered posteriorly. Umbo obtuse and large, subrounded, projected above hinge margin, situated about one-quarter of shell length back from anterior end. Posterior umbonal carina not developed. Without lateral sulcus and ventral sinus. Posterior area with shallow and indistinct sulcus. Surface ornamented with radial costae of 2 orders, more than 60 in number; becoming weaker and obscure anteriorly and posteriorly. Without concentric ridges and undulations.

Type locality.—Xindianzi, Qiaojia, Yunnan, southwestern China.

Type occurrence.—Bianjinggou Formation, upper Lower Devonian.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0091 (holotype); IVy0092.

Distribution of subgenus.—upper Lower Devonian; Yunnan, southwestern China; Guangxi, South China (Guo, 1985a, p. 226).

Taxonomic position.—Grammysiidae (by original designation).

Revision suggestion.—Junior synonym of *Sinodora* Pojeta & Zhang, 1984 (published in USA, not included in present paper) suggested herein. See also Johnston and Zhang (1998, p. 365) for a new interpretation of *Sinodora*.

SYSTEMATIC POSITION INDET.
Genus RHENANIA Waagen, 1907
Subgenus RHENANIA (DIANORHENANIA) Guo, 1985a, p. 202

[in Chinese with English description, p. 268]

Figure 16.40

Discussion and diagnosis.—Original diagnosis of subgenus (Guo, 1985a, p. 268): shell small, obliquely subtriangular ["quadrilateral" in Chinese text, p. 202], inflated, arcuate from anterior to ventral margin, arched at posterior dorsal part, with acuminate posteroventral angle twisted upward. Umbo situated near anterior end; posterior umbonal carina well developed, reaching posteroventral angle, like a diagonal line. Area covered with radial ribs diverging from posterodorsal part to posterior umbonal carina, and with obscure radial threads from umbo. Flank ornamented by coarse strong and regular concentric costae. Interior unknown. Surface covered with radial ribs from posterodorsal part, while *Rhenania s.s.* is ornamented by curved oblique ridges from posterior umbonal carina [*sic*].

Type species.—*Rhenania (Dianorhenania) yunnanensis* Guo, 1985a, p. 203, pl. 2,*17* (holotype) by original designation; by monotypy.

Original description of type species.—(Translation from Chinese text, Guo, 1985a, p. 203): Shell small, obliquely quadrilateral. Inflated. Anterior and ventral margins nearly semicircular. Posterodorsal part highly convex, posterodorsal and posterior margins arcuate. Posteroventral angle pointed, twisted, and turned toward dorsal side. Umbo near anterior end, posterior umbonal carina well developed, extending from umbo to posteroventral extremity, like a diagonal line. Corselet ornamented with radial costae, radiating from posterodorsal part to posterior carina, intersected by obscure radial lines radiating from umbo; flank covered by regular concentric ridges, strong and thick. Interior unknown.

Type locality.—Chunai, Xundian, Yunnan, southwestern China.

Type occurrence.—Guandi Formation, upper Silurian.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0034 (holotype).

Distribution of subgenus.—upper Silurian; Yunnan, southwestern China (Guo, 1985a, p. 203).

Taxonomic position.—Myophoriidae (by original designation).

Revision suggestion.—The genus name is presently rejected because the only specimen is badly preserved, according to Fang (personal observation, November 2005). The holotype is probably an incomplete external mold of the ventral part of a slightly dislocated, bivalved specimen not related to *Rhenania*.

Order UNIONOIDA Stoliczka, 1870
Superfamily UNIONOIDEA Rafinesque, 1820
Family MARGARITIFERIDAE Hass, 1940
Genus SHIFANGELLA Liu & Luo in Liu, 1981, p. 121

[in Chinese with English diagnosis, p. 127]

Figure 18.1–18.5

Discussion and diagnosis.—Original diagnosis (Liu & Luo in Liu, 1981, p. 127): shell large to gigantic; equivalve, inequilateral; strongly developed in length, transversely elongate ovate to margaritiferiform in outline, and with distinctly sinuated ventral margin; moderately to rather inflated; strong or edge-form posterior ridge. Umbonal region compressively flattened. Beak broad and large, not projecting or slightly rising above hinge margin, prosogyrous, situated rather anteriorly. Surface ornamented with regularly spaced concentric rings and growth lines, but with regular concentric rings in minority only. No lunule; escutcheon relatively clear and wide. Ligament opisthodetic, external. Hinge plate rather narrow, unionid hinge structure, but hinge teeth fine. Anterior adductor scar relatively deep and rounded, with pedal scar above posterior part. Test very thin [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Liu & Luo in Liu, 1981, p. 121): Shell thin, large to very large; transversely elongate, ventral margin concave; elongate-oval to *Margaritifera*-shaped; equivalve, inequilateral; moderately to rather inflated. Posterior ridge strong, edge-form. Umbonal region compressively flattened; beaks broad, not projecting or slightly rising above hinge margin, prosogyrous, situated rather anteriorly. Surface ornamented with regularly spaced concentric

Figure 18. *1–5. Shifangella margaritiferiformis* Liu & Luo, scale bar 10 mm; *1–2,* holotype, dorsal view and left lateral view of articulated shell; *3,* paratype, left lateral view; *4–5,* paratype, right lateral views (adapted from Liu & Luo in Liu, 1981, pl. 1,*3a–b,1–2,4*).——*6–12. Pseudomargaritifera plana* Ma, scale bar 5 mm; *6,* holotype, left interior view; *7,* paratype, left lateral view; *8,* dorsal view of Fig. 18.7; *9,* paratype, left internal view; *10,* paratype, left lateral view; *11–12,* paratype, right lateral views (adapted from Ma, 1996, pl. 3,*10,5a–b,6–9*).——*13–21. Mengyinaia mengyinensis* (Grabau), scale bar 5 mm; *13–14,* holotype (designated by J. Chen, 1984, p. 150), left internal mold and dorsal view (adapted from Grabau, 1923a, p. 153,*4a,4b*); *15,* plesiotype, internal mold of articulated valves (adapted from J. Chen, 1984, pl. 1,8); *16–17,* plesiotype, right lateral view and left lateral view of articulated shell (adapted from J. Chen, 1984, pl. 2,*1a,1b*); *18,* plesiotype, left internal mold (adapted from J. Chen, 1984, pl. 2,2); *19,* plesiotype, left internal mold (adapted from J. Chen, 1984, pl. 2,*3*); *20–21,* (=Fig.18. 13–18.14, holotype), left internal mold (*21*) and dorsal view (*20*) (adapted from Gu et al., 1976, pl. 94,*1,2*).——*22–27. Solenoides tanggulaensis* (Wen), scale bar 5 mm; *22,* holotype, left internal mold (adapted from Wen in Zhang, Lu, & Wen, 1979, pl. 81,6); *23–24,* plesiotype, left interior views; *25–27,* plesiotype, right interior views (adapted from Ma, 1996, pl. 5,*4,6,8–9,12*).——*28–29. Dianoconcha alata* Guo, scale bar 10 mm; *28,* holotype, right composite mold; *29,* paratype, right possible internal mold (described as left valve in original text; adapted from Guo, 1988, pl. 3,*4,5*).——*30–31.* Holotype of *Margaritifera (Palaeomargaritifera) guangyuanensis* Ma, scale bar 10 mm; *30,* right interior view; *31,* left interior view (adapted from Ma, 1984, pl. 11,*1a,1b*).

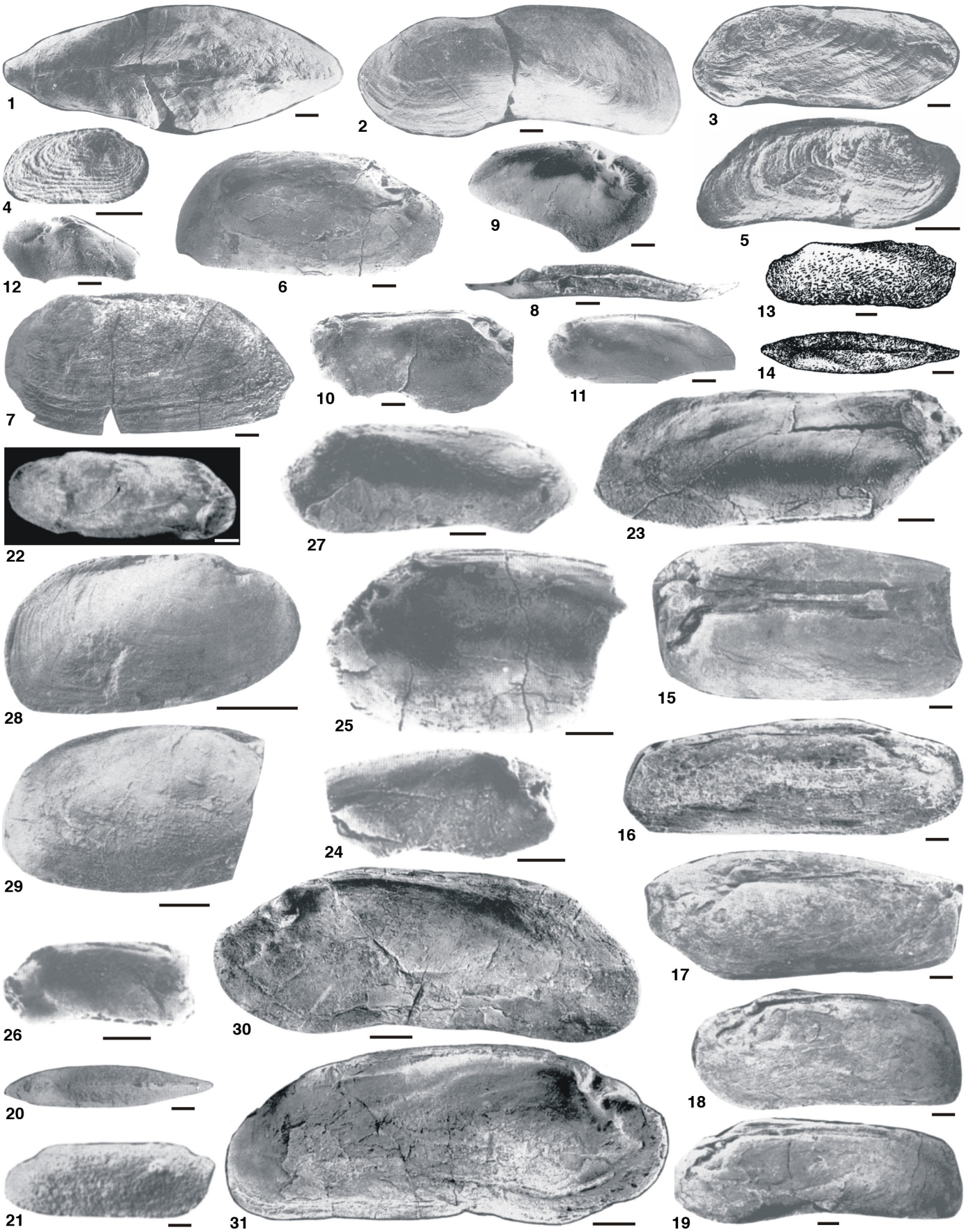

Figure 18. *For explanation, see facing page.*

rings and growth lines, but with regular concentric rings only in preadult specimens; lunule absent; escutcheon developed, relatively wide; ligament opisthodetic. Hinge plate narrow, with unionid dentition, but teeth fine and smooth, parallel to hinge margin. Anterior adductor scar shallow, rounded, accompanied by pedal scar at upper posterior side.

Type species.—*Shifangella margaritiferiformis* Liu & Luo in Liu, 1981, p. 122, pl. 1,*1–2*,*3a–b* (holotype), *4*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Liu & Luo in Liu, 1981, p. 122): Shell thin; very large, greatly elongate, with posterior part slightly expanded. Anterodorsal margin very short, straight, prosocline, gradually passing into narrowly convex and protracted anterior margin; posterodorsal margin long, weakly curved; roundly or rounded-obtuse, passing into posterior margin; posterior margin long, convex, slightly truncated; posteroventral end weakly protracted posteroventrally, angled at about 90° or slightly smaller; ventral margin long, with convex anterior part, but middle posterior part deeply concave. Shell strongly inflated, with largest inflation at middle to ventral parts of posterior ridge, about two-thirds shell length from anterior. Posterior umbonal carina broad and strong, ridgelike, running from umbo to posteroventral end; posterodorsal area very wide, accounting for more than two-fifths of entire shell surface, flat or depressed; surface in front of carina with broad depression. Lunule absent; escutcheon well developed, fairly wide. Umbonal region broad and flat; beak slightly prosogyrate, not projecting, positioned at one-quarter to one-fifth shell length from anterior. Surface ornamented with growth lines and well-developed commarginal costae. Hinge plate very narrow, with unionid dentition basically; teeth very fine and weak; right valve of pre-adult specimens with one short, fine, and small, anterior pseudocardinal tooth and one very long, linear posterior lateral tooth; some left valves of preadult growth stages with two short and fine pseudocardinal teeth; lateral teeth of left valve not observed. Anterior adductor scar shallow, ovate, accompanied by one pedal scar at posterodorsal side. Measurements: 60–155 mm long, 25–56 mm high, 32–54 mm wide, ratio of height to length 0.36–0.4.

Type locality.—Jinhe, Shifang, Sichuan, southwestern China.

Type occurrence.—Second Member, Wuzhongshan Formation, Upper Triassic.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: bi503 (holotype); bi500–502.

Distribution of genus.—Upper Triassic; South China (Liu & Luo in Liu, 1981, p. 122).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—*Shifangella* possibly represents an early member of Margaritiferidae. The earliest occurrence of the genus is Upper Triassic, but it is also found in the Lower Jurassic to Middle Jurassic in China, central Asia, and Siberia (previously referred to *Margaritifera*).

Note.—We retranslate Chinese diagnosis of *Shifangella* Liu & Luo, because the English diagnosis (p. 127) does not coincide with original Chinese diagnosis (p. 121).

Genus MARGARITIFERA Schumacher, 1816 Subgenus MARGARITIFERA (PALAEOMARGARITIFERA) Ma, 1984, p. 606

[in Chinese]

Figure 18.30–18.31

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Ma, 1984, p. 606): shell large; elongate; kidneylike; relatively thin shelled; flat; umbo low; umbonal W-shaped sculpture invisible; umbonal cavity shallow. Hinge teeth well developed; dental formula: 3a, (1), PI (1b in original text), PIII (3b in original text)/4a, 2a, PII (2b in original text); anterior pseudocardinal teeth one in right valve and two in left valve, nipplelike, generally grooved; posterior lateral teeth, two in right valve and one in left valve, elongate-lamellar, smooth, extending respectively into antero- and posteroventral end; sometimes submedian tooth 1 present in right valve. Dimyarian; anterior adductor scar large and deep, with arborescent-like striations; posterior side accompanied by two buttresses; pedal scars fairly deep, lower one isolated; posterior adductor scar larger and shallower, elliptical in outline.

Type species.—*Margaritifera (Palaeomargaritifera) guangyuanensis* Ma, 1984, p. 607, pl. 11,*1a–b* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Ma, 1984, p. 607): Shell large; greatly elongate, with largest shell about 120 mm long and 44 mm high; length about 2.7 times as long as height; shell width about one-fifth as long as height; anterior margin rounded; posterodorsal margin nearly straight, obliquely passing into rounded posterior margin; posteroventral end prominently protracting backward; ventral margin long, with wide, shallow sinus; umbo broad and low, positioned at about two-ninths shell length from anterior; posterior ridge obtuse. Shell flat, surface with irregular commarginal lines. Anterior pseudocardinal teeth strong, two in left valve and one in right valve; posterior lateral lamellar teeth, one in left valve and seemingly two in right valve; anterior adductor scar deep, elongate-oval, with arborescent-like striations; upper pedal scar deeper, lower one isolated and shallower; posterior adductor scar also shallow.

Type locality.—Nanshan, Guangyuan, Sichuan, southwestern China.

Type occurrence.—Third Member, Guangyuan Group, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25378 (holotype).

Distribution of subgenus.—Jurassic; China (Ma, 1984, p. 606).

Taxonomiac position.—Margaritiferidae (by original designation).

Revision suggestion.—Junior synonym of *Shifangella* Liu & Luo in Liu, 1981.

Genus DIANOCONCHA Guo, 1988, p. 121

[in Chinese]

Figure 18.28–18.29

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1988, p. 121): subtrapezoid, elongate-elliptical or rhomboid; equivalve, inequilateral; moderately inflated; test moderately thick; anterior shorter and narrower than posterior, largest height positioned at one-half to one-third shell length from posterior; posterodorsal margin rounded, widely curving, passing into posterodorsal end; posterior margin sometimes truncated; ventral margin widely arched; posteroventral angle fairly distinct; posterior dorsal shell slightly expanded; posterodorsal angle obtuse; umbo broad, low, positioned at about one-third length from anterior; posterior ridge broad, rounded, not strong; surface with growth lines and rugae. Hinge plate narrow, with two anterior pseudocardinal teeth in left valve and one in right valve; posterior lateral teeth degenerated, only traces remaining; anterior adductor scar observable, posterior adductor scar indistinct.

Type species.—Dianoconcha alata Guo, 1988, p. 121, pl. 3,*4* (holotype), *5–6*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1988, p. 121): Shell elongate, with length about two times height; subtrapezoid or rhomboid; moderately inflated; test moderately thick; anterior shell short, narrow, anterior margin rounded; posterior shell elongate, slightly expanded, with largest height at one-half to one-third shell length from posterior; posterior margin rounded; posterodorsal shell somewhat winglike; posteroventral angle rounded; umbo low, broad, obtuse, located one-third shell length from anterior; posterior ridge not prominent, broadly rounded; surface with growth lines and rugae. Hinge with anterior pseudocardinal teeth, one (stout) in right valve and two (weak) in left valve; posterior lateral teeth degenerated, only traces remain; anterior adductor scar observable, posterior adductor scar not clear.

Type locality.—Jinding, Lanping, Yunnan, southwestern China.

Type occurrence.—Huakaizuo Formation, Middle Jurassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0665 (holotype); IVy0666, 0667.

Distribution of genus.—Middle Jurassic; Western Yunnan, southwestern China (Guo, 1988, p. 121).

Taxonomic position.—Margaritiferidae (by original designation, Guo, 1988).

Revision suggestion.—Junior synonym of *Shifangella* Liu & Luo in Liu, 1981.

Genus PSEUDOMARGARITIFERA Ma, 1996, p. 420

[in Chinese, with English diagnosis, p. 427]

Figure 18.6–18.12

Discussion and diagnosis.—Original diagnosis (Ma, 1996, p. 427): shell medium to large, rectangular, rather thin and compressed. Ventral region not concave; umbonal area and surface covered with irregular growth lines. Right shells bearing one and left shells bearing two nipple-shaped anterior pseudocardinals with no ridges or grooves. Posterior lamellar tooth (teeth) with one on right and two on left, but often difficult to separate 2b from 4b. Umbonal cavity shallow; anterior adductor scar on posterior shallow, elongate-oval, with small retractor scar. Pallial line simple [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Ma, 1996, p. 420): Shell medium to large, tetragonal; test thin to moderately thick; mostly compressed; ventral margin not concave. Surface ornamented with irregular commarginal growth lines and rugae. Anterior pseudocardinal teeth, one in right valve and two in left valve, nipplelike, not laterally striated; posterior lamellar teeth also, one in right valve and two in left valve; the PII (2b in original text) separated from PIV (4b in original text) by only shallow socket. Anterior adductor scar deep, with arborescent-like striae, accompanied by two small pedal scars at inner side; posterior adductor scar oblique-elliptical, shallower, smooth, accompanied by one small pedal scar at upper-inner side. Umbonal cavity shallow; pallial line simple.

Type species.—Pseudomargaritifera plana Ma, 1996, p. 420, pl. 3,*5–9*,*10* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Ma, 1996, p. 420): Medium, obliquely tetragonal, with length of 55 mm and height of 24.5 mm; thin shelled, flat, width of 5.35 mm in single valve. Anterior margin rounded, both dorsal and ventral margins nearly straight, nearly parallel to each other; posterodorsal angle widely curved, posteroventral angle narrowly rounded. Umbo low; beak prosogyrate, positioned at about one-quarter shell length from anterior; posterior ridge obtusely rounded; surface with irregular growth lines only. Anterior tooth 2a of left valve oblique-triangular, conelike; 4a low, small, triangular; PII (2b in original text) and PIV (4b in original text) relatively short, thin, flaky; between them socket not very clear; tooth 3a of right valve nipplelike; PIII (3b in original text) lamellar; not all teeth laterally striated. Anterior and posterior adductor scars, pedal scars, and pallial line same as in generic diagnosis.

Type locality.—Guangyuan, Sichuan, southwestern China.

Type occurrence.—Middle to upper part of Guangyuan Group, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 110812 (holotype); 110808–110811.

Distribution of genus.—Lower Jurassic–Upper Cretaceous; China, North America, Europe, and Siberia (Ma, 1996, p. 420).

Taxonomic position.—Margaritiferidae (by original designation).

Revision suggestion.—Pseudomargaritifera is a compound genus, defined to include seven species based mainly on shell shape (Ma, 1996). However, these species might be reassigned to *Shifangella*, *Mengyinaia,* and *Qiyangia* according to their dentition and ornament. Thus, *Pseudomargaritifera* might be invalid.

Note.—We retranslate Ma's (1996) Chinese diagnosis of *Pseudomargaritifera* Ma, because his English diagnosis (p. 427) is too brief and does not coincide with his Chinese diagnosis (p. 420).

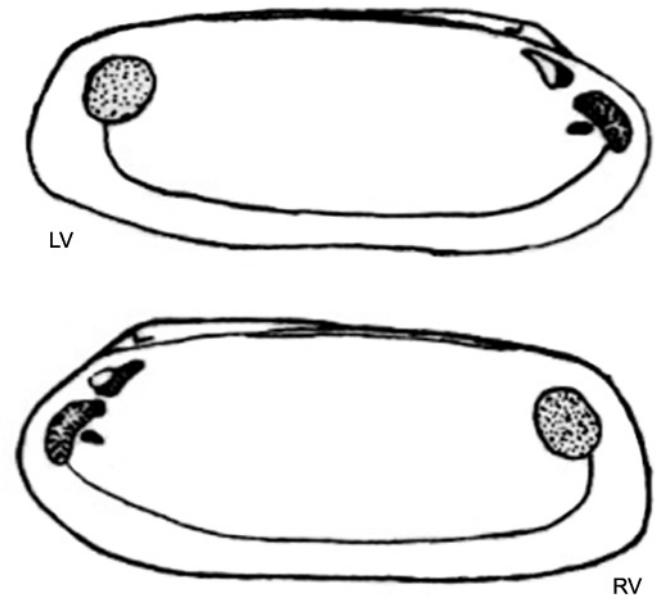

Figure 19. Diagrammatic drawing of hinge of *Mengyinaia* (no scale; adapted from J. Chen, 1984, p. 149, text-fig. 1).

Genus SOLENOIDES Ma, 1996, p. 422

[in Chinese, with English diagnosis, p. 428]

Figure 18.22–18.27

Discussion and diagnosis.—Original diagnosis (Ma, 1996, p. 428): characterized by narrow and elongate-rectangular or soleniform outline and thin and slightly convex shell; sculpture and system of retractor scar similar to *Pseudomargaritifera* [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Ma, 1996, p. 422): Elongate-rectangular or soleniform; test thin; moderately inflated; both lunule and escutcheon absent. Umbonal region and other surface ornamented only with irregular growth lines. Dental formula: 3a, PIII (3b in original text)/4a, 2a, PII (2b in original text), PIV (4b in original text); anterior pseudocardinal teeth 2a, 3a, and 4a triangular, conelike, or nipplelike, without lateral striations; posterior lateral teeth PII (2b) and PIII (3b) lamellar, PIV (4b) thin-lamellar; PII (2b) and PIV (4b) shorter, close to each other; anterior adductor scar deep, with arborescent-like striations, posterior side inserted with two pedal scars; posterior adductor scar elongate-elliptical in form, shallow and smooth; pallial line entire.

Type species.—*Solenaia tanggulaensis* Wen in Zhang, Lu, & Wen, 1979, p. 282, pl. 81,*6* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Wen in Zhang, Lu, & Wen, 1979, p. 282): Left internal mold; medium; elongate-elliptical, with length about three times height. Dorsal margin and ventral margin nearly parallel to each other, both straight; anterior margin rounded; posteroventral end narrow and rounded; posterodorsal margin nearly truncated. Shell weakly inflated; umbo low; beak small, not projected, positioned at about one-quuarter shell length from anterior. Surface ornamented with commarginal lines; hinge margin fragmented, remaining small part with trace of posterior lamellar tooth; adductor scars and pallial line not clear. Measurements: 48 mm long, 18 mm high.

Type locality.—About 6 km north of Tanggula Mountain Pass, Geermu, Qinghai, northwestern China.

Type occurrence.—Yanshiping Group, Middle Jurassic.

Repository of the type material.—Nanjing Institute of Geology and Palaeontology; accession number: 37069 (holotype); plesiotypes: 110813–110818a-b.

Distribution of genus.—Lower Jurassic–Upper Cretaceous; China (Ma, 1996, p. 422).

Taxonomiac position.—Margaritiferidae (by original designation).

Revision suggestion.—Similar to *Pseudomargaritifera*, *Solenoides* was proposed mainly based on shell shape. It included the species that might be respectively reassigned to *Shifangella*, *Mengyinaia,* and *Qiyangia* according to dentition and ornament. Therefore, *Solenoides* may be invalid.

Note.—We retranslate Ma's (1996) Chinese description of *Solenoides* Ma, because his English diagnosis (p. 428) is too simple and brief.

Genus MENGYINAIA Chen, 1984, p. 149

[in Chinese with English diagnosis, p. 154]

Figure 18.13–18.21, 19

Discussion and diagnosis.—Original diagnosis (Chen, 1984, p. 154): shell medium; elongate; equivalve, inequilateral; moderately inflated; umbo positioned near anterior end; anterior margin rounded, narrowly; ventral margin wide, with a sinus in middle part; concentric lines seen on entire surface; umbonal ridge absent. Hinge plate with one smooth, tubercular-form anterior pseudocardinal tooth in each valve; anterior adductor scar with arborescent striations; posterior adductor scar smooth; two pedal scars inserted at posterior side of anterior adductor scar; one elevator scar located at anterior part of umbonal cavity; pallial line simple [*sic*].

Type species.—*Mycetopus mengyinensis* Grabau, 1923a, p. 153, figs. 4a–b, 5a–b; by original designation, J. Chen, 1984 [=*Solenaia mengyinensis* (Grabau) in Gu et al., 1976, p. 340, pl. 94,*1* (holotype), *2–9*]; *emend*. J. Chen, 1984, p. 151.

Original diagnosis of type species.—(After Grabau, 1923a, p. 153): Shell small, greatly elongate, with nearly parallel dorsal and ventral margins. Hinge apparently edentolous. Valves equally convex, greatest convexity behind and somewhat below umbos. Beak about one-fifth length from anterior end. Just in front of them, internal mold marked by impression of strong oblique subumbonal internal ridge or callosity extending to rather pronounced anterior muscular impression, also recognizable, though less strongly marked, in modern Chinese species of this genus. The hinge line of mold extends in straight line behind beak for a distance equal to about three-fifths length of shell and then curves into posterior margin, which is regularly rounded. No depression in hinge line, showing that valves met internally with edentulous and unthickened hinge margin. Anterior to beak, mold is depressed and characterized by impressions of two oblique callosities already referred to, but so far as can be ascertained from two specimens now in our possession, there is no dentition. Anterior end of mold appears somewhat nasute, due to dorsal depression, rounding regularly into ventral margin, straight for greatest length of shell except for very gentle median concavity. Posterior muscle scar situated close to

posterodorsal margin, this and anterior one being deposed much as in modern species of *Mycetopus* [*sic*].

Emended diagnosis of type species.—(Translation from Chinese text, J. Chen, 1984, p. 151): Shell medium; elongate, with height to length ratio about 0.4; umbo low and broad, slightly projecting above hinge line, located at about one-quarter shell length from anterior; anterior end narrow, rounded, protracting forward; anterior dorsal margin distinctly incurved near unbo; posterior shell elongate, with posterior margin roundly quadrate in form; middle part of ventral margin generally with shallow sinus; posterior ridge absent; surface only with commarginal lines and few rugae, but without W-shaped sculpture; dentition and musculature same as in genus.

Type locality.—Ningjiagou, Mengyin, Shandong, eastern China.

Type occurrence.—Middle part of Mengyin Formation, Lowest Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology (type material lacking accession number; plesiotypes: 63120–63127).

Distribution of genus.—Upper Jurassic; northern and eastern China and Mongolia (J. Chen, 1984, p. 150); Recently, J. Chen (1999, p. 101) regarded *Mengyinaia* as ranging from Upper Jurassic to Berriasian, Lower Cretaceous, based on faunal correlation.

Taxonomic position.—Margaritiferidae (by original designation).

Genus PSEUDELLIPTIO
Zhu, 1976, p. 23
[in Chinese]

[*emend*. Ma, 1991, p. 709 (in Chinese)]
Figure 20.16–20.25

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Zhu, 1976, p. 23): shell medium to large, elliptical to oval. Umbonal region ornamented with more than 10 regular, W-shaped costae, and two radial ribs extending from umbo to posterior; lower radial rib coinciding with posterior ridge; other surface with fine and dense irregular growth lines. Dental formula: (5a), 3a, (1), (1'), 3b, 5b/6a, 4a, (2), (2'), 4b, 6b; among them, tooth 5a weakly developed and unstable; submedian teeth (1 and 1') sometimes present at lower left side of tooth 3a in right valve; tooth 4b undeveloped; anterior adductor scar with row of cocoonlike projections.

Emended diagnosis of genus.—(Translation from Chinese text, Ma, 1991, p. 709): Shell medium to large, elliptical. Umbonal region ornamented with more than 10 regular, W-shaped costae, and 2 radial ribs extending from umbo to posterior; among them, lower radial rib just coinciding with posterior ridge, upper one disappearing on posterodorsal part; other surface with fine and dense irregular growth lines. Dental formula: (5a), 3a, PIII (3b in original text)/4a, 2a, PII (2b in original text), PIV (4b in original text); pseudocardinal teeth arranged as imbricate-like, among them 2a, 3a, and 4a generally split; 5a thin-lamellar, smooth; posterior lateral teeth (PII, PIII, and PIV, 2b, 3b and 4b respectively in original text) elongate-lamellar, smooth. Anterior adductor scar deep, striated, accompanied by two pedal scars respectively at middle-inner side and upper-inner side; posterior adductor scar shallower; pallial line simple; internal shell margin smooth.

Type species.—*Pseudelliptio longus* Zhu, 1976, p. 23, pl. 1,*5–6,7a–c* (holotype), *8–11*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Zhu, 1976, p. 23): Shell medium to large, elliptical to oval; with length more than two times height; largest specimen about 70 mm long. Umbo low; beak small, slightly prosogyrate, slightly projecting above hinge line, positioned at about one-fifth shell length from anterior. Umbonal region ornamented with 15–18 regular, W-shaped or commarginal costae and two radial ribs; ribs prominent in umbonal region but indistinct distally; upper one more prominent and running from umbo to posterodorsal part and interrupting W-shaped or commarginal costae; lower one just coinciding with posterior ridge and intersecting costae at angles of about 60°; other surface with irregular, closely spaced growth lines. Measurements: 40–50 mm long, 18–20 mm high, holotype not complete, 47 mm long, 20 mm high, 14 mm wide (bivalved).

Type locality.—Qagan Limen Nur, Sonid Youqi, Inner Mongolia, North China.

Type occurrence.—Qagan Limen Nur Formation, Lower Cretaceous.

Repository of type material.—Shenyang Institute of Geology and Mineral Resources, Shenyang, Liaoning, China; type material lacking accession number; plesiotypes (deposited in Nanjing Institute of Geology and Palaeontology): 102344, 102346–102349.

Distribution of genus.—Lower Cretaceous; Inner Mongolia, North China (Zhu, 1976, p. 23).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—?Margaritiferidae.

Family UNIONIDAE Rafinesque, 1820
Subfamily UNIONINAE Rafinesque, 1820
Genus PERIODUNIO
Guo, 1988, p. 123
[in Chinese]

Figure 20.32–20.33

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1988, p. 123): elongate-oval; equivalve, inequilateral; both anterior and posterior ends rounded; dorsal and ventral margins arched. Umbo broadly rounded, projecting above hinge line; beak slightly incurved, prosogyrate, positioned at one-third shell length from anterior. Surface ornamented with commarginal lines. Hinge of left valve with enclosed lamellar tooth extending from upper side of anterior adductor scar to upper side of posterior adductor scar; this results from connection and merging of two anterior teeth (4a and 2a) with posterior tooth (PII) as in *Unio*; posterior tooth PIV positioned on upper side of PII, starting from near umbo and extending backward and nearly parallel to dorsal margin and enclosed lamellar tooth; between two teeth is a long socket. Right valve with two anterior teeth (3a and 5a) and one posterior lamellar tooth (PIII); tooth 3a short-lamellar, opisthocline, laterally striated; 5a weak, thin, low, opisthocline; PIII elongate-lamellar. Anterior adductor scar deep, kidneylike in

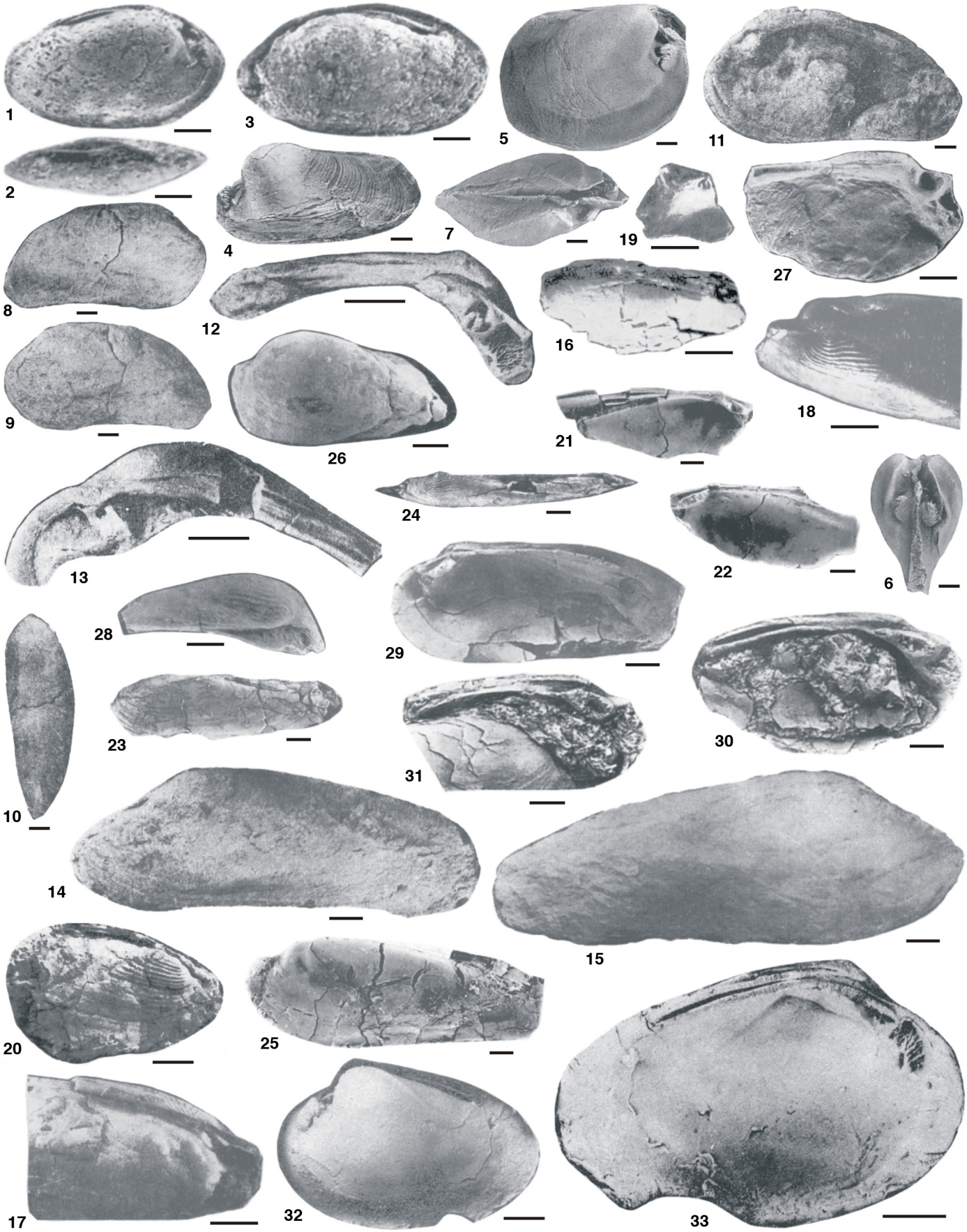

Figure 20. *For explanation, see facing page.*

form, with arborescent-like striations, posterior side inserted by two pedal scars; posterior adductor scar larger and shallower, elliptical in form, with one deep pedal scar on upper side.

Type species.—*Periodunio yunnanensis* Guo, 1988, p. 124, pl. 3,*3* (holotype), text-fig. 5; by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1988, p. 124): Elongate oval, with length less than two times height; moderately inflated; test medium thick. Both anterior and posterior ends rounded; dorsal and ventral margins arched; umbo broad, rounded, projecting above hinge line; beak slightly incurved, prosogyrate, positioned at about one-third shell length from anterior; posterior ridge not prominent. Surface covered by growth lines; inner surface with shallow and narrow radial groove at posterior slope of umbonal cavity, but not reaching posterior adductor scar.

Type locality.—western Yunnan, southwestern China.

Type occurrence.—Huakaizuo Formation, Middle Jurassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0664 (holotype).

Distribution of genus.—Middle Jurassic; Western Yunnan, southwestern China (Guo, 1988, p. 124).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—*Periodunio* might be a junior synonym of *Unio* Philipsson; minor difference in dentition between it and *Unio* might be due to variation.

Genus NINGXIACONCHA Ma, 1991, p. 707

[in Chinese with English diagnosis, p. 712]

Figure 20.1–20.3

Discussion and diagnosis.—Original diagnosis (Ma, 1991, p. 712): shell medium sized, oval-orbicular, elliptic to elongate-quadrilateral. Umbonal region containing regular concentric plications or concentric striae. Hinge teeth strong, arranged in formula of (5a), 3a, 3b, 5b/4a, 2a, 2b, 4b, among which 2a and 3a are triangular, with irregular crenulation on surface; 4a is short-flaky, appearing smooth in appearance, subparallel to anterior dorsal margin; 5a slender, sometimes absent; while 2b, 3b, 4b, and 5b are long-flaky, smooth parallel to posterior dorsal margin. In dimyarians, anterior adductor scar deep, with rough grooves on inner side but shallower and smooth on outer side, with a small retractor scar on upper and middle parts of inner side; posterior adductor scar shallow and smooth, also with small retractor scar on upper part of inner side; pallial line simple [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Ma, 1991, p. 707): Shell medium, ovate, elliptical to elongate-quadrilateral; umbonal region ornamented with regular commarginal costae or lines. Hinge teeth well developed; dental formula: (5a), 3a, PIII (3b in original text), PV (5b in original text)/4a, 2a, PII (2b in original text), PIV (4b in original text); teeth 2a and 3a triangular in form, irregularly crenulated; 4a short, lamelliform, smooth, nearly parallel to anterodorsal margin; 5a lamelliform, sometimes absent; all posterolateral teeth elongate-lamellar, smooth, parallel to posterodorsal margin. Dimyarian; posterior side of anterior adductor scar deep, strongly and irregularly striated, anterior side shallow and smooth; upper-inner side and middle-inner side inserted respectively with one pedal scar; posterior adductor scar shallow, smooth, upper-inner side accompanied by pedal scar; pallial line entire.

Type species.—*Unio obrutschewi* Martinson, 1956, p. 50, pl. 7,*64*; by original designation.

Type occurrence.—Lower Cretaceous.

Distribution of genus.—?Upper Jurassic, Lower Cretaceous; northern China, Siberia, Mongolia, and Europe (Ma, 1991, p. 707).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Junior synonym of *Unio*.

Note.—See Martinson (1956) for figure and original diagnosis of type species. We retranslate Ma's (1991) Chinese diagnosis of *Ningxiaconcha* Ma, because his English diagnosis (p. 712) does not coincide with his Chinese diagnosis (p. 707).

Genus LINSHUIELLA Ma, 1999, p. 225

[in Chinese with English diagnosis, p. 231]

Figure 20.4–20.7

Discussion and diagnosis.—Original diagnosis (Ma, 1999, p. 231): shell thin, medium, almost round to rectangular. Deep triangular groove extending from umbo area to ventral area. Growth lines fine and dense, covering whole surface. Dental formula: (5a), 3a, 3b/4a, 2a, 2b, 4b. Anterior pseudocardinal teeth with shape, structure, and depth of lines unstable. Posterior lamellar

Figure 20. *1–3.* Plesiotypes of *Ningxiaconcha obrutschewi* (Martinson), scale bar 5 mm; *1,* right internal mold; *2,* dorsal view of Fig. 20.1; *3,* left internal mold (adapted from Ma, 1991, pl. 1,*7a–b,8*).——*4–7. Linshuiella tetragonalis* Ma, scale bar 5 mm; *4,* holotype, left composite mold; *5–7,* paratype, right internal mold; *5,* right lateral view; *6,* anterior view; *7,* dorsal view (adapted from Ma, 1999, pl. 8,*12,13a–c*).——*8–15. Eocuneopsis* Guo, 1985a, scale bar 5 mm; *8–13, Eocuneopsis princepus* Guo; *8–10,* holotype, articulated shell; *8,* right lateral view; *9,* left lateral view; *10,* dorsal view; *11,* paratype, right internal view; *12,* paratype, left interior view; *13,* paratype, right internal view (adapted from Guo, 1988, pl. 7,*10a–c,11b,13,14*); *14–15, Eocuneopsis yunnanensis* Guo; *14,* holotype, right lateral view; *15,* paratype, left lateral view (adapted from Guo, 1985a, pl. 41,*2,3*).——*16–25. Pseudelliptio longus* Zhu, scale bar 5 mm; *16–20,* type material; *16–18,* holotype, articulated shell; *16,* left interior view; *17,* right lateral view; *18,* left lateral view; *19,* paratype, right interior view; *20,* paratype, right lateral view (adapted from Zhu, 1976, pl. 1,*7a–c,5,6b*); *21–25,* plesiotypes; *21,* left interior view; *22,* right interior view; *23–24,* left valve; *23,* lateral view; *24,* dorsal view; *25,* left internal mold (adapted from Ma, 1991, pl. 1,*13,16,17a–b,18*).——*26–28. Acuneopsis luochengensis* Liu & Zhu, scale bar 10 mm; *26,* holotype, left valve; *27,* paratype, left interior view; *28,* dorsal view of Fig. 20.27 (adapted from Liu & Zhu in Cai & Liu, 1978, pl. 119,*1,2a–b*).——*29–31. Unio (Palaeunio) sichuanensis* Ma, scale bar 5 mm; *29,* holotype, right interior view; *30–31,* paratype, left interior views (adapted from Ma, 1999, pl. 1,*9,5,6*).——*32–33.* Holotype of *Periodunio yunnanensis* Guo, scale bar 5 mm; *32,* left internal mold; *33,* latex cast of Fig. 20.32 (adapted from Guo, 1988, pl. 3,*3a–b*).

teeth smooth. Muscle scar system as in *Zhongbanaia* mentioned above [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Ma, 1999, p. 225): Shell medium; circular to elongate-rectangular; test very thin; fairly inflated. Surface with broad-triangular groove extending from umbo to ventral part; posterior ridge carina-like or broadly rounded; commarginal lines fine and dense, obliquely intersecting posterior hinge margin. Dental formula: (5a), 3a, PIII (3b in original text), PV (5b in original text)/4a, 2a, PII (2b in original text), PIV (4b in original text); anterior pseudocardinal teeth variable in shape and arrangement and in strength of teeth crenulation; posterior lateral teeth smooth. Anterior adductor scar deep, with arborescent-like striations, accompanied by two small pedal scars at upper-inner side and middle-inner side respectively; posterior adductor scar shallow; pallial line simple.

Type species.—*Linshuiella tetragonalis* Ma, 1999, p. 226, pl. 8,*7–11*,*12* (holotype), *13*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Ma, 1999, p. 226): Shell fairly large, elongate tetragonal; test very thin; moderately inflated. Anterior margin rounded; ventral margin widely curved; posterodorsal margin nearly straight; posterior margin slightly truncated; posterodorsal end obtuse-angular; posteroventral end narrowly rounded. Umbo obtuse; beak prosogyrate, situated near anterodorsal end; posterior ridge prominent or carina-like at umbonal region, becoming obtusely rounded toward posteroventral part. Surface with triangular groove extending from umbo to anteroventral part; groove narrower and deeper in umbonal region, gradually becoming wider and shallower ventrally. Growth lines fine and dense, intersecting posterodorsal margin at varying angles. Each valve with two posterior lateral teeth, lamellar and smooth; in left valve anterior tooth 2a oblique-triangular, 4a short-lamellar; in right valve tooth 3a triangular, conelike, strongly grooved; 5a undeveloped. Musculature as in genus. Lived in brackish water.

Type locality.—Houziyan, Linshui, Sichuan, southwestern China.

Type occurrence.—Xujiahe Formation, Upper Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 108633 (holotype); 108628–108632, 108634.

Distribution of genus.—Upper Triassic; Sichuan, southwestern China (Ma, 1999, p. 226).

Taxonomic position.—?Actinodontophoridae (by original designation).

Revision suggestion.—Unionidae.

Note.—We retranslate Ma's (1999) Chinese diagnosis of *Linshuiella* Ma, because his English version (p. 231) does not coincide with his Chinese diagnosis (p. 225).

Genus EOCUNEOPSIS Guo, 1985a, p. 178

[in Chinese]

Figure 20.8–20.15

Name history.—Originally *Cuneopsis (Eocuneopsis)* Guo, 1985a, p. 178; *non Cuneopsis (Eocuneopsis)* Guo, 1988, p. 122.

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1985a, p. 178): shell elongate, cuneiform or elliptical; moderately inflated; test medium thick or thick. Anterior shell short, narrow; anterior margin subrounded; posterior shell longer and becoming gradually narrower posteriorly; sometimes winding laterally; ventral margin widely curved or with sinus. Surface usually with shallow and broad median sulcus extending from umbo to ventral margin. Umbo broad, obtuse, positioned anteriorly; posterior ridge not prominent. Umbonal region ornamented with regular commarginal costae, other surface with growth lines and rugae. Hinge plate moderately broad, with two anterior pseudocardinal teeth in each valve, two posterior lateral teeth in left valve and one in right valve; sometimes right valve additionally with one small submedian tooth; dental formula: 5a, 3a, 1, PIII/4a, 2a, PII, PIV; tooth 3a strong, short, conelike, laterally striated; 5a weak and low, short-lamellar; tooth 1 generally lacking; 4a slightly opisthocline, lamellar; 2a relatively strong, oblique-triangular; PII, PIII, and PIV elongate-lamellar, nearly parallel to hinge line.

Type species.—*Cuneopsis (Eocuneopsis) yunnanensis* Guo, 1985a, p. 180, pl. 41,*2* (holotype), *3* (by new designation herein); *non Cuneopsis (Eocuneopsis) princepus* Guo, *sp. nov.,* in Guo, 1988, p. 122, pl. 7,*10* (holotype), *11–14*; original designation by Guo (1985a) and later designation by Guo, 1988; but according to Art. 69.3 of the ICZN (1999), Guo's designations are invalid.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1985a, p. 180): Shell narrow and elongate, cuneiform, with length slightly more than 2.8 times as long as height; rather inflated, with convexity about two-thirds shell height. Anterior shell short, narrow, and slightly pointed; anterior margin suborbicular; posterior shell elongate and becoming narrower posteriorly, cuneiform; posterior end suborbicular; ventral margin slightly concave. Umbo broad, obtuse; beak incurved, slightly projecting above hinge line, positioned at about one-quarter shell length from anterior. Posterior ridge broadly rounded, not very distinct; median sulcus wide and shallow, not very distinct. Surface covered by growth lines.

Type locality.—Heping, Jinggu, Yunnan, southwestern China.

Type occurrence.—Hepingxiang Formation, Middle Jurassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0482 (holotype); IVy0483.

Distribution of genus.—Jurassic; Asia (Guo, 1985a, p. 179).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—The hinge of *Cuneopsis (Eocuneopsis)* not very similar to that of the Cenozoic genus *Cuneopsis*, therefore *Eocuneopsis* should be regarded as generically distinct from *Cuneopsis. Eocuneopsis* is confined to Lower Jurassic–Middle Jurassic in Asian paleoland.

Note.—*Cuneopsis (Eocuneopsis)* first appearred as a manuscript subgenus name in Guo, 1985a, p. 178, with *Cuneopsis (Eocuneopsis) princepus* Guo (Fig. 20.8–20.13) designated as the type species. The latter species name was not then available, as it too was only a manuscript name. However, Guo (1985a) also named, described, and figured three new species, *Cuneopsis (Eocuneopsis) dehuaensis* Guo, *C. (E.) sulcatus* Guo, and *C. (E.) yunnanensis* Guo, under the subgenus name *Cuneopsis (Eocuneopsis)* Guo, and we interpret these as validating *Cuneopsis (Eocuneopsis)* Guo, 1985a, with *Cuneopsis (Eocuneopsis) yunnanensis* Guo, 1985a as the type species

(Fig. 20.14–20.15). Guo (1988, p. 122) once again proposed *Cuneopsis (Eocuneopsis)* as a new subgenus and described the new species *Cuneopsis (Eocuneopsis) princepus* Guo, which was illegally designated as the type species.

Genus LIOVETULONAIA Ma, 1999, p. 212

[in Chinese with English diagnosis, p. 229]

Discussion and diagnosis.—Original diagnosis (Ma, 1999, p. 229): shell oval or long-rectangular, thick and heavy with concentric lines covering umbonal region and surface. Denticles formula: (5a), 3a, 3b/4a, 2a, 2b, 4b, with upper and lower parts of 2a and 4a combined together to form socket of 3a; 3a triangular, 5a V-shaped when present. In dimyarians, anterior adductor scar bearing arborescent structures with two small retractor scars on inner side; posterior adductor scar shallow and smooth, pallial line simple [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Ma, 1999, p. 212): Shell medium, elongate-oval to cuneiform. Shell thick and heavy; inflated. Entire surface covered by commarginal growth lines. Hinge paleoheterodont, dental formula: 5a, 3a, PIII (3b in original text)/4a, 2a, PII (2b in original text), PIV (4b in original text); anterior pseudocardinal teeth laterally striated in general; 2a oblique-cuneifom; 3a triangular, conelike or nipple-like; 4a short, flaky, its apex generally incurved and adjoining 2a; 5a small, reversed-triangular, sometimes absent; posterior lateral teeth long, lamellar, smooth. Anterior adductor scar deep, with arborescent-like striations; upper-inner side and middle-inner side respectively inserted with small and deep, striated pedal scar; posterior adductor scar shallower, with concentric striae, accompanied by one pedal scar at upper-inner side; pallial line simple.

Type species.—*Unio thailandica* Hayami, 1968, p. 101, pl. 49,*10–11*; by original designation, Ma, 1999.

Type locality.—Khorat, Thailand.

Type occurrence.—Phu Kradung Formation, Khorat Series, Middle Jurassic.

Distribution of genus.—Mesozoic; Asia, North America, North Africa, and Europe (Ma, 1999, p. 213).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Junior synonym of *Eocuneopsis* Guo, 1985a; originally *Cuneopsis (Eocuneopsis)* in Guo, 1985a.

Note.—Refer to Hayami (1968) for figures and original diagnosis of type species. We retranslate Ma's (1999, p. 212) Chinese diagnosis of *Liovetulonaia* Ma, because his English diagnosis is difficult to understand.

Genus UNIO Philipsson in Retzius, 1788
Subgenus UNIO (PALAEUNIO)
Ma, 1999, p. 208

[in Chinese]

Figure 20.29–20.31, 21.12–21.14

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Ma, 1999, p. 208): medium, elongate-quadrilateral; test fairly thin; umbonal region ornamented with W-shaped costae; hinge unionid; dental formula: (5a), 3a, PIII (3b in original text)/4a, 2a, PII (2b in original text), PIV (4b in original text); anterior pseudocardinal teeth laterally grooved; tooth 2a transverse cuneiform or obliquely-triangular; 3a short-lamellar; 4a lamellar, anterior apex curved backward and fused with 2a; posterior lateral teeth elongate-lamellar, smooth. Anterior adductor scar deep, with arborscent-like striations; rear side inserted with two pedal scars; posterior adductor scar shallow with concentric and radial lines, posterodorsal side inserted with one pedal scar; pallial line entire.

Type species.—*Unio (Palaeunio) sichuanensis* Ma, 1999, p. 208, pl. 1,*4–8*,*9* (holotype), *10–13*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Ma, 1999, p. 208): Transversely elongate-quadrilateral; anterior margin rounded, posterodorsal margin nearly straight, posterior margin truncated, posteroventral angle narrowly rounded; ventral margin with wide sinus at middle-posterior part; umbonal region ornamented with five W-shaped costae; other surface with irregular growth lines. Tooth 3a short-lamellar, irregularly grooved; 5a undeveloped; 2a oblique-triangular; 4a short-lamellar, anterior apex curved backward and connecting 2a to form a socket between them, which receives tooth 3a of right valve; posterior lamellar teeth smooth, two in left valve and one in right valve; musculature same as in diagnosis for subgenus.

Type locality.—Dakang, Zhongba, Sichuan, southwestern China.

Type occurrence.—Ziliujing Formation, Middle Jurassic (Ma, 1999); Lower Jurassic–Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 58508 (holotype); 58503, 58505, 58506, 58513–58518.

Distribution of subgenus.—Middle Jurassic; South China (Ma, 1999, p. 208); Lower Jurassic–Middle Jurassic.

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Junior synonym of *Eocuneopsis* Guo, 1985a; originally *Cuneopsis (Eocuneopsis)* in Guo, 1985a.

Genus ACUNEOPSIS
Liu & Zhu in Cai & Liu, 1978, p. 371

[in Chinese]

Figure 20.26–20.28

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Liu & Zhu in Cai & Liu, 1978, p. 371): shell thick; medium to large; anterior part short, posterior part elongate; oval, elongate-elliptical, or cuneiform; equivalve, inequilateral. Hinge margin long, slightly incurved; anterior margin rounded; posterior margin short and oblique; ventral margin long, generally curved, but occasionally incurved; moderately to strongly inflated; posterior ridge generally prominent. Umbonal region broad and convex, generally with broad groove; beak big, prosogyrate, projecting high above hinge line, positioned anteriorly; in front of it shell margin distinctly incurved. Surface ornamented with commarginal lines and rugae; umbonal region with highly projected, acutely topped, W-shaped costae, and a row of radially arranged pustules or nodes along posterior ridge. In front of umbo, two S-formed radial grooves, wide and deep, extending from beak to anterodorsal end and anteroventral margin respectively; surface between two

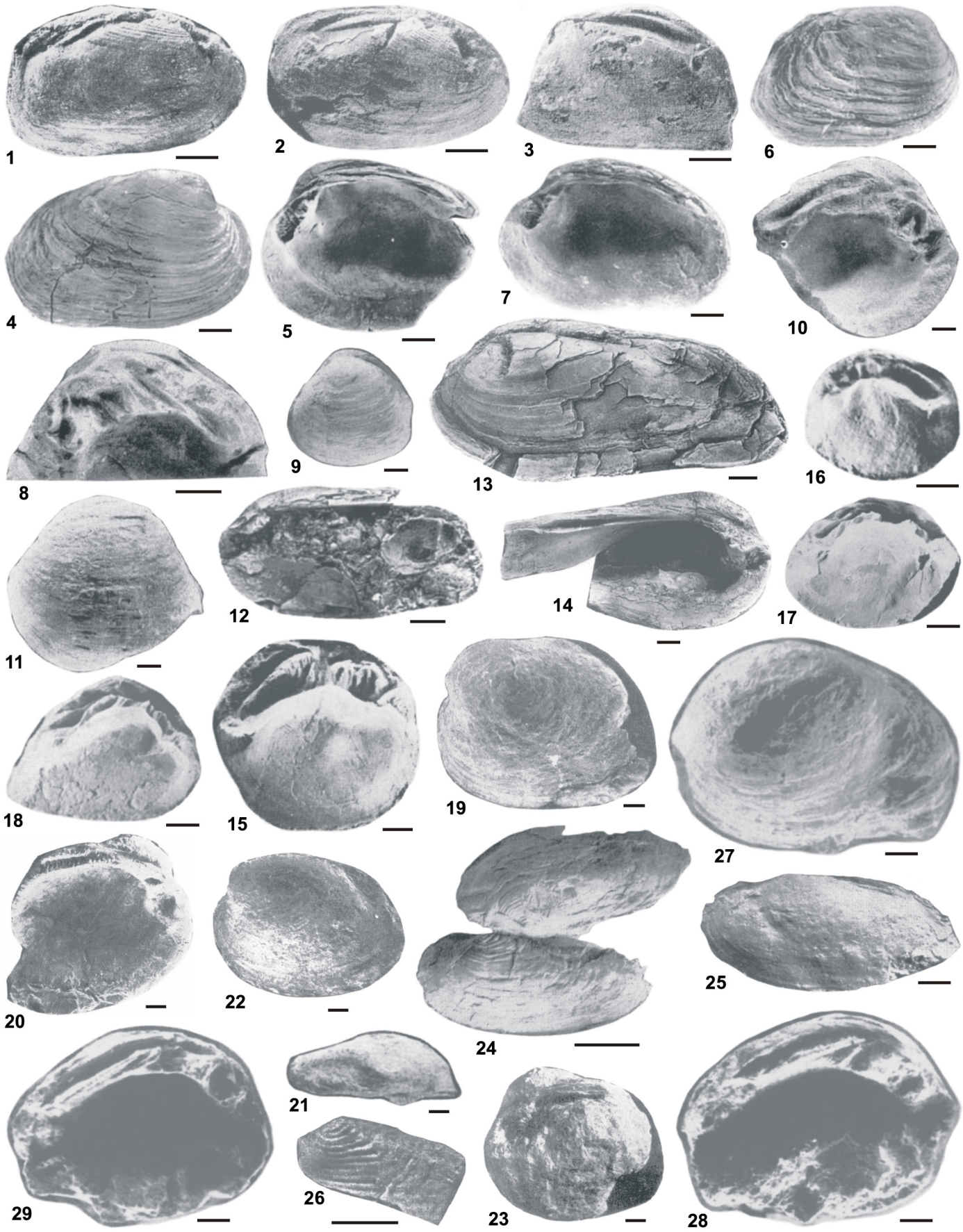

Figure 21. *For explanation, see facing page.*

grooves ornamented with dense commarginal lines and fine radial lines or striae; dorsal side of upper groove with only commarginal lines. Lunule wide, deeply impressed; escutcheon narrow, not distinct. Hinge plate developed, very broad and thick in anterior part, but narrower posteriorly; hinge teeth stout and strong; right valve with three anterior pseudocardinal teeth and one posterior lateral tooth; tooth 1 elongate-triangular; 3a large; 5a small; PIII (3b in original text) long, ridgelike; left valve with three anterior pseudocardinal teeth and two posterior lateral teeth; tooth 2a elongate-oblique-triangular; 4a and 6a curved-conelike, pointed backward; PII (2b in original text) and PIV (4b in original text) long-ridgelike; all pseudocardinal teeth of both valves laterally striated. Umbonal cavity deep; internal surface smooth; anterior adductor scar deep, not smooth, sometimes with honeycomb-like striations, oval in form; posterior side inserted with two pedal scars; buttress especially developed.

Type species.—*Acuneopsis luochengensis* Liu & Zhu in Cai & Liu, 1978, p. 372, pl. 119,*1* (holotype), *2–3*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Liu & Zhu in Cai & Liu, 1978, p. 372): Shell thick, fairly large; cuneate-oval; length about two times as long as height. Posterodorsal margin long and straight, slightly opisthocline; anterodorsal margin short; anterodorsal angle about 90º; anterior end broad, slightly protracted, widely curving, passing into weakly curved ventral margin; posterodorsal margin fairly long, slightly oblique, intersecting short and truncated posterior margin at obtuse angle; posteroventral end protracted backward, posteroventral angle about 60º–70º; strongly inflated, most convex at one-third to one-half shell height from beak, but ventral part relatively flat; posterior ridge prominent, posterior area narrow and steep. Umbo broad and inflated; beak large, incurved, prosogyrate, projecting high above hinge line, positioned at one-quarter to one-fifth shell length from anterior; shell in front of beak distinctly depressed. Surface ornamented with irregular commarginal lines and rugae; umbonal region with highly projected, acutely topped W-shaped costae, and row of radially arranged pustules or nodes along posterior ridge; broad groove just below umbo; in front of umbo with two S-formed, wide, and deep grooves, extending radially from beak to anterodorsal end and anteroventral margin respectively; surface between two grooves ornamented with dense commarginal lines and fine radial lines or striae; dorsal side of upper groove with only commarginal lines; lunule wide, deeply impressed; escutcheon narrow, not distinct. Hinge plate developed, very broad and thick in anterior, but narrower posteriorly; hinge teeth stout and strong; right valve with three anterior pseudocardinal teeth and one posterior lateral tooth; tooth 1 elongate-triangular; 3a large; 5a small; PIII (3b in original text) long, extending to posterodorsal angle; left valve with three anterior pseudocardinal teeth and two posterior lateral teeth; tooth 2a elongate-oblique-triangular; 4a and 6a curved-conelike, pointed backward; PII (2b in original text) and PIV (4b in original text) long-ridgelike, extending to posterodorsal angle; all pseudocardinal teeth of both valves laterally striated. Umbonal cavity deep and wide; internal surface smooth; anterior adductor scar deep, oval in form; posterior side inserted with two pedal scars; posterior adductor scar large and shallow; buttress especially developed. Measurements: 54–62 mm long, 28–32 mm high, 30–40 mm wide, ratio of height to length 0.5.

Type locality.—Luocheng, Jianwei, Sichuan, southwestern China.

Type occurrence.—Dongyuemiao Member, Ziliujing Formation, Lower Jurassic–Middle Jurassic.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: Sbi356 (holotype); Sbi357, 358.

Distribution of genus.— Lower Jurassic–Middle Jurassic; Sichuan, southwestern China (Liu & Zhu in Cai & Liu, 1978, p. 372).

Taxonomic position.—Unionidae (by original designation).

Genus UNIONELLOIDES Gu [Ku], 1962, p. 148

[in Chinese]

[*emend.* Ma, 1984, p. 598 (in Chinese)]

Figure 21.8–21.11

Discussion and diagnosis.—Original diagnosis of genus [translation from Chinese text, Gu (Ku), 1962, p. 148]: rounded-triangular, test thick; surface smooth; posterior ridge fairly prominent;

Figure 21. *1–3. Comptio weiyuanensis* Liu & Luo, scale bar 10 mm; *1,* holotype, right composite mold; *2,* paratype, right composite mold; *3,* paratype, left internal mold (adapted from Liu & Luo in Cai & Liu, 1978, pl. 114,*1–3*).——*4–7. Liopotomida subquadrata* Ma, scale bar 5 mm; *4,* holotype, right valve; *5,* paratype, right interior view; *6,* paratype, right valve; *7,* paratype, right interior view (adapted from Ma, 1999, pl. 3,*17,14,21,22*).——*8–11. Unionelloides globitriangularis* Gu [Ku], scale bar 5 mm; *8,* lectotype, right interior view (adapted from Gu in Gu et al., 1976, pl. 85,*6,* =Gu [Ku], 1962, pl. 90,*4*); *9,* paralectotype, left lateral view (adapted from Gu in Gu et al., 1976, pl. 85,*1*); *10–11,* metatype, left valve, interior view and exterior view (adapted from Gu in Gu et al., 1976, pl. 85,*8,10*).——*12–14. Unio (Palaeunio) sichuanensis* Ma, scale bar 5 mm; *12,* paratype, right interior view; *13–14,* paratype, left lateral views (adapted from Ma, 1999, pl. 1,*10,12,13*).——*15–18. Jishuiconcha circularis* Ding, Li, & Sun, scale bar 5 mm; *15,* holotype, right internal mold; *16,* paratype, left internal mold, juvenile; *17–18,* paratype, right internal molds (adapted from Ding, Li, & Sun in Ding, Ma, & Huang, 1982, pl. 25,*11,5,10,12*).——*19–23. Qianweiella latiovalis* (Liu & Luo), scale bar 5 mm; *19–21,* holotype, left valve; *19,* lateral view; *20,* interior view; *21,* dorsal view; *22,* paratype, left valve; *23,* paratype, left interior view (adapted from Liu & Luo in Cai & Liu, 1978, pl. 115,*2a–c,1,3*).——*24–26. Jilinoconcha songhuaensis* (Gu & Yu), scale bar 5 mm; *24,* holotype, conjoined valves; *25,* paratype, left internal mold; *26,* paratype, an incomplete left valve, showing ornament of umbo (adapted from Gu & Yu in Gu et al., 1976, pl. 105,*1–3*).——*27–29. Wulongiconcha yajiangensis* Liu, scale bar 5 mm; *27–28,* holotype, left valve, exterior (*27*) and interior view (*28*); *29,* paratype, left interior view (adapted from Liu, 1984, pl. 11,*1a–b,3*).

dentition unionoid, with two lamellar teeth in each valve, sometimes additionally with small embryo lamellar tooth.

Emended diagnosis.—(Translation from Chinese text, Ma, 1984, p. 598): Shell medium; globoid, rounded-triangular, subrhomboid, rounded-quadrate to elliptical; greatly inflated, shell width about two-thirds shell length; umbo obtuse; beak prosogyrate, slightly incurved; posterior ridge prominent. Surface ornamented with only irregular growth lines. Hinge plate fairly thick; teeth well developed; dental formula: 5a, 3a, (1a), PIII (3b in original text), PV (5b in original text)/4a, 2a, (PII) (2b in original text), PIV (4b in original text), PVI (6b in original text); among them tooth 1a poorly developed; size of other pseudocardinal teeth successively decreased in order of 2a>3a>4a>5a; 3a deeply grooved, sometimes rifted; posterior tooth PII (2b) variable and poorly developed, sometimes thin-lamellar when present, but feeble; PIV (4b) and PV (5b) stout, lamellar, crenulated; PVI (6b) lamellar; hinge plate at space between anterior and posterior teeth also finely crenulated. Anterior adductor scar deep, with distinct arborescent-like striations; inner side inserted with two small pedal scars; posterior adductor scar shallower, with no striations, upper-inner side inserted with one pedal scar; umbonal cavity shallow; pallial line entire.

Type species.—*Unionelloides globitriangularis* Gu [Ku], 1962, p. 148, pl. 90,*1*,*4* (lectotype, subsequently designated by Gu in Gu et al., 1976); pl. 91,*1*; by original designation [=*Psilunio globitriangularis* Gu (Ku) in Gu et al., 1976, p. 311, pl. 85,*1–5*,*6* (lectotype, Gu (Ku), 1962, pl. 90,*4*), *7–16*].

Original diagnosis of type species.—[Translation from Chinese text, Ma, 1984, p. 599]: Shell medium, subcircular to roundly triangular; posterodorsal margin obliquely curved; posterior ridge broad or obtuse-angular in transverse section; posterior margin weakly narrow; posteroventral end not protracted; anterior margin short, rounded; ventral margin rounded; beak obtuse, prosogyrate, incurved; umbonal region strongly inflated, highly projected; lunule deeply depressed; posterior ridge developed; posterior area behind ridge steep; nymphs well developed; surface with only commarginal lines; internal structure as in genus diagnosis.

Type locality.—Yongping, Jiangyou, Sichuan, southwestern China.

Type occurrence.—Lower part of Shaximiao Formation, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25199 (holotype); paratypes: 25194, 25196; metatypes: 25195, 25197, 25198, 25200–25203.

Distribution of genus.—Middle Jurassic; China (Ma, 1984, p. 599). More materials (Liu, 1981, 1984; Ma, 1984; Guo, 1985a) indicate that *Unionelloides* ranges from Upper Triassic to the lower Upper Jurassic in China.

Taxonomic position.—Unionidae (by original designation).

Note.—Gu [Ku] (in Gu et al., 1976, p. 308) renounced the genus name *Unionelloides* because he regarded it as a junior synonym of *Psilunio* Stefanescu (=*Potomida* Swainson). But Ma (1984, p. 598) suggested using the genus name because *Unionelloides* is not similar to the latter in dentition and other important characters. Ma's (1984) opinion is herein accepted.

Genus QIANWEIELLA
Liu & Luo in Liu, 1981, p. 123

[in Chinese with English diagnosis, p. 127]

Figure 21.19–21.23

Discussion and diagnosis.—Original diagnosis (Liu & Luo in Liu, 1981, p. 127): Shell medium to large; variable in outline, commonly trigonally ovate, cuneiform and tetragonal in outline; equivalve, inequilateral; moderately to strongly inflated; bluntly rounded posterior ridge. Umbonal region broad and convex, beak rising high above hinge margin, strongly prosogyrous and incurved, situated rather anteriorly. Surface covered with fairly developed concentric rings and lines; without lunule; escutcheon undeveloped. Ligament opisthodetic, external. Umbonal cavity very deep. Inner surface of shell smooth. Hinge plate relatively broad, with 1 pseudocardinal tooth (3a) and 1 long posterior lateral tooth (3b) on right valve; 2 pseudocardinal teeth (4a, 2a) and 2 long posterior lateral teeth (2b, 4b). Dental formula: 3a, 5b/4a, 2a, 2b, 4b; 2a is less stout, less long and narrow, trigonal or luniform with few grooves. 4a shorter, lamellar, situated under pseudocardinal tooth (2a), pointed backward, parallel to posterior lateral teeth, and intersected with pseudocardinal teeth (2a) at sharp angle from 20°–30°. Anterior adductor scar rounded and strongly impressed; posterior one rather large, not so prominent. Pallial line simple and distinctly impressed [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Liu & Luo in Liu, 1981, p. 123): Shell fairly thick; medium to large; oval, circular, triangular, or cuneiform; retrocrescent; equivalve, inequilateral; moderately to rather inflated. Posterior ridge weakly developed, bluntly rounded; umbonal region broad; beaks projecting high above hinge line, strongly prosogyrate, incurved, situated anteriorly. Surface ornamented with commarginal lines; lunule absent; escutcheon undeveloped; ligament external, opisthodetic, ligament groove long and narrow. Internal surface smooth; umbonal cavity deep. Hinge plate broad; hinge teeth well developed; anterior pseudocardinal tooth (3a) of right valve stout, cuneiform or long-triangular; posterior lateral tooth PIII (3b in original text) long-lamellar or ridgelike, slightly curved; tooth 2a of left valve fairly thin, longer-triangular or lunate; 4a also thin, short-lamellar, located on lower side of 2a and intersecting latter at angle of 20°–30°; posterolateral teeth (PII, PIV; 2b and 4b respectively in original text) of left valve long-lamellar, slightly curved; 2a and PII (2b) nearly connected; all pseudocardinal teeth weakly striated. Anterior adductor scar circular, deep; posterior adductor scar larger, shallower.

Type species.—*Psilunio lativalis* Liu & Luo in Cai & Liu, 1978, p. 377, pl. 115,*1*,*2a–c* (holotype), *3*; by original designation, Liu & Luo in Liu, 1981.

Original diagnosis of type species.—(Translation from Chinese text, Liu & Luo in Cai & Liu, 1978, p. 377): Shell thick; medium; widely oval or subquadrilateral. Hinge margin curved; anterodorsal angle obtusely rounded; anterior margin slightly convex, gradually passing into long and convex ventral margin; posterior part slightly expanded; posterodorsal margin long; posterior margin weakly convex, upper-middle part obliquely truncated, and lower part roundly angular; posterodorsal angles ~130°–135°,

posteroventral angles ~75°–80°. Shell fairly inflated, but flat in ventral part, largest inflation at upper-anterior part. Umbonal region broad, umbo broadly gibbose, beak large and low, distinctly prosogyrate, projecting above hinge line, positioned anteriorly. Posterior carina moderately prominent, rounded, but disappearing at posteroventral end. Surface ornamented with regular, closely spaced commarginal costae and lines. Right valve preserved with one triangular-conelike anterior pseudocardinal tooth (3a) and one slightly curved long-lamellar posterior lateral tooth (PIII, 3b in original text); left valve with two anterior pseudocardinal teeth (2a and 4a) and two posterior lateral teeth (PII and PIV; 2b and 4b respectively in original text); tooth 2a long-triangular, 4a opisthocline-triangular, lateral teeth PII (2b) and PIV (4b) extending into posterodorsal end; all pseudocardinal teeth with regular lateral striations. Umbonal cavity deep; internal shell surface smooth. Anterior adductor scar deep, circular; posterior adductor scar shallower and larger. Measurements: 47–54 mm long, 37–41 mm high, ratio of height to length 0.76–0.80.

Type locality.—Jiayang, Qianwei, Sichuan, southwestern China.

Type occurrence.—Wuzhongshan Formation, Upper Triassic.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: Sbi313 (holotype); Sbi312, 314.

Distribution of genus.—Upper Triassic; Sichuan, southwestern China (Liu & Luo in Liu, 1981, p. 124).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—*Qianweiella* is a junior synonym of *Unionelloides* Gu [Ku], 1962, and represents oldest occurrence of latter genus.

Note.—We retranslate the Chinese diagnosis of *Qianweiella* Liu and Luo because the English diagnosis (p. 127) does not coincide with the original Chinese diagnosis (p. 123).

Genus JISHUICONCHA Ding, Li, & Sun in Ding, Ma, & Huang, 1982, p. 64

[in Chinese]

Figure 21.15–21.18

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Ding, Li, & Sun in Ding, Ma, & Huang, 1982, p. 64): shell medium; test fairly thick; circular, rounded-triangular to elliptical; moderately to strongly inflated, with greatest inflation at upper part; umbo highly projected; beak prosogyrate, located at one-half to one-third shell length from anterior; posterior ridge prominent or not prominent. Inner surface smooth; external surface ornament not preserved. Hinge plate broad and thick; teeth stout and large; left valve with two strongly grooved anterior pseudocardinal teeth and two posterior lateral teeth; upper one of posterior teeth (PIV, 4b in original text) thin-lamellar, smooth; lower one (PII, 2b in original text) thicker and stronger, with oblique striations; right valve with two anterior pseudocardinal teeth and two or three posterior teeth; 3a fairly stout and strong; 5a short and small; PIII (3b in original text) rather short, laterally striated; PV (5b in original text) fairly long, thick-lamellar, with lateral striations; PVII (7b in original text) thin-lamellar and short when present; umbonal cavity shallow or fairly deep. Anterior adductor scar deep, oblique-oval, with arborescent-like striations; two deep pedal scars accompany it, upper one close to it and lower one distinctly isolated; posterior adductor scar larger, semicircular; upper part deeper and lower part shallower; dorsal side inserted with one isolated pedal scar.

Type species.—*Jishuiconcha circularis* Ding, Li, & Sun in Ding, Ma, & Huang, 1982, p. 65, pl. 25,*5*,*10*,*11* (holotype), *12*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Ding, Li, & Sun in Ding, Ma, & Huang, 1982, p. 65): Shell medium; circular or subcircular, nearly as long as high; all anterior, posterior, and ventral margins rounded; moderately inflated, with largest inflation at umbonal region; beak prosogyrate, projecting above hinge line, positioned slightly anterior of midpoint of shell length; posterior ridge rather prominent, broadly rounded; inner surface smooth; hinge teeth weak and not striated in preadult specimens.

Type locality.—Xidong, Jishui, Jiangxi, eastern China.

Type occurrence.—Luoao Formation, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Mineral Resources, Nanjing; accession number: H1544 (holotype); H1542, 1543, 1545.

Distribution of genus.—Middle Jurassic; Jiangxi, eastern China (Ding, Ma, & Huang, 1982, p. 65).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Junior synonym of *Unionelloides* Gu [Ku] (suggested by Ma, 1999, p. 218; accepted herein).

Genus WULONGICONCHA Liu, 1984, p. 551

[in Chinese]

Figure 21.27–21.29, 22.11

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Liu, 1984, p. 551; slightly abridged): shell thick and heavy, fairly inflated; medium or large; circular, rounded-triangular, oval or elliptical; equivalve; inequilateral. Posterior ridge obtusely rounded; umbo obtuse; beak incurved, prosogyrate, projecting high above hinge line, positioned anteriorly. Surface ornamented with commarginal lines and rugae; lunule rather deep; escutcheon narrow, not developed; opisthodetic, ligament long, inserted in narrow, long, and deep groove. Hinge plate very broad and thick; teeth developed; dental formula: 5a, 3a, PIII (3b in original text), PV (5b in original text)/4a, 2a, PII (2b in original text), PIV (4b in original text), PVI (6b in original text); tooth 5a undeveloped; 3a large and stout, triangular-conelike or nipplelike; 4a narrow and small; 2a strong, conelike; posterior lateral tooth PII (2b) short, not well developed, invisible sometimes; PIII (3b) fairly thin; PIV (4b), PV (5b), and PVI (6b) long, well developed, among them PV (5b) most strong; all anterior and posterior teeth regularly striated. Anterior adductor scar smaller, deep, circular, with arborescent-like striations; upper-posterior and lower-posterior sides respectively inserted with pedal scar; lower one isolated; posterior adductor scar deep, circular, larger, its upper-anterior side inserted with isolated pedal scar; umbonal cavity shallow or moderately deep; inner shell surface smooth; pallial line entire.

Type species.—*Wulongiconcha yajiangensis* Liu, 1984, p. 552, pl. 11,*1* (holotype), *2–4*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Liu, 1984, p. 552): Shell thick and heavy; small to medium; oval, with largest height at one-third shell length from anterior. Dorsal margin curved; anterior margin widely rounded; posterior margin narrower; posteroventral end roundly acute; ventral margin long and curved; fairly inflated, with largest inflation at middle-upper part; posterior ridge obtusely rounded, not prominent. Umbo broad, not projecting; beak prosogyrate, positioned at one-quarter to one-fifth shell length from anterior. Surface ornamented with commarginal lines or rugae. Hinge plate very broad and thick; teeth developed; dental formula: 5a, 3a, PIII (3b in original text), PV (5b in original text)/4a, 2a, PII (2b in original text), PIV (4b in original text), PVI (6b in original text); among them, tooth 5a undeveloped; 3a stout and strong, triangular-conelike or nipplelike; 4a narrow and small; 2a fairly stout and strong, conelike; posterior teeth lamellar; PII (2b) not developed, short; teeth PIII (3b), PIV (4b), PV (5b), and PVI (6b) well developed and long, with fairly broad base and edgelike top, but PIII (3b) slightly thinner; all teeth striated. Anterior adductor scar smaller, deep, circular, with arborescent striations, upper-posterior and lower-posterior sides respectively inserted with small deep pedal scar, lower one isolated; posterior adductor scar also deep and circular, larger, upper-anterior side inserted with isolated pedal scar. Umbonal cavity shallow; internal shell surface smooth; pallial line simple. Measurements: 35–41 mm long, 24–30 mm high, 20–26 mm wide, ratio of height to length 0.7–0.75.

Type locality.—Yajiang, Wulong, Sichuan, southwestern China.

Type occurrence.—Lianggaoshan Member, Ziliujing Formation, Middle Jurassic.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: bi2201 (holotype); bi2200, 2202, 2203.

Distribution of genus.—Jurassic (most abundant in Middle Jurassic); Asia (Liu, 1984, p. 552).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Junior synonym of *Unionelloides* Gu [Ku], 1962 (suggested by Ma, 1999, p. 218; accepted herein).

Genus LIOPOTOMIDA Ma, 1999, p. 214

[in Chinese with English diagnosis, p. 230]

Figure 21.4–21.7

Discussion and diagnosis.—Original diagnosis (Ma, 1999, p. 230): shell oval or long-rectangular, thick and heavy with concentric lines covering umbonal region and surface. Denticles formula: (5a), 3a, 3b/4a, 2a, 2b, 4b, with upper and lower parts of 2a and 4a combined together to form socket of 3a; 3a triangular, 5a V-shaped when present. In dymyarians, anterior adductor scar bearing arborescent structures with two small retractor scars on inner side; posterior adductor scar shallow and smooth, pallial line simple [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Ma, 1999, p. 214): Shell medium; circular, elliptical, roundly quadrate to short-triangular; opisthodetic; lunule and escutcheon not distinct. Umbonal region with only commarginal growth lines. Hinge paleoheterodont; dental formula: (5a), 3a, (PI) (1b in original text), PIII (3b in original text)/4a, 2a, PII (2b in original text), PIV (4b in original text); tooth 2a transversely cuneiform; 3a nipplelike or triangular-conelike; 4a short-lamellar, anterior apex generally curved backward and connecting 2a to form a socket; 5a small, reversed-triangular in form when present; posterior teeth PII (2b), PIII (3b), and PIV (4b) long-lamellar; PI (1b) undeveloped or sometimes lacking; anterior pseudocardinal teeth generally with lateral grooves; posterior lamellar teeth smooth; umbonal cavity deep; anterior adductor scar deep, with arborescent-like striations, middle-inner side and upper-inner side respectively inserted with one deep pedal scar; posterior adductor scar shallow, smooth or with concentric striations, its upper-inner side inserted with one pedal scar; pallial line simple.

Type species.—*Liopotomida subquadrata* Ma, 1999, p. 215, pl. 3,*7*,*14*,*16*,*17* (holotype), *21–22*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Ma, 1999, p. 215): Medium, rectangular. Anterior margin rounded, posterodorsal margin nearly straight or slightly oblique; posterior margin truncated or obliquely curved; ventral margin nearly straight, but with shallow sinus at middle-posterior part. Umbo obtuse; beak prosogyrate, incurved, positioned at one-third shell length from anterior; posterior ridge obtusely rounded, accompanied by radial trough in front of it. Surface ornamented with commarginal costae. Internal structure same as in genus diagnosis, but pseudocardinal tooth 3a triangular, conelike; sometimes a posterior lateral lamellar tooth PI (1b in original text) present on lower side of PIII (3b in original text).

Type locality.—Nanshan, Guangyuan, Sichuan, southwestern China.

Type occurrence.—Middle part of Guangyuan Group, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 108548 (holotype); 108545–108547, 108549, 108550.

Distribution of genus.—Mesozoic; Asia, Europe, and North America (Ma, 1999, p. 215). [Note: Ma (1999) included five species in *Liopotomida*, all from Lower Jurassic–Middle Jurassic, but no representatives of other ages.]

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Junior synonym of *Unionelloides* Gu [Ku], 1962.

Note.—We retranslate Ma's (1999) Chinese description of *Liopotomida* Ma, because his English diagnosis (p. 230) does not coincide with his Chinese diagnosis (p. 214).

Genus PSILOUNIO Guo, 1985a, p. 175

[in Chinese]

Figure 22.12–22.17, 23.21

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1985a, p. 175): subtriangular, subcircular, subtrapezoid, elliptical or suboval; inflated or fairly inflated; equivalve; subequilateral or inequilateral; thick or fairly thick. Umbo broad, highly projected or low; beak incurved, prosogyrate, positioned anteriorly; posterior ridge developed or undeveloped.

Surface ornamented with commarginal lines or rugae; umbonal region with W-shaped costae, but sometimes not preserved; lunule small, escutcheon narrow. Hinge plate broad and thick, teeth strong; anterior tooth 3a of right valve strongest, large and stout, short conelike, generally groove-topped; teeth 5a (in front of 3a) and 1 (behind 3a) small and low, short-lamellar when present; posterior tooth PIII long-lamellar, subparallel to hinge line; left valve with two anterior teeth; 4a short-lamellar, opisthocline, nearly parallel to hinge line; 2a stout and large, oblique-triangular, prosocline; posterior teeth PII and PIV long-lamellar, subparallel to hinge line; dental formula: (5a), 3a, 1, PIII/4a, 2a, PII, PIV. Anterior adductor scar deep, suboval in form, with arborescent-like striations, accompanied by two small isolated pedal scars respectively at lower-posterior and upper-posterior sides; posterior adductor scar deep, larger, accompanied by one small, deep pedal scar at upper-anterior side.

Type species.—*Psilounio sinensis* Gu in Gu et al., 1976, p. 309, pl. 82,*1–3*,*4* (holotype), *5–7*,*23*; by original designation, Guo, 1985a.

Original diagnosis of type species.—(Translation from Chinese text, Gu in Gu et al., 1976, p. 309): Medium or fairly large; rhomboid to round-quadrate; posteroventral angle rounded; posterior ridge rounded, rather prominent; beak prosogyrate, acutely projecting above hinge line; shell margin in front of umbo moderately incurved.

Type locality.—Haitangpu, Jiangyou, Sichuan, southwestern China.

Type occurrence.—Lower part of Shaximiao Formation, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25164 (holotype); 25165–25167.

Distribution of genus.—Jurassic; China (Guo, 1985a, p. 177).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Junior synonym of *Unionelloides* Gu [Ku], 1962 (suggested by Ma, 1999, p. 218; accepted herein).

Note.—Guo (1985a, 1986) listed *Unionelloides* Gu [Ku], 1962 as a synonym of *Psilounio* Guo, 1985a, but the former has priority without dispute. Guo (1986, p. 340) again proposed *Psilounio* as a new genus.

Subgenus PSILOUNIO (PSILOUNIO) Guo, 1985a, p. 176

[in Chinese]

[*emend*. Guo, 1986, p. 341 (in Chinese)]

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Guo, 1986, p. 341): characterized by having shorter and higher shell (ratio of length to height generally less than 1.5); subtriangular, suboval, subcircular, or subtrapezoid; test fairly thick; fairly inflated; umbo broad, rounded; beak slightly incurved, prosogyrate.

Distribution of subgenus.—Jurassic; China (Guo, 1986, p. 341).

Revision suggestion.—Junior synonym of *Unionelloides* Gu [Ku], 1962 (suggested by Ma, 1999, p. 218; accepted herein).

Subgenus PSILOUNIO (DAGAUROSTOMA) Guo, 1985a, p. 177

[in Chinese]

Figure 22.5–22.7

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Guo, 1986, p. 341): similar to *Psilounio (Psilounio)* in external and internal morphological characters; it differs from latter in having a very high umbo; beak strongly prosogyrate and incurved.

Type species.—*Unio suni* Chow, 1953, p. 169,*1*,*2* (holotype); *emend*. Gu in Gu et al., 1976, p. 312, pl. 86,*1–6*,*17* [for *Psilounio suni* (Chow, 1953)]; by original designation.

Original diagnosis of type species.—(Chow, 1953, p. 177): Shell medium in size and thickness, nearly as long as high, about 40 mm in largest specimen. Umbo incurved, twisted and in contact with that of opposite valve above hinge. Right valve with two bifurcating pseudocardinal teeth and long posterior lateral teeth, parallel to external ligamental groove. Outline of shell subtriangular, anterior end broadly rounded and somewhat subtruncated in larger specimens; posterior obtusely angular and margin forming an angle of about 60° with ventral margin. Surface of shell with rather coarse and irregularly spaced concentric ribs, more or less wrinkled at dorsoposterior border and with small nodules along umbonal ridge and adjacent area [*sic*].

Original diagnosis of type species.—[Translation from Chinese text, Gu in Gu et al., 1976, p. 312; for *Psilounio suni* (Chow, 1953)]: Shell medium, triangular; length nearly equal to height; inflated; umbo projecting high above hinge line; beak strongly prosogyrate and incurved; posterior ridge very close to posterodorsal margin; posterior area very narrow and steep; surface with only commarginal lines and costae.

Type locality.—Huluhe, Fuxian, Shaanxi, northwestern China.

Type occurrence.—Anding Formation, lower Upper Jurassic.

Repository of type material.—Institute of Vertebrate Paleontology and Paleoanthropology (lacking accession number).

Distribution of subgenus.—Middle Jurassic; China (Guo, 1985a, p. 177) [Guo (1986, p. 341) revised age of subgenus *Dagaurostoma* to be Jurassic].

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—There might be no important distinguishing characters between *Psilounio (Dagaurostoma)* and *Psilounio (Psilounio)*, therefore *Dagaurostoma* might also be a junior synonym of *Unionelloides* Gu [Ku], 1962.

Note.—Guo (1986, p. 341) again proposed *Dagaurostoma (Dagaurostoma)* as a new subgenus.

Subgenus PSILOUNIO (PHORTUNIO) Guo, 1985a, p. 177

[in Chinese]

Figure 22.1–22.4

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Guo, 1985a, p. 177): oval, elliptical or cuneiform; test thick; inflated; umbo broad, rounded; beak small, incurved, prosogyrate, positioned anteriorly; posterior ridge developed or undeveloped. Umbonal region with W-shaped

costae; other surface with commarginal lines and rugae; lunule small, cordate; escutcheon long and narrow, lanceolate. Hinge plate broad; teeth strong and stout; anterior tooth 3a of right valve strong and stout, triangular-conelike; posterior tooth PIII long-lamellar; anterior tooth 4a of left valve short-lamellar; 2a strong, large, and stout, oblique-triangular; posterior teeth PII and PIV long-lamellar; ligament external, opisthodetic, ligament grooves long and deep. Anterior adductor scar deep, large, suboval in form, upper-posterior and lower-posterior sides respectively inserted with one small pedal scar; posterior adductor scar slightly larger, shallower, subcircular in form.

Type species.—*Psilounio impensus* Huang & J. Chen, 1980, p. 81, pl. 3,*4*; pl. 4,*6* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Huang & Chen, 1980, p. 81): Shell very large; elliptical, longer than high; inflated, with largest inflation at middle-upper part of shell height. Umbo broad; beak small, incurved, prosogyrate, positioned at one-third shell length from anterior; posterior ridge rounded, not prominent, disappearing posteroventrally; posterodorsal end obtuse-angular, with posterodorsal angle about 140°; posteroventral end slightly protracted, with posteroventral angle about 110°. Umbonal region with six W-shaped costae within about four mm from beak, other surface with irregular commarginal lines, or rugae in ventral surface; lunule semicircular; escutcheon long and narrow. Hinge teeth completely preserved; right valve with two anterior pseudocardinal teeth; anterior one strong and high, long-triangular in form, pointed forward; posterior one weak and low, oblique, situated at lower-posterior side of former; posterior lamellar teeth, two in right valve, upper one stronger, lower one weak, sometimes lacking; left valve with two pseudocardinal teeth, posterior one large and stout, and anterior one thin; two teeth fused at their apices; also two posterior lamellar teeth in left valve; ligament groove long and deep; anterior adductor scar large and deep, suboval in form; posterior adductor scar shallower and larger, circular in form. Measurements: 127 mm long, 86 mm high, 66 mm (bivalved) wide.

Type locality.—Hongqin, Shexian, Anhui, southeastern China.

Type occurrence.—Hongqin Formation, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 38408 (holotype).

Distribution of subgenus.—Jurassic; China and Thailand (Guo, 1985a, p. 179).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—*Phortunio* might be reallocated as a subgenus of *Unionelloides* Gu [Ku], 1962.

Note.—Guo (1986, p. 341) again proposed *Phortunio* as a new subgenus.

Genus LAMPROTULA Simpson, 1900
Subgenus LAMPROTULA (DICONCAVELAMPROTULA) Ma, 1999, p. 219
[in Chinese]

Figure 23.9–23.10

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Ma, 1999, p. 219): umbonal region ornamented with W-shaped costae; in front of and behind posterior ridge respectively with a groove, extending from umbo to posteroventral and posterior margins respectively; posterior area with oblique ribs; internal structure same as in *Lamprotula (Eolamprotula).*

Type species.—*Lamprotula (Diconcavelamprotula) sichuanensis* Ma, 1999, p. 219, pl. 4,*4*,*11* (holotype), *14*; by original designation.

Original diagnosis of the type species.—(Translation from Chinese text, Ma, 1999, p. 219): Oblique-triangular, longer slightly than high; anterior margin rounded; ventral margin curved; posterodorsal margin obliquely straight; posterior margin narrowly rounded. Beak fairly distinctly prosogyrate, positioned at one-third shell length from anterior; posterior ridge carina-like in umbonal region, becoming obtusely rounded ventrally; in front of and behind it respectively with a groove, extending from umbo to posteroventral and posterior margins respectively. Umbonal region with several W-shaped costae; tubercles smaller and densely and reticulately arranged in dorsal side, becoming flatter and longer and commarginally arranged in ventral side; posterior area depressed, with more than 15 oblique ribs that are distributed on almost entire area; internal structure same as in subgenus diagnosis.

Type locality.—Haitangpu, Zhongba, Sichuan, southwestern China.

Type occurrence.—Lower part of Shaximiao Formation, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology [accession number: 108566 (holotype); 108565, 108567].

Distribution of subgenus.—Middle Jurassic; Sichuan and Zhejiang, South China (Ma, 1999, p. 219).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Junior synonym of the genus *Eolamprotula* Gu (Ku).

Subgenus LAMPROTULA (SINOLAMPROTULA) Gu & Huang in Gu et al., 1976, p. 324
[in Chinese]

Synonymy.—This is a new name for *Lamprotula (Richthofenia)* Modell, 1964, p. 110, preoccupied by *Richthofenia* Kayser, 1881, p. 351 (=Kayser, 1883, p. 195) (Brachiopoda: Richthofeniidae).

Type species.—*Unio leai* Gray (in Griffith and Pidgeon, 1834); by original designation; Gu and Huang in Gu et al., 1976, p. 324.

Distribution of subgenus.—Oligocene to Holocene; eastern Asia (Gu & Huang in Gu et al., 1976, p. 324).

Taxonomic position.—Unionidae (by original designation).

Subgenus LAMPROTULA (CUNEOLAMPROTULA) Gu & Huang in Gu et al., 1976, p. 319
[in Chinese]

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Gu and Huang in Gu et al., 1976, p. 319): shell shape and dentition similar to *Cuneopsis*; posterior end pointed; posterior inner margin with cocoonlike nodes; external surface ornamented with tubercles as in *Lamprotula*.

Type species.—*Unio bazini* Heude, 1877, pl. 9,*20*; by original designation.

Original diagnosis of the type species.—(Translation from Chinese text, Gu & Huang in Gu et al., 1976, p. 319): Shell thick, tongue shaped; anterior shell short, posterior shell elongate; dorsal and ventral margins nearly parallel to each other; posterodorsal margin truncately or windingly passing into posterior margin; umbo low, located near anterior end; surface ornamented with large tubercles on umbonal region and posteroventral side.

Distribution of subgenus.—?Pliocene, Pleistocene–Holocene; eastern Asia and eastern Europe (Gu & Huang in Gu et al., 1976, p. 319).

Note.—See Heude (1877) for figures and original diagnosis of type species.

Genus RADIOPLICATA Huang, 1981, p. 203

[in Chinese]

Figure 24.14–24.16

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Huang, 1981, p. 203): shell thin and solid, medium to large in size, rounded rectangular in form, equivalve, inequilateral, moderate inflated. Dorsal and ventral margins nearly straight, the latter slightly concave at its middle part. Umbo small, not salient. Posterior umbonal ridge wide and gentle. Siphonal area with oblique plicae radiating from posterior umbonal ridge toward dorsal or posterodorsal margins and becoming wider, interspaces narrow; small short and narrow plicae can be seen just before posterior umbonal ridge, crossing over radial plicae to form inverted-V-shaped pattern. Surface ornamented with numerous fine concentric lines. Hinge plate wide, left valve with two anterior posterior pseudocardinal teeth and two posterior lamellae, the latter very short and far from umbo. Right valve with one pseudocardinal and one posterior lamella. Pallial line entire.

Type species.—*Radioplicata guangxiensis* Huang, 1981, p. 204, pl. 4,*5,10,11–12* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Huang, 1981, p. 204): Medium in size, rounded rectangular in form, with length two times height. Holotype: 84 mm long and 42 mm high. Siphonal area with 5–7 radial plicae, becoming wider toward the margins; small short and narrow plicae can be seen just before posterior umbonal ridge, crossing over radial plicae to form inverted-V-shaped pattern. Hinge plate wide, left valve with two anterior posterior pseudocardinal teeth, 2a papillate, 4a thick ridge-like, both grooved; two posterior lamellae grooved, short and far from umbo. Right valve with one papillate pseudocardinal tooth, and one short posterior lamella. Anterior adductor scar deep. Pallial line entire.

Type locality.—Zhenpiyan cave, Guilin, Guangxi, South China.

Type occurrence.—Cave deposits, Neolithic Age, Quaternary.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 47603 (holotype); 47604, 47701, 47702.

Distribution of genus.—Quaternary.

Taxonomic position.—Unioninae (by original designation).

Subfamily QIYANGIINAE J. Chen, 1987, p. 15

[in Chinese]

[*emend*. J. Chen, herein]

Name history.—The family name Qiyangiidae was originally based on shell microstructural peculiarities, without other description.

Diagnosis of subfamily.—(*emend*. J. Chen, herein): Medium-sized Unionidae; test thick or medium thick; main surface ornamented with prominent W-shaped or commarginal costae, or tubercles arranged in W-shape; hinge plate broad, generally with two anterior pseudocardinal and two posterior lateral teeth in left valve, one or two anterior pseudocardinal and one or two posterior lateral teeth in right valve; dental formula: (5a), 3a, (PI), PIII/2a, 4a, PII, PIV; anterior teeth grooved; posterior teeth thick-lamellar, striated or smooth; two pedal scars in anterior and one in posterior; pallial line entire. Shell wall aragonitic, composed of three layers, outer layer of simple prismatic structure, middle layer of lenticular nacreous structure, and inner layer of sheet nacreous structure; prisms of outer layer broad, with no branching striae, longer axes intersecting shell surface at angles of 83°–90°.

Distribution of subfamily.—Lower Jurassic–Middle Jurassic (by original designation, J. Chen, 1987, p. 15); Upper Triassic–Middle Jurassic; Asia.

Taxonomic position.—Unionoidea (by original designation for family).

Revision suggestion.—Placement in Unionidae; the following fossil genera should be placed in subfamily Qiyangiinae: *Qiyangia* J. Chen & Xu, 1980, *Comptio* Liu & Luo in Cai & Liu, 1978; *Undulatula* Gu in Gu et al., 1976; *Eolamprotula* Gu [Ku], 1962; *Luochengella* Liu & Zhu in Cai & Liu, 1978; and *Yunnanophorus* Chen in Gu et al., 1976.

Genus QIYANGIA J. Chen & Xu, 1980, p. 357

[in Chinese with English diagnosis, p. 365]

Figure 22.22–22.25

Discussion and diagnosis.—Original diagnosis (J. Chen & Xu, 1980, p. 365): shell medium to large; ovate, trapezoid or cuneiform in form. Test thick with ligament external and opisthodetic. Umbo broad; beak prosogyrate, situated at anterior part of shell. Surface ornamented with numerous well-developed concentric or double-angular costae. Costae stronger on dorsal part than on ventral part, but very weak on internal molds. Posterior carina well developed. Two pseudocardinal teeth (2a and 4a) and two posterior lamellar teeth (PII and PIV) visible in left valve; 2a subtrigonal, and 4a pointed or cuneate in form. One pseudocardinal tooth (3a) and one posterior lamellar tooth (PIII) in right valve. Anterior adductor scar with arborescent-like striae, and posterior one smooth; pallial line simple [*sic*].

Type species.—*Qiyangia loxos* J. Chen & Xu, 1980, p. 358, pl. 1,*1* (holotype), *2–4*; text-fig. 1; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, J. Chen & Xu, 1980, p. 358): Medium; subtrapezoid; anterior margin broadly rounded; posterior margin curvedly truncated; ventral margin long, middle posterior part widely incurved; umbo slightly projecting above hinge line, positioned

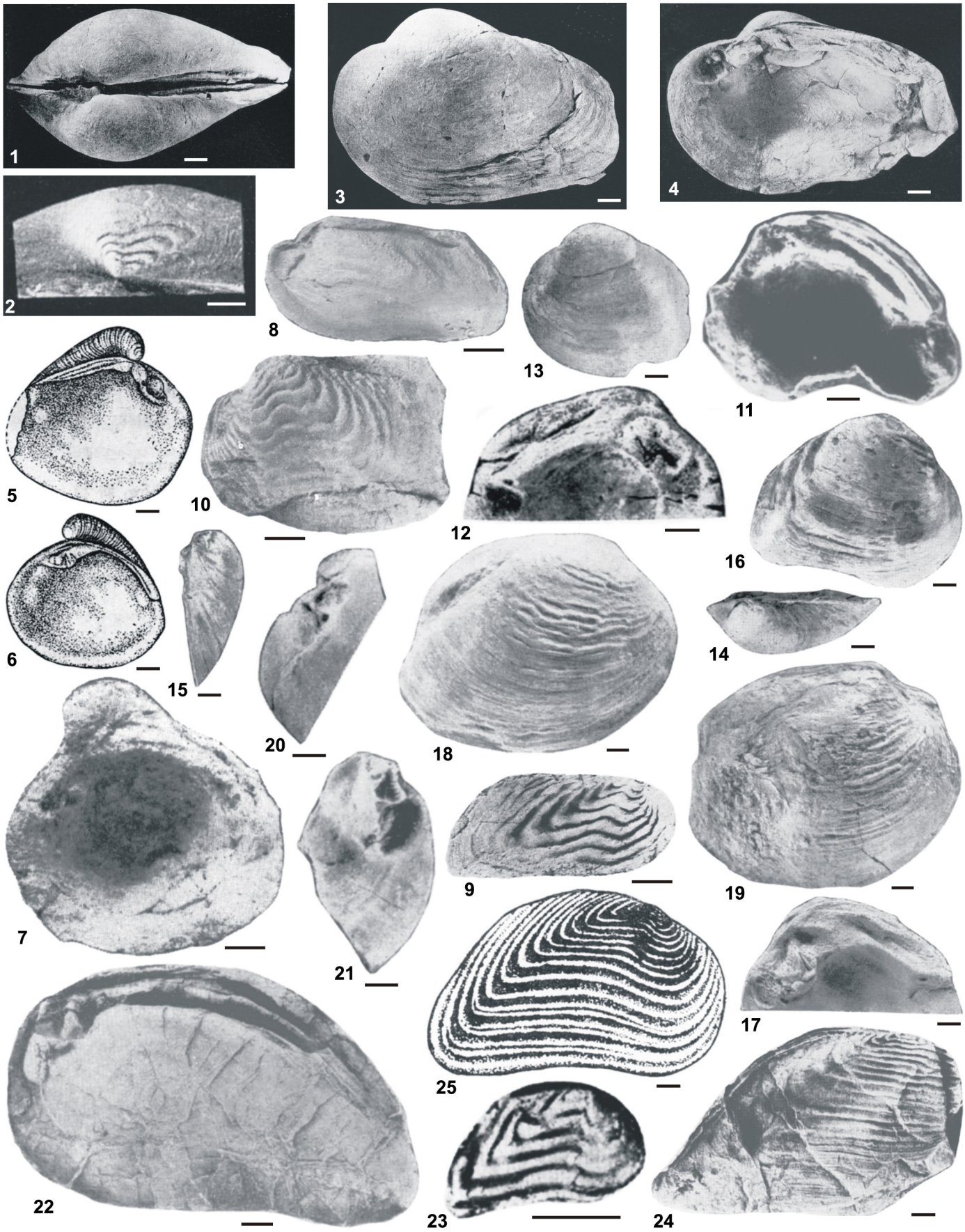

Figure 22. *For explanation, see facing page.*

near anterior end; shell moderately inflated; center surface with shallow but distinct depression extending from umbo to ventral margin; posterior area depressed; posterior ridge obtuse-angular in transverse section. Surface ornamented with well-developed W-shaped and commarginal costae; W-shaped costae restricted to umbonal region. Left valve with two pseudocardinal teeth, tooth 2a oblique-triangular, pointed forward; 4a narrow and short; two posterior lamellar teeth; anterior adductor scar deep, kidneylike in form, with arborescent-like striations; posterior adductor scar subcircular, shallower; upper-posterior and lower-posterior sides of anterior adductor scar respectively inserted with pedal scar; upper side of posterior adductor scar also with pedal scar; buttress strong; pallial line entire. Measurements for holotype: 76 mm long and 43 mm high.

Type locality.—Guanyintan, Qiyang, Hunan, South China.

Type occurrence.—Paijiachong Member, Guanyintan Formation, Lower Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 47603 (holotype); 47604, 47701, 47702.

Distribution of genus.—Lower Jurassic; South China (J. Chen & Xu, 1980, p. 358). Occurs abundantly in Lower Jurassic, but probably extends to Middle Jurassic.

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Qiyangiinae, family Unionidae.

Genus UNDULATULA
Gu in Gu et al., 1976, p. 325

[in Chinese]

Figure 22.18–22.21

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Gu in Gu et al., 1976, p. 325): shell medium to large; shape varying from oval to rhomboid or longer; posteroventral end more or less developed; moderately inflated; posterior ridge well developed; behind ridge with differentially developed radial trough running from umbo to posteroventral margin. Umbo low, generally not projecting into hinge margin; beak prosogyrate. Surface ornamented with commarginal lines and numerous wave-shaped undulations, which are derived from W-shaped costae on umbonal region; posterior area with several oblique ribs; ribs intersecting undulations to form chevron-shape sculpture near trough, but gradually weaker distally and finally disappearing near shell margin; umbonal cavity rather deep. Anterior pseudocardinal tooth 3a of right valve triangular, conelike, laterally striated; in front of it may be a short-lamellar tooth (5a); submedian tooth 1 small, short; left valve with two pseudocardinal teeth, both opisthocline and crenulated; anterior one thin, slicelike, and posterior one triangular; posterior lateral lamellar teeth not preserved. Anterior adductor scar deep, with arborescent-like striations, accompanied by two pedal scars respectively at posterodorsal and posteroventral sides; dorsal one very close it, and ventral one distinctly isolated.

Type species.—*Undulatula sichuanensis* Gu in Gu et al., 1976, p. 326, pl. 90,*5–11*,*12* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Gu in Gu et al., 1976, p. 326): Shell fairly large, oblique-rhomboid to rounded-quadrate; posterior shell higher than anterior; posteroventral shell slightly expanded; preadult shells generally rounded-quadrate, afterward, posteroventral part grew quicker; moderately inflated; posterior ridge and radial trough well developed; internal structure well preserved, same as in genus diagnosis; umbonal cavity fairly deep.

Type locality.—South of Guangyuan, Sichuan, southwestern China.

Type occurrence.—Upper part of Shaximiao Formation, Middle Jurassic–Upper Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25244 (holotype); 25240–25243.

Distribution of genus.—Jurassic (Middle Jurassic or upper Middle Jurassic–Upper Jurassic); China (Gu in Gu et al., 1976, p. 326).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Qiyangiinae, family Unionidae.

Note.—According to records, this genus is restricted to the Bajocian–Bathonian of Middle Jurassic in China and Indochina.

Subgenus UNDULATULA (ANCYRUNIO)
Guo, 1985a, p. 181

[in Chinese, with English diagnosis, p. 267]

Figure 22.8–22.10

Discussion and diagnosis.—Original diagnosis of subgenus (Guo, 1985a, p. 267): shell cuneate, elliptical, elongate elliptical, elongate rectangular, subrhomboidal, moderatedly inflated,

Figure 22. *1–4.* Holotype of *Psilounio (Phortunio) impensus* (Huang & J. Chen); *1,* dorsal view, scale bar 10 mm; *2,* enlarged umbo, showing umbonal sculpture, scale bar 2 mm; *3,* left lateral view, scale bar 10 mm; *4,* right interior view, scale bar 10 mm (adapted from Huang & J. Chen, 1980, pl. 3,*4a–c*; pl. 4,*6*).——*5–7. Psilounio (Dagaurostoma) suni* (Chow), scale bar 5 mm; *5,* paratype, drawing of left valve, interior view; *6,* holotype, drawing of right valve, interior view (adapted from Chow, 1953, p. 169, text-fig. 2 [1], 2 [2]); *7,* photograph of Fig. 22.6 (adapted from Gu et al., 1976, pl. 86,*1*).——*8–10. Undulatula (Ancyrunio) omegoides* Guo, scale bar 5 mm; *8,* holotype, left internal mold; *9,* left external mold of Fig. 22.8; *10,* paratype, left valve (adapted from Guo, 1985a, pl. 40,*3a–b,4*).——*11. Wulongiconcha yajiangensis* Liu, scale bar 5 mm; paratype, right interior view (adapted from Liu, 1984, pl. 11,*4*).——*12–17. Psilounio sinensis* (Gu), scale bar 5 mm; *12–15,* holotype, left valve; *12,* interior view; *13,* lateral view; *14,* dorsal view; *15,* anterior view; *16–17,* paratype, left valve, lateral and interior views (adapted from Gu in Gu et al., 1976, pl. 82,*4,1–3,5–6*).——*18–21. Undulatula sichuanensis* Gu, scale bar 5 mm; *18,* holotype, right valve; *19,* paratype, right valve; *20,* paratype, left interior view; *21,* paratype, right interior view (adapted from Gu in Gu et al., 1976, pl. 90,*12,5,7,9*).——*22–25. Qiyangia loxos* J. Chen & Xu, scale bar 5 mm; *22,* holotype, left internal mold; *23,* paratype, right internal mold, juvenile; *24,* paratype, left external mold (adapted from J. Chen & Xu, 1980, pl. 1,*1,3,2*); *25,* diagrammatic drawing of right valve (adapted from J. Chen & Xu, 1980, p. 358, text-fig. 1, showing ornament of double angular costae).

moderate thickness of shell wall, sometimes with broad and shallow lateral sulcus and obscure ventral sinus. Umbo near anterior end, with incurved and prosogyrous beak; posterior umbonal carina more or less developed. Umbonal region or nearly whole surface ornamented with anchor-shaped ribs, namely, W-shaped ribs. Hinge plate moderate in breadth, anterior teeth, 2 in each valve, and posterior teeth, 2 in left valve and 1 in right. They may have following dental formula: 5a, 3a, PIII/4a, 2a, PII, PIV. 5a weak, shortly lamellar or absent; 3a subtriangular; 4a narrow and short; 2a coarse. PII, PIII, and PIV elongate lamellar, parallel with adjacent hinge margin [*sic*].

Original diagnosis of subgenus.—(Translation from Chinese text, Guo, 1985a, p. 181): Shell elliptical, elongate-quadrate, subrhomboidal, or suboval; moderately inflated; test moderately thick. Beak incurved, slightly prosogyrous, positioned anteriorly; posterior ridge varying in development; generally with wide and shallow lateral sulcus extending from umbonal region to ventral margin, with corresponding ventral sinus at ventral margin; weak anterior umbonal ridge sometimes present. Umbonal region or nearly whole surface ornamented with W-shaped costae. Right valve with two anterior teeth, anterior one (5a) short-lamellar, posterior one (3a) projecting or triangular-conelike; left valve with two anterior teeth, anterior one (4a) narrow, short, slightly opisthocline, posterior one (2a) projecting, elongate; posterior teeth elongate-lamellar, two in left valve (PII and PIV) and one in right valve (PIII), all subparallel to hinge line.

Type species.—*Undulatula (Ancyrunio) omegoides* Guo, 1985a, p. 182, pl. 40,*3* (holotype), *4*; by original designation, Guo, 1985a.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1985a, p. 182): Shell elliptical to subrhomboidal, length as long as about two times height. Hinge margin arched, length as long as about two-thirds shell length; anterior shell short, with anterior margin rounded; posterior shell elongate; posterior margin truncated; ventral margin widely arched; posteroventral angle subrounded, slightly smaller than 90°; posterodorsal angle obtuse, about 130°. Umbo low, broad, and obtuse, subrounded, slightly projecting above hinge line; beak incurved, slightly prosogyrous, positioned at about one-quarter shell length from anterior; posterior ridge broad, rounded, nearly disappearing toward posteroventral end; anterior ridge weakly developed, broad, extending into anteroventral margin; flank between two ridges depressed, forming a broad and shallow sulcus, becoming wider ventrally, forming corresponding sinus at ventral margin. Whole surface or nearly two-thirds of surface ornamented with W-shaped costae; costae becoming weaker or disappearing near margins and on posterior area, but becoming coarser on posterior ridge.

Type locality.—Dashitou, Puer, Yunnan, southwestern China.

Type occurrence.—Hepingxiang Formation, Lower Jurassic–Middle Jurassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0471 (holotype); IVy0472.

Distribution of subgenus.—Jurassic; southwestern China (Guo, 1985a, p. 182) [Lower Jurassic–Middle Jurassic; South China].

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Junior synonym of *Qiyangia* J. Chen & Xu, 1980.

Note.—We retranslate Guo's (1985a) Chinese diagnosis of *Undulatula (Ancyrunio)* Guo, because some of his English diagnosis (p. 267) does not coincide with his Chinese diagnosis (p. 181).

Genus COMPTIO
Liu & Luo in Cai & Liu, 1978, p. 368

[in Chinese]

Figure 21.1–21.3

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Liu & Luo in Cai & Liu, 1978, p. 368): medium to relatively large; oval, elliptical or subrectangular; equivalve, inequilateral; moderately to well inflated. Beak prosogyrate, slightly projecting above hinge line, positioned anteriorly; posterior ridge weak; opisthodetic. Upper surface, especially umbonal region, ornamented with regular commarginal costae; other surface with fine growth lines and low, flat-topped commarginal rugae; opisthodetic. Hinge teeth well developed, each valve with two cuneiform, conelike anterior pseudocardinal teeth and two elongate-lamellar posterior lateral teeth; all anterior teeth obliquely and strongly striated; anterior pair of teeth intersecting at angles of about 30°; two posterior lateral teeth different in development, lower one generally longer and coarser; but both parallel to hinge line, and lateral striations of both indistinct. Internal shell surface smooth; pallial line simple; anterior adductor scar deep, kidney shaped, or semicircular, with arborescent-like striations; upper-posterior side accompanied by one pedal scar; posterior adductor scar larger, shallower, circular in form; accompanied by a pedal scar at upper-anterior side.

Type species.—*Comptio weiyuanensis* Liu & Luo in Cai & Liu, 1978, p. 369, pl. 114,*1* (holotype), *2–3*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Liu & Luo in Cai & Liu, 1978, p. 369): Shell large, elliptical; dorsal margin slightly curved, length about three-quarters shell length; anterodorsal margin short, gradually passing into narrowly rounded anterior margin and then curving, joining long and straight ventral margin; posterior shell gradually expanded; posterior margin broad, nearly straight vertically; posterior end distinctly wider than anterior end; posterodorsal angles about 90°–100°; posteroventral angles 85°–90°; moderately and evenly inflated; posterior ridge undeveloped or weakly developed. Umbo low and wide; beak large, prosogyrous, slightly projecting above hinge line, located at about one-third shell length from anterior. Upper-middle surface ornamented with 10–12 coarse commarginal costae; middle-lower surface with growth lines. Right valve with two anterior pseudocardinal teeth, 3a large and slightly elongate, cuneiform; 5a smaller, cuneiform; two teeth intersecting at angles of 30°, both grooved laterally; posterior lateral teeth PIII (3b in original text) and PV (4b in original text) long and strong, lamellar; anterior pseudocardinal teeth in left valve not preserved; but two posterior lateral teeth PII (2b in original text) and PIV (4b) well developed, PII (2b) longer, stouter, and stronger; internal surface smooth; anterior adductor scar deep, kidney shaped,

with arborescent-like striations; posterior adductor scar circular, shallower, and larger; its anterior upper side inserted with small and deep pedal scar. Measurements: 52–57 mm long, 30–36 mm high, height to length ratio 0.60–0.64.

Type locality.—Lianjiechang, Weiyuan, Sichuan, southwestern China.

Type occurrence.—Wuzhongshan Formation, Upper Triassic.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: Sbi300 (holotype); Sbi 301, 302.

Distribution of genus.—Uppermost Triassic, Sichuan, southwestern China (Liu & Luo in Cai & Liu, 1978, p. 368); Upper Triassic–Middle Jurassic.

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Qiyangiinae, family Unionidae.

Genus POTOMIDA Swainson, 1840
Subgenus POTOMIDA (PALAEOPOTOMIDA) Ma, 1999, p. 214

[in Chinese]

Figure 23.11–23.14

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Ma, 1999, p. 214): shell medium; rounded-triangular to rounded-rhomboid; umbo projecting high above hinge line; umbonal region ornamented with W-shaped or wavelike costae; costae gradually becoming commarginal lines or rugae ventrally; beak strongly incurved. Dental formula: (5a), 3a, PIII (3b in original text)/4a, 2a, PII (2b in original text), PIV (4b in original text); pseudocardinal tooth 2a oblique-triangular; 3a and 4a short-triangular, conelike; 5a short-lamellar; all anterior teeth laterally striated; posterior lateral teeth lamellar, slightly curved. Anterior adductor scar deep, with arborescent-like striations, posterior side and dorsal-posterior side respectively inserted with one pedal scar; upper one nearly joining adductor scar; posterior adductor scar shallower; pallial line simple; umbonal cavity fairly deep.

Type species.—Potomida (Palaeopotomida) sichuanensis Ma, 1999, p. 214, pl. 6,*11*,*15* (holotype), *16*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Ma, 1999, p. 214): Subcircular; anterior margin rounded; ventral margin widely rounded; posterodorsal margin nearly straight, posterior margin slightly truncated. Umbo small; beak prosogyrous, slightly incurved, positioned at one-third shell length from anterior; posterior ridge obtusely rounded. Umbonal region ornamented with 7–8 W-shaped costae; costae gradually becoming commarginal rugae or lines ventrally. Pseudocardinal tooth 3a of right valve triangular, conelike; 5a short-lamellar; both teeth with lateral striations; tooth 4a of left valve triangular, conelike, laterally striated; 2a elongate-cuneiform, smooth; two posterior lateral teeth of left valve smooth; sometimes both 2a and 4a without striations; musculature same as in subgenus diagnosis.

Type locality.—Nanshan, Guangyuan, Sichuan, southwestern China.

Type occurrence.—Middle part of Guangyuan Group, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 108601 (holotype); 108600, 108602.

Distribution of subgenus.—Middle Jurassic; Sichuan, southwestern China (Ma, 1999, p. 214).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Junior synonym of *Comptio* Liu & Luo in Cai & Liu, 1978.

Genus EOLAMPROTULA Gu [Ku], 1962, p. 149

[in Chinese]

[*emend*. Gu in Gu et al., 1976, p. 315 (in Chinese)]

Figure 23.15–23.20

Name history.—Originally *Lamprotula (Eolamprotula)* Gu [Ku], 1962, p. 149

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Gu in Gu et al., 1976, p. 315): center and posterior parts of flank generally ornamented with V-shaped arranged tubercles or costae; umbo not positioned at anterodorsal end or away from it; anterior pseudocardinal tooth, e.g., 4a and others, prosocline.

Type species.—Unio cremeri Frech, 1911, p. 223, pl. 31,*1a–b*; by original designation, Gu [Ku], 1962.

Original diagnosis of type species.—(Translation from Chinese text, Gu in Gu et al., 1976, p. 315): Shell medium to rather large; subelliptical; umbo positioned anteriorly; surface ornamented with numerous tubercles; base of tubercles mostly elongate-lunate-form; tubercles on middle-upper shell arranged as W-shape and thus more or less displaying double-hooks-shaped umbonal sculpture, which is concentrated at upper surface; anteroventral surface with only commarginal lines; preadult growth stages rather elliptical and generally with denser tubercles; adult specimens with disconnectedly chevron-shape-arranged tubercles on posterodorsal surface.

Type locality.—Xiangxi, Zigui, Hubei, South China.

Type occurrence.—Ziliujing Formation, Middle Jurassic.

Distribution of genus (or subgenus).—Middle Jurassic–Holocene; central to eastern Asia, eastern Europe (Gu in Gu et al., 1976, p. 315). Range of subgenus (or genus) *Eolamprotula* is restricted to Middle Jurassic.

Taxonomic position.—Unionidae (by original designation, Gu in Gu et al., 1976).

Revision suggestion.—Guo (1988, p. 123; without discussion) elevated *Eolamprotula* to genus and separated it from *Lamprotula* Simpson (accepted herein). *Eolamprotula* might be included in subfamily Qiyangiinae.

Note.—See Frech (1911) for figures and original diagnosis of type species. See also *Lamprotula (Eolamprotula) cremeri* (Frech) in Gu et al., 1976, p. 315, pl. 86,*7–16*.

Subgenus EOLAMPROTULA (YANQUIA) Guo, 1988, p. 123

[in Chinese]

Figure 23.34

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Guo, 1988, p. 123): shell small; subtriangular; nearly equilateral; moderately inflated. Anterior and ventral margins

rounded, posterodorsal and posterior margins widely curved. Beak slightly incurved, prosogyrate, projecting above hinge line, located near center; posterior ridge sawtoothed, extending from umbo to posteroventral angle. Flank covered by two sets of diagonally arranged nodes; nodes of posterior set broader than those of anterior set; two sets intersecting each other to form V-shaped sculpture below umbo. Surface behind ridge smooth; internal structure unknown.

Type species.—*Eolamprotula (Yanquia) yanquensis* Guo, 1988, p. 123, pl. 6,*7;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1988, p. 123): Shell subtriangular, slightly longer than high; subequilateral; moderately inflated. Umbo broad, rounded, projecting high above hinge line; beak slightly incurved, prosogyrate, located slightly anterior of midpoint of shell length. Posterior ridge well developed, sawtoothed, carina-like in umbonal region, becoming broader and subdued toward posteroventral end. Main surface ornamented with two sets of diagonally arranged nodes; nodes of posterior set broader than those of anterior set; two sets intersecting each other to form V-shaped sculpture below umbo.

Type locality.—Yanqu, Jianchuan, Yunnan, southwestern China.

Type occurrence.—Huakaizuo Formation, Middle Jurassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0705 (holotype).

Distribution of subgenus.—Middle Jurassic; western Yunnan, southwestern China (Guo, 1988, p. 123).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Guo (1988) designated *Eolamprotula (Yanquia) yanquensis* as the type species of *Yanquia*. The latter species is represented by only one small left valve (Guo, 1988, pl. 6,*7*), which most possibly represents the preadult growth stage of *Eolamprotula*.

Genus ZHONGBANAIA Ma, 1999, p. 226

[in Chinese with English diagnosis, p. 230]

Figure 23.1–23.8

Discussion and diagnosis.—Original diagnosis (Ma, 1999, p. 230): shell medium, oblique-triangular. Front part of shell heavy and thick, back part rather thin. Posterior umbonal ridge obvious. Siphonal area compressed. Umbo area with a W-shaped sculpture. Triangular groove extending from umbo area to posterior ventral margin. In front of groove, many ridges extending toward direction of lower back; at back of groove another ridge extending toward direction of lower front. Below these two ridges, bumps or radial tubercles often present from beaks to ventral margin. Dental formula: (5a), 3a, 3b/4a, 2a, 2b, 4b, among which 3a is triangular. Anterior adductor scar deep, with arborescent structure inside. Small retractor scar present on both upper and middle parts inside shell. Posterior adductor scar shallow, with pallial line simple [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Ma, 1999, p. 226): Shell medium; oblique-triangular. Test rather thick in anterior part, thinner in posterior part; inflated; posteroventral margin possibly with a sinus; posterior ridge prominent; posterior area depressed. Whole surface ornamented with W-shaped costae and lines; triangular-shaped groove (or belt) running from umbo to posteroventral margin and dividing surface into three sectors: anterior sector with costae obliquely backward, posterior sector with costae obliquely forward, and center sector (i.e., groove) with lines curving upward; lower ends of costae of anterior and posterior sectors generally with tubercles, forming two radially arranged rows of tubercles. Dental formula: (5a), 3a, PIII (3b in original text)/4a, 2a, PII (2b in original text), PIV (4b in original text); tooth 2a oblique-cuneiform; 3a triangular, conelike, strongly crenulated; 4a short-lamellar, anterior part curved downward; 5a generally absent, small, reversed-triangular when present; posterior lateral teeth long-lamellar, smooth; siphonal area with no cocoon-like convexities. Anterior adductor scar deep, with arborescent-like striations; posterior and posterodorsal sides respectively inserted with pedal scar; posterior adductor scar shallow; pallial line simple; lived in freshwater.

Type species.—*Lamprotula (Eolamprotula) abruptiscripta* Gu in Gu et al., 1976, p. 316, pl. 89,*10–12,13* (holotype) by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Ma, 1999, p. 227): Shell medium; oblique-triangular; anterior margin rounded; posteroventral margin possibly with sinus;

Figure 23. *1–8. Zhongbanaia abruptiscripta* (Gu), scale bar 5 mm; *1–3,* holotype, interior, dorsal, and exterior views of left valve; *4,* paratype, left valve (adapted from Gu in Gu et al., 1976, pl. 89,*11–13,10*); *5–8,* plesiotypes; *5,* right valve; *6,* left valve; *7,* lateral view of conjoined valves; *8,* left interior view (adapted from Ma, 1999, pl. 7,*15–17,19*).——*9–10.* Holotype of *Lamprotula (Diconcavelamprotula) sichuanensis* Ma, scale bar 5 mm; *9,* left lateral view; *10,* left interior view (adapted from Ma, 1999, pl. 4,*11a–b*).——*11–14. Potomida (Palaeopotomida) sichuanensis* Ma, scale bar 5 mm; *11–12,* holotype, left valve and interior view; 1*3–14,* paratype, right valve and interior view (adapted from Ma, 1999, pl. 6,*15a–b,16a–b*).——*15–20.* Plesiotypes of *Eolamprotula cremeri* (Frech), scale bar 5 mm; *15,* left valve; *16,* hinge of left valve; *17,* right interior; *18,* left interior; *19,* dorsal view of bivalved specimen; *20,* right lateral view of Fig. 23.19 (adapted from Gu in Gu et al., 1976, pl. 86,*7–8,10,13,15–16*).——*21. Psilounio sinensis* (Gu), scale bar 5 mm; paratype, left interior view (adapted from Gu in Gu et al., 1976, pl. 82,*7*).——*22–25. Sichuanoconcha amica* Liu, scale bar 5 mm; *22,* holotype, left composite mold; *23,* paratype, left composite mold; *24,* paratype, right interior view; *25,* paratype, right interior view (adapted from Liu, 1984, pl. 16,*1–2,4–5*).——*26–28.* Holotype of *Luochengella luochengensis* Liu & Zhu, scale bar 5 mm; *26,* left leteral view; *27,* interior view; *28,* dorsal view (adapted from Liu & Zhu in Cai & Liu, 1978, pl. 118,*4a–c*).——*29–33. Yunnanophorus boulei* (Patte), scale bar 5 mm; *29,* holotype, conjoined valves; *30,* plesiotype, right valve; *31,* paratype, conjoined valves; *32,* paratype, right valve; *33,* plesiotype, right internal mold (adapted from Chen in Gu et al., 1976, pl. 23,*19,18,20–22*).——*34.* Holotype of *Eolamprotula (Yanquia) yanquensis* Guo, scale bar 2 mm; left valve (adapted from Guo, 1988, pl. 6,*7*).

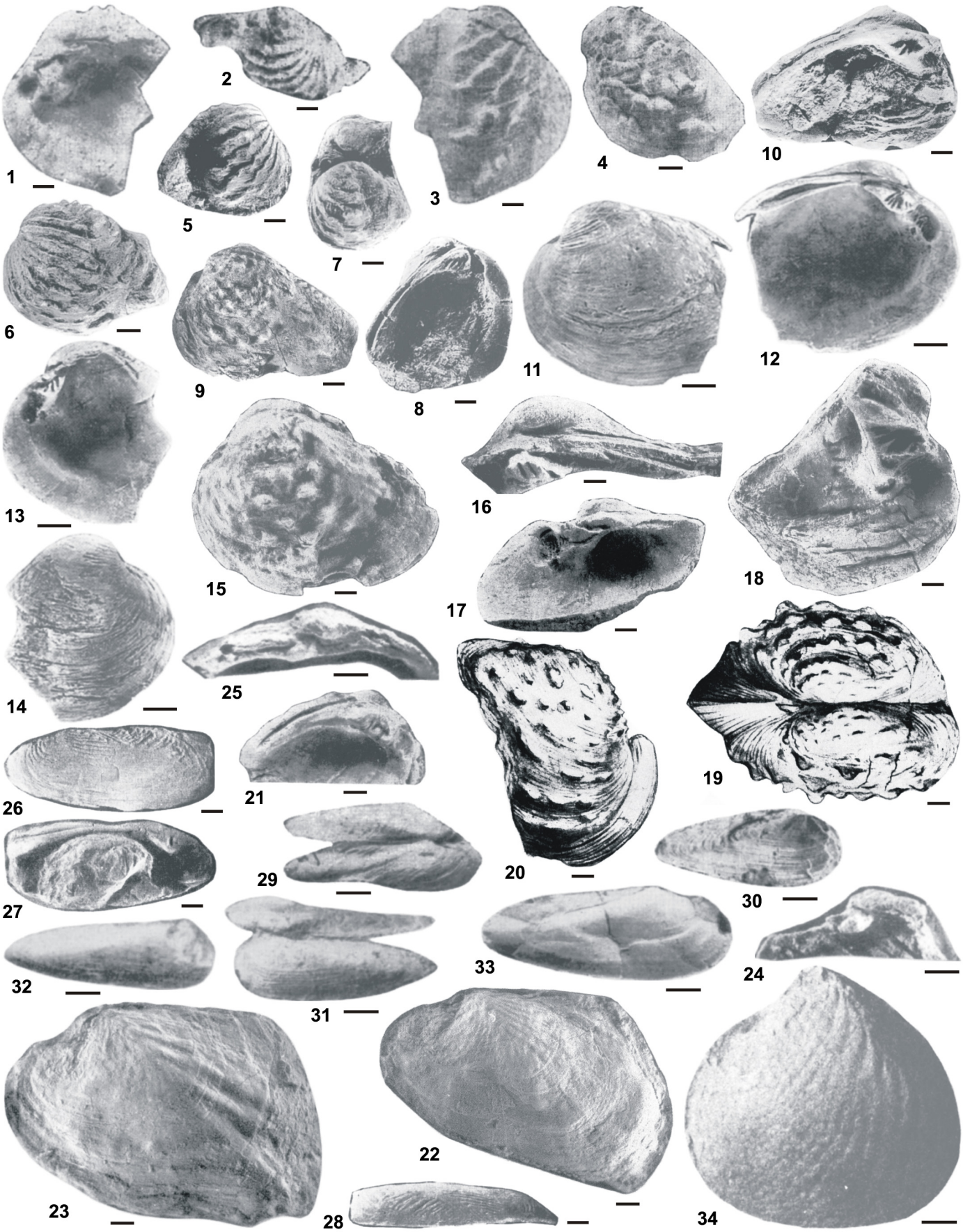

Figure 23. *For explanation, see facing page.*

posterodorsal margin oblique and straight; posterior margin obliquely truncated; beak incurved, prosogyrate, positioned near anterodorsal end; posterior ridge carina-like in dorsal part and obtusely rounded in ventral part. Surface ornament same as in genus diagnosis; anterior sector with 11–13 costae, and fine and closely spaced growth lines between costae and on outer slope of costae; posterior sector with 15–16 costae; groove of center sector with commarginal lines, curving upward, and well preserved in dorsal part, but weaker or worn in ventral part. Dentition and musculature same as in genus diagnosis.

Type locality.—Haitangpu, Jiangyou, Sichuan, southwestern China.

Type occurrence.—Lower part of Shaximiao Formation, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25233 (holotype); 25232 (paratype); 108617–108621 (plesiotype).

Distribution of genus.—Middle Jurassic; South China and Laos (Ma, 1999, p. 227).

Taxonomic position.—?Actinodontophoridae (by original designation).

Revision suggestion.—*Zhongbanaia* might be a junior synonym of *Eolamprotula* Gu [Ku], 1962.

Note.—We retranslate Ma's (1999, p. 226) Chinese diagnosis of *Zhongbanaia* Ma, because his English diagnosis is difficult to understand.

Genus LUOCHENGELLA
Liu & Zhu in Cai & Liu, 1978, p. 370

[in Chinese]

Figure 23.26–23.28

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Liu & Zhu in Cai & Liu, 1978, p. 370): medium, oval to elliptical; equivalve, inequilateral; moderately to fairly inflated; posterior ridge prominent; posterodorsal part behind ridge fairly impressed; umbonal region inflated; beak broad, prosogyrate, incurved, projecting above hinge line, located anteriorly; anterior shell margin distinctly curved. Whole surface ornamented with commarginal rugae; umbonal region with distinct W-shaped costae; costae consisting of two V-shaped rows; posterior row more narrow and elongate, V-shaped angles pointing posteroventrally; posterior surface with numerous oblique ribs, obliquely intersected with posterior ridge. Opisthodetic; lunule and escutcheon undeveloped. Right valve with one very small pseudocardinal tooth and one long, ridgelike posterior lateral tooth; in left valve, anterior pseudocardinal teeth degenerated, with only traces remaining, or only a small socket on hinge plate remains; two lateral teeth in left valve well developed, long, ridgelike, with fine lateral striations. Umbonal cavity fairly deep; internal surface smooth; anterior adductor scar large, shallow, circular in form, with honeycomb-like striations.

Type species.—*Luochengella luochengensis* Liu & Zhu in Cai & Liu, 1978, p. 371, pl. 118,*4a–c* (holotype), *5;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Liu & Zhu in Cai & Liu, 1978, p. 371): Shell medium; elongate-oval to elliptical; equivalve, inequilateral; dorsal margin weakly curved; anterodorsal margin short, slightly prosocline; anterodorsal angle obtusely rounded; anterior end narrow and rounded, gradually passing into long and slightly curved ventral margin; posterior shell slightly expanded; posterodorsal margin straight and long, intersecting truncated posterior margin at rounded-obtuse angles. Moderately to strongly inflated, with largest inflation at posteroventral side about one-half to one-third shell height. Posterior ridge prominent, but not attaining posteroventral end; surface behind ridge depressed and narrow; umbonal region slightly inflated; beak broad, incurved, prosogyrate, projecting above hinge line, positioned at about one-quarter to one-fifth shell length from anterior. Surface with commarginal lines and numerous commarginal rugae; umbonal region with developed W-shaped costae, consisting of two V-shaped rows; posterior row more narrow and elongate; posterior area with coarser oblique ribs, obliquely intersected with posterior ridge. Opisthodetic; lunule and escutcheon undeveloped. Right valve with one very small pseudocardinal tooth (3a) and one long, developed, ridgelike posterior lateral tooth; in left valve, two anterior pseudocardinal teeth (2a and 4a) degenerated, only traces remain, or only a small socket on hinge plate remains; two lateral teeth (PII and PIV, 2b and 4b in original text respectively) long, ridgelike. Internal surface smooth; umbonal cavity fairly deep; anterior adductor scar small, shallow, circular in form, with honeycomblike striations. Measurements: 31–51 mm long, 17–20 mm high, 17–18 mm wide, height to length ratio 0.39–0.46.

Type locality.—Luocheng, Qianwei, Sichuan, southwestern China.

Type occurrence.—Dongyuemiao Member, Ziliujing Formation, upper Lower Jurassic–lower Middle Jurassic.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: Sbi370 (holotype); Sbi371 (paratype).

Distribution of genus.—Lower Jurassic to Middle Jurassic; southwestern China (Liu & Luo in Cai & Liu, 1978, p. 371).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Qiyangiinae, family Unionidae.

Genus YUNNANOPHORUS Chen, 1974, p. 337

[in Chinese]

[*emend.* J. Chen & Fang, herein]

Figure 23.29–23.33

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Chen in Gu et al., 1976, p. 57): equivalve, fairly elongate; anterior margin rounded; posterodorsal margin truncated; umbonal region convex; umbo small and low, positioned near anterior end; posterior ridge generally prominent, highly protruded, extending from umbo to posteroventral end, accompanied by a shallow radial depression in front of it. Surface ornamented with regular commarginal lines, or sometimes well-developed commarginal costae. Hinge of left valve with two fine, long-lamellar posterior lateral teeth; short anterior pseudocardinal tooth (teeth) possibly present; right valve with two short anterior pseudocardinal teeth and one long-lamellar posterior lateral tooth;

both adductor scars circular, nearly equal with each other in size, pallial line simple.

New emended hinge diagnosis.—[Based on the dentition of *Yunnanophorus zetoides* Guo (1985a, p. 188, pl. 28,*1–2*)]: Anterior teeth short-lamellar, slightly prosocline, nearly parallel to anterior hinge line, two in right valve and one in left valve (possibly additionally with a short tooth below beak of left valve); posterior lateral teeth long-lamellar, two in left valve and one in right valve, nearly parallel to posterior hinge line.

Type species.—Anatina? (Cercomya) boulei Patte, 1922, p. 63, pl. 2,*6*; see also: *Yunnanophorus boulei* (Patte), Chen, 1974, p. 338, pl. 179,*8*,*13–16*; by original designation; *Yunnanophorus boulei* (Patte), Chen in Gu et al., 1976, p. 58, pl. 23,*17–22*; among them, specimen NIGP24794 (pl. 23,*19*) preserving both valves in open articulation was chosen as holotype by Chen.

Original diagnosis of type species.—(Translation from Chinese text, Chen in Gu et al., 1976, p. 58): Shell elongate, length about three times as long as height; anterior margin rounded; posterior end narrow; umbonal region convex; convex area rapidly expanding dorsally and ventrally; umbo located at about one-quarter shell length from anterior, where shell height is largest; posterior ridge sharp, running from umbo to ventral end. Surface ornamented with fine and regular commarginal lines and costae; costae not distinct in umbonal region, but clearly in anterior end, ventral surface, or near hinge margin, becoming weaker in area behind posterior ridge and intersecting hinge margin at right angles.

Type locality.—Niaoge, Kaiyuan, Yunnan, southwestern China.

Type occurrence.—Huobachong Formation, Norian, Upper Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology (holotype accession number: 24794).

Distribution of genus.—middle Upper Triassic; China and Vietnam (Chen in Gu et al., 1976, p. 58). Genus ranges from Norian–Rhaetian, brackish or freshwater, in southwestern China and Indochina.

Taxonomic position.—Pachycardiidae (by original designation).

Revision suggestion.—?Qiyangiinae (family Unionidae), based on dentition and surface ornament.

Note 1.—The name *Yunnanophorus* first appeared in Yin (1962, p. 182) as a manuscript name and without description. Chen (1974, p. 337) reported *Yunnanophorus* as an old genus name with two species, *Y. boulei* (Patte) and *Y. gracilis sp. nov.,* and designated the former as the type species. Unfortunately Chen's original manuscript remains unpublished. In 1976, Chen (in Gu et al., 1976, p. 57) formally proposed *Yunnanophorus* as a new genus. According to ICZN (1999) rules, this genus should be attributed to Chen (1974) and dated accordingly.

Note 2.—Yunnanophorus zetoides Guo (1985a, p. 188, pl. 28,*1–2*) shows hinge teeth much better than the type species, the anterior teeth of which are not fully visible. This gives us a clear understanding of the dentition of *Yunnanophorus*.

Subfamily ANODONTINAE Ortmann, 1910
Genus SICHUANOCONCHA Liu, 1984, p. 564

[in Chinese]

Figure 23.22–23.25

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Liu, 1984, p. 564): shell large, test not thick; quadrilateral, oval, or rounded triangular; retrocrescent; equivalve, inequilateral; inflated; a broad diagonal ridge extending from umbo to posteroventral end, in front of ridge with shallow groove; shell surface behind ridge fairly broad, accounting for about two-fifths of entire surface. Umbo broad; beak prosogyrate, positioned anteriorly. Shell surface in front of ridge with W-shaped costae; behind ridge having radial costae or lines, which intersect W-costae to form chevon-shaped sculpture; commarginal ornament developed. Lunule absent; escutcheon undeveloped; ligament external, opisthodetic; hinge plate narrow. Each valve with one submedian tooth below umbo, low conelike or nipple-like; anterior lamellar teeth short, two in left valve, one or two in right valve; posterior lamellar teeth fine and long, two in left valve, one in right valve, extending from post-umbo to posterodorsal end; all lateral teeth smooth and parallel to hinge line. Inner surface smooth; anterior adductor scar not deep, large, subcircular, with arborescent-like striations; posterior adductor scar not well preserved.

Type species.—Sichuanoconcha amica Liu, 1984, p. 564, pl. 16,*1* (holotype), *2–6*; pl. 17,*1*,*4*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Liu, 1984, p. 564): Shell large, elongate oval, posterior part slightly expanded; dorsal margin long; anterior margin rounded; posterior margin truncated in upper and rounded in lower part; moderately inflated, with largest inflation at middle-upper part of posterior ridge; posterior ridge prominent, running from umbo to posteroventral end; groove in front of ridge wide and shallow. Umbo broad, slightly projecting above hinge line, positioned at one-third shell length from anterior. Surface in front of ridge with 8–10 pairs of W-shaped costae, behind it with 8 radial costae or ribs; commarginal ornament developed. Lunule absent; escutcheon undeveloped; ligament external, opisthodetic; hinge plate narrow. Anterior lamellar teeth short, two in left valve, one or two in right valve; posterior lamellar teeth fine and long, two in left valve, one in right valve; all lateral teeth smooth and parallel to hinge line; submedian tooth low-conelike or nipple-like, situated below umbo. Anterior adductor scar not deep, large, subcircular, with arborescent-like striations; posterior adductor scar not well preserved. Measurements: 58–70 mm long, 37–51 mm high, 23–26 mm wide, height to length ratio about 0.63.

Type locality.—Gaosi, Lezhi, Sichuan, southwestern China.

Type occurrence.—Penglaizhen Formation, Upper Jurassic.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: bi2230 (holotype); bi2231–2234, 2236, 2237, 2255.

Distribution of genus.—Upper Jurassic–Lower Cretaceous; Asia (Liu, 1984, p. 564). Genus is restricted to Upper Jurassic in Sichuan and Qinghai, China. The occurrence of *Sichuanoconcha* in Qinghai is represented by *Undulatula? tangulaensis* Gu (=*Sichuanoconcha*

tanggulaensis) from the Xueshan Formation, Upper Jurassic, Wenquan area (Gu et al., 1976, p. 326, pl. 91,*1*, *6–8*).

Taxonomic position.—Unionoidea; family position not designated in Liu (1984).

Revision suggestion.—*Sichuanoconcha* is better placed in the Anodontinae (family Unionidae) based on hinge structure and shell outline.

Genus JILINOCONCHA
Ma, 1989, p. 259
[in Chinese]

Figure 21.24–21.26

Discussion and diagnosis.—(Translation from Chinese text, Ma, 1989, p. 259): Original diagnosis of genus as for family (see Jilinoconchidae Ma below). Shell shape and ornament similar to those in *Protelliptio (Plesielliptio)* and *Pseudelliptio*. Internal structure of *Protelliptio* still unknown, and musculature indicates it belongs to superfamily Unionoidea. But internal structure of Jilinoconchidae, as well as that of *Jilinoconcha*, seem to place it in the superfamily Trigonioidoidea.

Type species.—*Protelliptio (Plesielliptio) songhuaensis* Gu & Yu in Gu et al., 1976, p. 338, pl. 105,*1* (holotype), *2–3;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Gu & Yu in Gu et al., 1976, p. 338): Shell medium; narrow elongate-oval, with shell length up to about 55 mm; posterior end narrow and rounded; ornament of umbonal region same as in genus [*Protelliptio (Plesielliptio)*], but costae slightly broader; two radial ridges broader and more rounded, and positioned more posteriorly due to shell outline being more narrow and elongate, but lower one remaining coincident with indistinct posterior ridge.

Type locality.—Sanqingshan, Nongan, Jilin, northeastern China.

Type occurrence.—Upper part of Nenjiang Formation to Sifangtai Formation, Upper Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25471 (holotype); 25472, 25473.

Distribution of genus.—Upper Cretaceous; Jilin, northeastern China (Ma, 1989, p. 260).

Taxonomic position.—Jilinoconchidae Ma, 1989 (by original designation).

Revision suggestion.—*Jilinoconcha* is synonymous with *Protelliptio (Plesielliptio)* Russell. *Protelliptio (Plesielliptio) songhuaensis*, the type species of *Jilinoconcha*, was indicated by Gu and Yu (in Gu et al., 1976) to be based on three type specimens. Among these, one specimen (paratype, see Gu et al., 1976, pl. 105,*2,* NIGP25473) occurring in an isolated site of the Sifangtai Formation, Late Cretaceous, has a hinge similar to *Martinsoella* Hong in Martinson, 1961 (Nippononaiidae, Trigonioidoidea). The assignment by Ma (1989) for *Jilinoconcha*, and the family Jilinoconchidae, is based mainly on this paratype. However, the other two specimens (holotype and other paratype, see Gu et al., 1976, pl. 105,*1*,*3*; NIGP25471, 25472; see also Figure 21.24–21.26, herein), from the Nenjiang Formation, Upper Cretaceous, are externally very similar to *Protelliptio (Plesielliptio)* Russell. Therefore, the opinion of Ma (1989) is not accepted herein.

Note.—Gu and Yu (1999, p. 33) restudied *Protelliptio (Plesielliptio) songhuaensis* Gu & Yu (1999, p. 34, pl. 6,*10–17*) and insisted that it should be a member of *Protelliptio* Russell, within the family Unionidae.

Family JILINOCONCHIDAE
Ma, 1989, p. 259
[in Chinese]

Discussion and diagnosis.—Original diagnosis of family (translation from Chinese text, Ma, 1989, p. 259): medium; elongate-oval. Umbonal region with W-shaped costae; posterior area with one radial thread or riblet running from umbo to posterior margin; other surface with growth lines; posterior ridge fairly prominent. Dental formula: 5a, 3a, PIII (3b in original text)/6a, 4a, (2a?), PII (2b in original text), PIV (4b in original text); all teeth smooth; both anterior and posterior teeth nearly parallel to dorsal margins; tooth 2a possibly present. Musculature and pallial line same as in superfamily (Trigonioidoidea); inner shell margins smooth. Diagnosis of family based on observation of type specimens of *Protelliptio (Plesielliptio) songhuaensis* Gu & Yu in Gu et al., 1976; ornament based on holotype (NIGP 25471), and hinge structure based on one paratype (NIGP 25473), but presence of tooth 2a by inference.

Type genus.—*Jilinoconcha* Ma, 1989, p. 259; by original designation; by monotypy.

Distribution of family.—Upper Cretaceous; Jilin, northeastern China (Ma, 1989, p. 259).

Taxonomic position.—Trigonioidoidea Cox, 1952 (by original designation).

Revision suggestion.—Junior synonym of family Unionidae (suggested herein; see *Jilinoconcha*).

Note.—Family name Jilinoconchidae was originally misspelled as Jilinoconchadidae by Ma (1989, p. 259).

Genus TUBERONAIA
Gu & Huang in Gu et al., 1976, p. 313
[in Chinese]

Figure 24.1–24.13

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Gu & Huang in Gu et al., 1976, p. 313): shell inflated; triangular; lunule small but distinct. Beak fairly strongly prosogyrate and incurved. Commarginal umbonal ornament not prominent; anterocentral surface with row of knobs extending from umbo downward (knob ridge), formed by strengthening and towering of commarginal costae; posterior ridge prominent, but low, without knobs; posterodorsal side with one weak, radial curving line and few short and weak, oblique lines; sometimes radial lines also appearing on lower slope of knobs and in front of knob ridge. Umbonal cavity deep. Pseudocardinal teeth grooved, tooth 2b of left valve narrow, pointed backward; lower part of 2a turning backward; tooth 1 of right valve largest, pointed backward; 3a and 3b situated at same horizon, narrowly separated from each other. Only one anterior pedal scar, inserted at posterior side of anterior adductor scar.

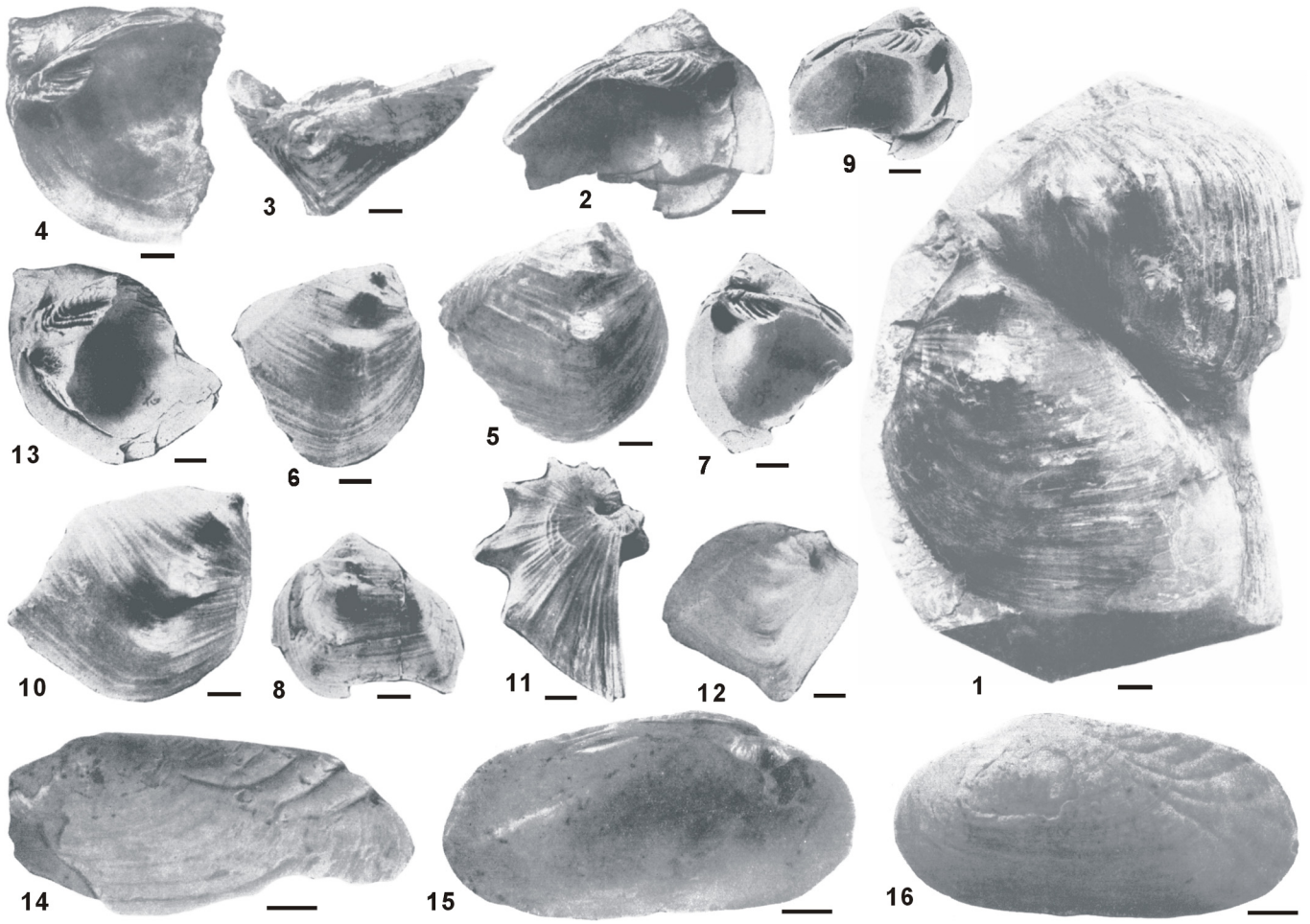

Figure 24. *1–13. Tuberonaia tuberosus* (Odhner), scale bar 5 mm; *1–5,* syntype; lateral view (*1*) of both valves; and left interior (*2*), umbonal (*3*), right interior (*4*), and right lateral (*5*) views (adapted from Odhner, 1930, figs. 18,14–17); *6–13,* plesiotypes; *6–7,* right lateral (*6*) and interior (*7*) views; *8–9,* left lateral (*8*) and interior (*9*) views; *10–13,* right lateral (*10*), anterior (*11*), dorsal (*12*), and interior (*13*) views (adapted from Gu and Huang in Gu et al., 1976, pl. 127,*4–11*).—*14–16. Radioplicata guanxiensis* Huang, scale bar 10 mm; *14,* paratype, left lateral; *15–16,* holotype, left interior and left exterior (adapted from Huang, 1981, pl. 4,*10–12*).

Type species.—*Psilunio tuberosus* Odhner, 1930, p. 12, pl. 2,*14–18* (syntype) by original designation; Gu and Huang in Gu et al., 1976; also see Gu et al., 1976, pl. 127,*4–14*.

Original diagnosis of type species.—(Odhner, 1930, p. 12): Shell solid, broad and high, elongate trigonal when seen from side, cardiform when seen from front, with large enrolled umbos in upper anterior corner. Surface coarsely sculptured in umbonal half of valve with regular distant concentric ribs, which form a series of about 9 knobs descending from umbos on anterior half of each valve; in posterior half, a sharp diagonal keel, and above it, some longitudinal regulations; besides [in addition], more or less pronounced lines of growth. Well-defined lunula in front of umbones. Teeth in left valve: 2b in form of a narrow, irregularly striate and knotted, obliquely placed ridge, 2a in its continuation, almost dissolved into low ridges and knobs; socket between these cardinals very shallow and strongly ribbed at bottom, ribs running parallel to 2b and forming a repetition of it; lateral teeth bent at angle relative to cardinals and extending closely parallel to each other as short, thin, lamelliform ridges. Right valve with tooth 1 parallel to hinge line and separated from 3b in very deep, very obliquely furrowed socket; 3a very small, separated by a well-defined socket from 1; lateral tooth lamelliform. Anterior adductor scar ovate, very deep; protractor scar joined to or separated from it, on underside of cardinals 1 and 2a; no trace of retractor pedis proper. No scars of elevator foot muscles within deep umbonal cavity [*sic*].

Original diagnosis of type species.—(Translation from Chinese text, Gu & Huang in Gu et al., 1976, p. 313): Shell solid, highly triangular. Umbo small and projecting high above hinge line, positioned at anterodorsal corner; umbonal ridge highly protruded, ornamented with a series of about 11 knobs; knobs in ventral part larger; surface with commarginal costae and lines.

Type locality.—Nanning, Guangxi, South China.

Type occurrence.—Yongning Formation, ?Pliocene.

Distribution of genus.—?Pliocene or earlier; Guangxi, South China (Gu & Huang in Gu et al., 1976, p. 313).

Taxonomic position.—Unionidae (by original designation).

Superfamily ANTHRACOSIOIDEA Amalitsky, 1892
Family PALAEOMUTELIDAE Weir in Vokes, 1967
Genus SOLONODON Liang, 1982, p. 136

[in Chinese with English diagnosis, p. 145]

Figure 25.1–25.6

Discussion and diagnosis.—Original diagnosis (Liang, 1982, p. 145): shells small to middle, equivalve, inequilateral. Shells of variable shape, mainly triangular, elliptical or subcricoid-form. Umbo situated subanterior of end. Hinge line arcuate in shorter shells but in longer ones may be subangulate below umbo and nearly straight posteriorly. Hinge plate with continuous series of dentitions. Teeth small in front of beak, but [inverted-V] form and nodulated behind beak. Resilifer absent. Anterior adductor large and strong, lunate. Posterior adductor larger and weaker than anterior one. Anterior pedal retractor scar prominent. Pallial line simple. Shell sculpture consisting of concentric ornamentation only [*sic*].

Type species.—*Solonodon triangulatum* Liang, 1982, p. 137, pl. 2,*1–5* (syntype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Liang, 1982, p. 137): Shell small to medium; triangular; moderately inflated; anterior end more rounded than posterior; ventral margin straight or nearly straight; dorsal margins distinctively curved; beak projecting above hinge line. Hinge plate with row of continuously arranged small teeth; teeth in front of beak small, closely spaced, chevron shaped, numbering from 5–7; behind beak, teeth gradually becoming larger, nodular, about 11–13 in number. Anterior adductor scar large and deep, long-elliptical in form, with longer diameter up to 3 mm, situated at anterior end of hinge plate; posterior adductor indistinct; pallial line simple; surface with commarginal lines.

Type locality.—Solon, Horqin-Youqi, Inner Mongolia, North China.

Type occurrence.—Solon Formation, upper Permian.

Repository of type material.—Shenyang Institute of Geology and Mineral Resources, Shenyang, Liaoning, northeastern China; accession number: Bi 10042–10047.

Distribution of genus.—upper Permian; northeastern China and Inner Mongolia, northern China (Liang, 1982, p. 137).

Taxonomic position.—Palaeomutelidae (by original designation).

Revision suggestion.—Junior synonym of *Palaeomutela* Amalitsky (suggested by Fang, herein).

Genus HINGANODON Liang, 1982, p. 138

[in Chinese with English description, p. 145]

Figure 25.10–25.12

Discussion and diagnosis.—Original diagnosis (Liang, 1982, p. 145): shells small to medium; transversely elongate; equivalve, inequilateral. Hinge line straight or arcuate. Umbo situated subanterior to end. Hinge plate with continuous series of dentitions. Teeth smaller in front of beak and longitudinally imbricating behind beak. Resilifer absent. Anterior adductor large and strong; posterior adductor larger and weaker than anterior adductor. Anterior pedal retractor scar prominent. Pallial line simple. Shell sculpture consisting of concentric ornamentation only [*sic*].

Type species.—*Hinganodon triangulatum* Liang, 1982, p. 139, pl. 2,*6–7* (syntype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Liang, 1982, p. 139): Shell medium to large; fairly inflated; greatly elongate posteriorly; elongate-triangular; anterior end rounded or narrowly rounded; ventral margin straight; posterodorsal margin long and oblique; posterior end pointed; beak located at one-quarter shell length from anterior. Hinge plate with row of continuously arranged teeth; teeth in front of beak small and dense, 4–6 in number; behind beak with 7–8 teeth, teeth stronger posteriorly, imbricately arranged. Anterior adductor scar large and deep, kidneylike, 4 mm long and 3 mm wide, located

Figure 25. *1–6.* Syntype of *Solonodon triangulatum* Liang; *1,* right internal mold, scale bar 5 mm; *2,* right internal mold, scale bar 5 mm; *3,* left internal mold, scale bar 5 mm; *4,* enlarged hinge of Fig. 25.3, scale bar 2 mm; *5,* right internal mold, scale bar 5 mm; *6,* left internal mold, scale bar 5 mm (adapted from Liang, 1982, pl. 2,*1–2,3a–b,4–5*).——*7–9. Shaanxiconcha subparallela* Liu, scale bar 5 mm; *7,* holotype, conjoined valves; *8,* paratype, left valve; *9,* paratype, conjoined valves (adapted from Liu in Liu & Li, 1980, pl. 100,*18,20–21*).——*10–12.* Syntype of *Hinganodon triangulatum* Liang, scale bar 5 mm; *10,* right internal mold; *11,* right internal mold; *12,* enlarged hinge of Fig. 25.11 (adapted from Liang, 1982, pl. 2,*6,7a–b*).——*13–15.* Type material of *Neonuculites linxiensis* (Liang), scale bar 5 mm; *13,* right lateral view; *14,* dorsal view of internal mold of conjoined valves; *15,* local enlarged hinge of Fig. 25.14 (no scale; adapted from Liang, 1982, pl. 186,*18a–c*).——*16–19. Jiangxiella (Jiangxiella) subovata* Liu, scale bar 2 mm; *16,* lectotype, left internal mold; *17,* enlarged hinge of Fig. 25.16; *18,* paralectotype, right internal mold; *19,* paralectotype, left internal mold (adapted from Liu [anonymous in the original publication], 1968, pl. 39,*7,3,2,9;* =Liu in Gu et al., 1976, pl. 23,*3,4,2,7*).——*20–23. Lilingella (Xinyuella) liuyangensis* (Gu & Liu), scale bar 5 mm; *20,* holotype, left valve; *21,* paratype, left valve (adapted from Gu & Liu in Gu et al., 1976, pl. 22,*22,21*); *22,* plesiotype, right lateral view; *23,* plesiotype, left lateral view (adapted from J. Chen & Xu, 1980, pl. 2,*4,6*).——*24-27. Liaoningia opima* Yu & Dong, scale bar 5 mm; *24,* holotype, right internal mold; *25,* paratype, left composite mold; *26,* paratype, right external mold; *27,* paratype, left external mold (adapted from Yu & Dong, 1993, pl. 57,*15,1,4,12*).——*28–30. Jiangxiella (Guangdongella) exquisita* Li & Li, scale bar 2 mm; *28,* lectotype, left internal mold; *29,* paralectotype, left valve; *30,* paralectotype, right valve (adapted from Li & Li in Zhang, Wang, & Zhou, 1977, pl. 2,*4,1–2*).——*31–36.* Syntype of *Xishanoconcha xiazhuangensis* Wang; *31,* right interior view, scale bar 1 mm; *32,* right valve, scale bar 5 mm; *33–34,* right internal molds, scale bars 5 mm; *35,* left valve, scale bar 5 mm; *36,* right valve, scale bar 5 mm (adapted from Wang, 1984, pl. 17,*30–35*).——*37. Yananoconcha minor* Yu & Zhang, scale bar 1 mm; lateral view of holotype of Fig. 26.13 (adapted from Yu & Zhang, 1980, pl. 104,*9*).

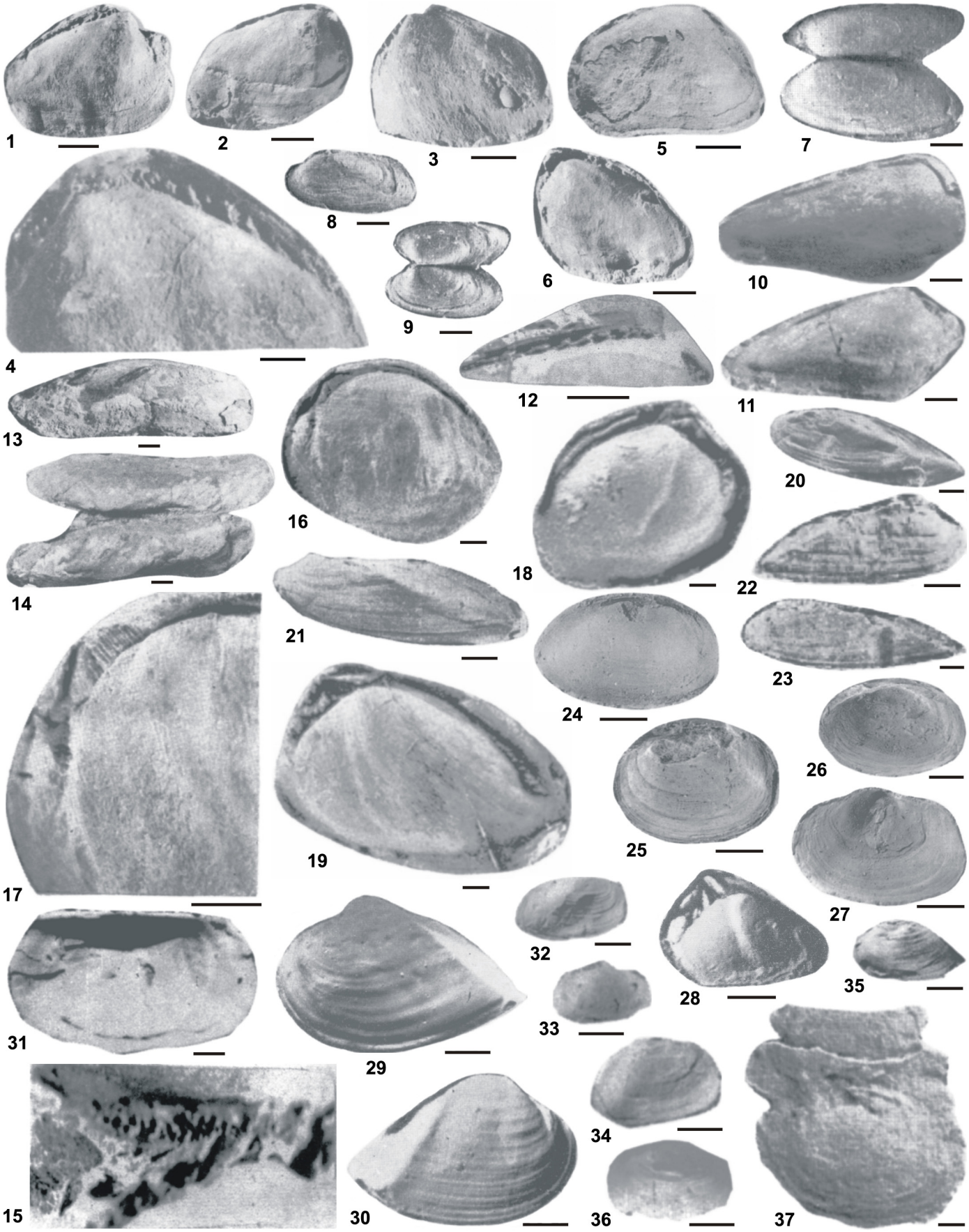

Figure 25. *For explanation, see facing page.*

at anterior end of hinge plate; posterior adductor scar larger and weaker, elliptical in form, 6 mm long and 4 mm wide; located at posterior extremity of hinge plate; pallial line simple. Surface ornament not preserved.

Type locality.—Solon, Horqin Youyi Qianqi, Inner Mongolia, northern China.

Type occurrence.—Solon Formation, upper Permian.

Repository of type material.—Shenyang Institute of Geology and Mineral Resources, Shenyang, Liaoning, northeastern China; accession number: Bi 10153, 10154.

Distribution of genus.—upper Permian; northeastern China and Inner Mongolia, northern China (Liang, 1982, p. 139).

Taxonomic position.—Palaeomutelidae (by original designation).

Revision suggestion.—Junior synonym of *Palaeomutela* Amalisky (suggested by Fang, herein).

Genus NEONUCULITES Liang, 1982, p. 140

[in Chinese with English description, p. 146]

Figure 25.13–25.15

Discussion and diagnosis.—Original diagnosis (Liang, 1982, p. 146): shells medium to large, transversely elongate, equivalve, inequilateral. Hinge line straight. Hinge plate with irregular dentitions. Front umbo with internal septum. Anterior adductor large and strong, lunate. Posterior adductor larger and weaker than anterior one. Anterior pedal retractor scar prominent. Pallial line simple. Shell sculpture consisting of concentric ornamention only [*sic*].

Type species.—*Nuculites linxiensis* Liang, 1980, p. 430, pl. 186,*18a–c* (holotype) [=*Neonuculites linxiensis* (Liang), 1982, p. 140, pl. 2,*14a–c*]; by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Liang, 1982, p. 140): Shell large; fairly inflated; transversely elongate; elliptical; beak positioned at one-third shell length from anterior; both anterior and posterior margins rounded; posterodorsal margin straight; ventral margin nearly straight and nearly parallel to dorsal margin, but with weak sinus at middle part in left valve; length 55 mm; height 22 mm. Surface with growth lines. Hinge plate of each valve with row of irregular teeth; 5–7 small teeth in front of beak and 11–12 behind beak. Anterior adductor scar large and deep, elliptical in form, 5 mm long and 3 mm wide, located at anterior extremity of hinge plate; posterior adductor scar very weak; anterior adductor scar accompanied by small but distinct pedal scar close to posterior side; internal septum situated at anterior side of umbo, extending radially into about two-fifths shell height; pallial line simple, anterior part composed of discontinuous small dots.

Type locality.—Guandi, Linxi, Inner Mongolia, northern China.

Type occurrence.—Linxi Formation, upper Permian.

Repository of type material.—Shenyang Institute of Geology and Mineral Resources, Shenyang, Liaoning, northeastern China; accession number: Bi10005, holotype.

Distribution of genus.—upper Permian; Inner Mongolia, northern China and northeastern China (Liang, 1982, p. 140).

Taxonomic position.—Palaeomutelidae (by original designation).

Revision suggestion.—The type species is a single, rather poorly preserved, strongly secondarily deformed specimen; it is difficult to confirm the existence of an internal septum. Nevertheless, more material is needed to validate *Neonuculites* Liang as a generic taxon.

Family SHAANXICONCHIDAE Liu in Liu & Li, 1980, p. 6

(without diagnosis) [in Chinese]

[*emend.* J. Chen, herein]

Emended diagnosis herein.—Small-shelled Anthracosioidea, with very weak lateral lamellar tooth; subumbonal teeth absent.

Distribution of family.—Triassic, ?Lower Jurassic; Asian paleoland (Liu in Liu & Li, 1980, p. 7, for the genus *Shaanxiconcha*). It is presently indicated that the family possibly extends from Lower Triassic to Lower Cretaceous.

Taxonomic position.—Anthracosioidea (by original designation).

Genus SHAANXICONCHA Liu in Liu & Li, 1980, p. 6

[in Chinese]

Figure 25.7–25.9

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Liu in Liu & Li, 1980, p. 6): shell thin, small to medium; shape varying from elongate elliptical, elliptical, suboval to oblique-triangular, obliquely quadrilateral, subrhomboid; equivalve, inequilateral; ligament external, opisthodetic. Hinge structure generally not easy to find; no trace of submedian teeth below beak; but one very weak, lamellar tooth visible respectively on anterior and posterior hinge in a small number of specimens; posterior tooth starting below umbo and extending parallel to posterodorsal margin, ending at about three-quarters length of posterodorsal margin from beak; anterior tooth more weak, extending obliquely from below umbo into anterodorsal end; anterior adductor scar shallow, oval-circular, positioned near anterodorsal end; posterior adductor scar and pallial line unknown. Shell moderately inflated, umbonal region broad and flat, anterior margin in front of umbo generally incurved. Posterior margin truncated; posterior ridge prominent, or broad and gentle; posteroventral angle rounded, acute or right; surface ornamented with commarginal lines and rugae only, lines becoming slightly warped in umbonal region.

Type species.—*Shaanxiconcha subparallela* Liu in Liu & Li, 1980, p. 20, pl. 100,*18* (holotype), *19–21;* by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Liu in Liu & Li, 1980, p. 20): Medium, obliquely quadrilateral, with ratio of height to length 0.5 or smaller; anterior end narrow and rounded; posterior part slightly expanded, posterior margin broadly truncated; largest shell height at posterior side of broad umbonal region; beak slightly projecting above hinge line, positioned at one-quarter to one-fifth shell length from anterior; anterior margin incurved, but not distinct; posterodorsal margin long and straight, laying at same level with beak; posterior margin

truncated; ventral margin long and slightly curved, nearly parallel to posterodorsal margin; posteroventral angle distinct, about 50°; moderately inflated; posterior ridge broad, prominent; commarginal lines becoming slightly warped in umbonal region; one posterior lateral lamellar tooth seen in each valve of paratype.

Type locality.—Dalihe, Zichang, Shaanxi, northwestern China.

Type occurrence.—Upper Member of Yanchang Formation, Upper Triassic.

Repository of type material.—China University of Geosciences, Beijing; accession number: Sh0090 (holotype); Sh0091, 0093, 0094.

Distribution of genus.—Triassic, ?Lower Jurassic; Asia (Liu in Liu & Li, 1980, p. 7).

Taxonomic position.—Shaanxiconchidae Liu in Liu & Li, 1980 (by original designation).

Genus XISHANOCONCHA Wang, 1984, p. 45

[in Chinese]

Figure 25.31–25.36

Synonomy.—Arguniella Kolesnikov, 1980, p. 25.

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Wang, 1984, p. 45): shell thin; medium; rather inflated; umbo broad and low, generally not projecting; hinge margin straight; ligament external, opisthodetic; surface ornamented with concentric lines only; hinge edentulous; each valve with narrow, straight, and smooth hinge plate; hinge plate extending from anterodorsal angle to posterodorsal angle, but becoming narrower below beak.

Type species.—Xishanoconcha xiazhuangensis Wang, 1984, p. 45, pl. 17,*30–35* (no holotype designated); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Wang, 1984, p. 43): Shell thin, medium, elliptical; fairly inflated; umbo triangular in form, broad and low, not projecting; beak positioned near midlength; hinge margin straight; anterior margin rounded, posterior margin weakly truncated; posterior ridge not prominent. Hinge edentulous, each valve with straight and smooth hinge plate, extending from anterodorsal end into posterodorsal end and becoming narrower below beak; muscle scars not distinct; surface with commarginal lines only.

Type locality.—Xiazhuang, Fengtai, Beijing, China.

Type occurrence.—Xiazhuang Formation, Lower Cretaceous.

Repository of type material.—Institute of Geology, Chinese Academy of Geological Sciences, Beijing; accession number: H711-1301–H711-1306.

Distribution of genus.—Upper Jurassic–Lower Cretaceous; Hebei and Beijing, North China (Wang, 1984, p. 45).

Taxonomic position.—Anodontinae, family Unionidae (by original designation).

Revision suggestion.—Junior synonym of *Arguniella* Kolesnikov, 1980 (suggested by J. Chen, 1999). *Arguniella* (=*Xishanoconcha*) was originally assigned to Sibireconchidae by Kolesnikov (1977), but it might be reassigned to family Shaanxiconchidae Liu in Liu & Li, 1980 based on dentition.

Note.—Genus name *Xishanoconcha* and species name *Xishanoconcha xiazhuangensis* first appeared in Hong et al. (1982, p. 106) as manuscript names, but without description.

Family SIBIRECONCHIDAE Kolesnikov, 1977
Genus LIAONINGIA Yu & Dong, 1993, p. 178

[in Chinese]

Figure 25.24–25.27

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Yu & Dong, 1993, p. 178): shell not large; test thin; subtriangular to elliptical; weakly to fairly inflated, with largest inflation at middle-upper part; posterior carina broadly rounded when present, running from umbo to posteroventral end; beak obtuse, positioned at midlength or slightly anterior; ligament external, opisthodetic; surface with commarginal lines only. Hinge teeth lamellar; left valve with two anterior teeth and two posterior teeth; upper anterior lamellar tooth stout, nearly parallel to hinge margin, lower one longer and finer; posterior lamellar teeth stout and strong, slightly curved; sometimes lamellar teeth with weak, irregular, lateral striations; right valve with one anterior tooth and one posterior tooth, both starting from below umbo and extending laterally.

Type species.—Liaoningia opima Yu & Dong, 1993, p. 179, pl. 57,*1,4–6,12,15* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Yu & Dong, 1993, p. 179): Shell small to medium; subelliptical; anterior margin broadly rounded; posterior margin quadrately rounded; ventral margin widely curved; umbo broad; beak slightly projecting above hinge line, located at about one-third shell length from anterior or slightly posterior; posterior carina weak; hinge structure same as in genus diagnosis; surface with commarginal lines and rugae.

Type locality.—Yangcaogou, Beipiao, Liaoning, northeastern China.

Type occurrence.—Yangcaogou Formation, Upper Triassic.

Repository of type material.—The Institute of Geology, Chinese Academy of Geological Sciences, Beijing; accession number: B0043 (holotype); B0038, B0042, B0567, B0854, L0687.

Distribution of genus.—Triassic, ?Lower Jurassic; Asia (Yu & Dong, 1993, p. 178).

Taxonomic position.—Liaoningiidae Yu & Dong, 1993 (superfamily ?Unionoidea) (by original designation).

Revision suggestion.—Sibireconchidae Kolesnikov, 1977.

Family LIAONINGIIDAE Yu & Dong, 1993, p. 178

[in Chinese]

Synonymy.—?=Sibireconchidae Kolesnikov, 1977, p. 49.

Discussion and diagnosis.—Original diagnosis of family (translation from Chinese text, Yu & Dong, 1993, p. 178): shell small to medium; test thin; shape varying, elongate-elliptical, oval-circular or rounded-triangular; equivalve, inequilateral; ligament external, opisthodetic; hinge teeth lamellar, two in anterior and two in posterior in left valve, and one in anterior and one in posterior in right valve; surface with commarginal lines; lived in freshwater.

Type genus.—*Liaoningia* Yu & Dong, 1993, p. 178; by monotypy.

Distribution of family.—Triassic, ?Jurassic; Asia (Yu & Dong, 1993, p. 178).

Taxonomic position.—Unionoidea (by original designation).

Revision suggestion.—Possible junior synonym of the family Sibireconchidae Kolesnikov, 1977.

Superfamily PSEUDOCARDINIOIDEA Martinson, 1961
Family PSEUDOCARDINIIDAE Martinson, 1961

[*emend*. Liu & J. Chen, 1981, p. 111 (in English)]

Discussion and diagnosis.—Diagnosis of family (Liu & J. Chen, 1981, p. 111): shell small to medium, oval to cuneiform, opisthodetic. Paleoheterodont hinge, all teeth laterally grooved; pseudocardinal and anterior lamellar teeth variable: primitive forms with two or three developed pseudocardinal teeth in each valve but without anterior lamellar teeth; advanced forms with well-developed anterior lamellar teeth, one in left valve and two in right. Posterior lamellar teeth always one in left valve and two in right valve. Anisomyarian: anterior adductor scar deep, irregularly grooved; distinct isolated pedal scar located at upper rear side of anterior adductor insertion area; posterior adductor scar weak and smooth; pallial line entire [*sic*].

Distribution of family.—Upper Triassic–Middle Jurassic; Asia (Liu & J. Chen, 1981, p. 112). Family may have earliest representative in Middle Triassic and latest representative in Lower Cretaceous.

Note.—Unlike Jurassic pseudocardiniids, Triassic *Jiangxiella* and *Jiangxiella (Guangdongella)* are often found in association with marine *Bakevelloides* and *Waagenoperna* and lived in estuaries, lagoons, or other nearshore environments, indicating derivation of normal marine ancestors. Jiang, Cai, and Chen (2005) confused Triassic euryhaline *Jiangxiella* and *Jiangxiella (Guangdongella)* with Jurassic freshwater pseudocardiniids. Their view is therefore rejected.

Genus JIANGXIELLA Liu, 1968, p. 94
[in Chinese]

[*emend*. Liu & J. Chen, 1981, p. 113 (in English)]

Figure 25.16–25.19

Discussion and diagnosis.—Original diagnosis (Liu & J. Chen, 1981, p. 113): shell oval, triangular, or elliptical in outline. Three pseudocardinal teeth in each valve: tooth 1 of right valve acutely to obtusely triangular; other teeth nodelike or short lamellar. Anterior lamella teeth not developed in primitive forms, while in advanced forms one anterior lamellar tooth present in left valve and two in right valve. Posterior lamellar teeth: one in left valve and two in right valve, beginning from below external ligament and extending to upper side of posterior adductor insertion areas; all teeth transversely grooved. Anterior adductor scar deep, oval, with irregular grooves, distinct pedal scar inserted at posterior upper side. Posterior adductor scar weak, oval; pallial line entire. Hinge formula: early jiangxielloid type: 3a, 1, 3b, PI, PIII/2a, 2b, 4b, PII; late jiangxielloid type: AIII, AI, 3a, 1, 3b, PI, PIII/AII, 2a, 2b, 4b, PII [*sic*].

Type species.—*Jiangxiella subovata* Liu (=anonymous in original publication), 1968, p. 95, pl. 39,*1–6,7* (lectotype, subsequently designated by Liu in Gu et al., 1976) *8–9;* by original designation; see also: *Jiangxiella subovata* Liu in Gu et al., 1976, p. 57, pl. 23,*1–2,3* (lectotype), *4–7*.

Original diagnosis of type species.—(Translation from Chinese text, Liu in Gu et al., 1976, p. 57): Medium to small, short-oval, inflated; anterior end narrow, posterior end obtuse and rounded; umbo low; beak small, positioned at one-third shell length from anterior end; posterior ridge rounded, not prominent; surface only with fine commarginal lines.

Type locality.—Shuibei, Xinyu, Jiangxi, South China.

Type occurrence.—Sanjiachong Member, Anyuan Formation, Upper Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 24780 (holotype); 24778, 24779, 24781–24783.

Distribution of genus.—Upper Triassic; South China (Liu & J. Chen, 1981, p. 114) and southwestern Japan (J. Chen & Tanaka, 2001).

Taxonomic position.—Pachycardiidae (by original designation).

Revision suggestion.—Pseudocardiniidae Martinson, 1961 (Chen & Xu, 1980; Liu & J. Chen, 1981; J. Chen, 1985).

Note.—The name *Jiangxiella* first appeared in Liu (= anonymous in the original publication) (1968), *Fossil Manual of Mesozoic Coal-bearing Strata in Hunan and Jiangxi Provinces,* published during the notorious Cultural Revolution in China, when scientists were prohibited from publishing papers or books with their names listed as authors. Now it is time to restore the historic truth.

Subgenus JIANGXIELLA (JIANGXIELLA) Liu, 1968, p. 94
[in Chinese]

[*emend*. Liu & J. Chen, 1981, p. 113 (in English)]

Diagnosis of subgenus.—(By J. Chen, herein): Oval to elliptical-shaped *Jiangxiella*; carina obtuse, not strong; surface ornamented with irregular commarginal lines and rugae.

Distribution of subgenus.—Upper Triassic; South China and southwestern Japan.

Subgenus JIANGXIELLA (GUANGDONGELLA) Li & Li in Chen & Xu, 1980, p. 361
[in Chinese]

[*emend*. Liu & J. Chen, 1981, p. 115 (in English)]

Figure 25.28–25.30

Name history.—Originally *Guangdongella* Li & Li, unpublished manuscript dating from the Cultural Revolution.

Discussion and diagnosis.—Original diagnosis of subgenus (Liu & J. Chen, 1981, p. 115): shell small, less than 10 mm long; posterior carina strong, acute; surface with regular commarginal rugae in front of carina, but smooth behind it; hinge and musculature same as in *Jiangxiella* [*sic*].

Type species.—*Guangdongella exquisita* Li & Li in Zhang, Wang, & Zhou, 1977, p. 26, pl. 2,*1–2,4* (lectotype, designated by Liu & Chen, 1981, p. 116), *non* fig. 3 (note: type species original designation by Li and Li in their unpublished manuscript, and subsequent designation by Li & Li in J. Chen & Xu, 1980, p. 361); also see: *Guangdongella exquisita* Liu & J. Chen, 1981, p. 115, text-fig. 6a–d; pl. 3,*10–14*.

Original diagnosis of type species.—(Liu & J. Chen, 1981, p. 115): Shell small, obliquely triangular, gibbous, umbo located anteriorly; anterior end rounded; posterior end narrow; carina strong, acute. Surface with 10 more or less regular concentric rugae in front of, and growth lines only behind, the carina. Left valve with three pseudocardinal teeth; 2a and 2b cuneiform, forming an angle of about 80°; 4b short, lamellar; one posterior lamellar tooth. Right valve with three pseudocardinal teeth; tooth 1 forming acute triangle; 3a and 3b short, lamellar; two posterior lamellar teeth; all teeth transversely grooved. Anterior adductor scar deep, oval, with irregular grooves; pedal scar located at upper posterior side; posterior adductor scar relatively weak [*sic*].

Type locality.—Xiaoshui, Lechang, Guangdong, South China.

Type occurrence.—Xiaoshui Formation, Upper Triassic.

Repository of type material.—Institute of Geology, Chinese Academy of Geosciences, Beijing (lacking accession number).

Distribution of subgenus.—Upper Triassic; South China (Li & Li in Zhang, Wang, & Zhou, 1977, p. 26).

Taxonomic position.—Pachycardiidae (by original designation).

Revision suggestion.—Pseudocardiniidae Martinson, 1961 (Liu & J. Chen, 1981, p. 115); *Guangdongella* is herein suggested as a subgenus of *Jiangxiella*.

Note.—The genus name *Guangdongella* first appeared in Li and Li in Zhang, Wang, & Zhou, 1977, p. 25, but no type species was designated. *Guangdongella* is made available by Li and Li in J. Chen and Xu, 1980, p. 361, which conforms to the ICZN (1999).

Genus LILINGELLA
Chen & Liu in Liu, 1968, p. 109
[in Chinese]

[*emend*. Liu & J. Chen, 1981, p. 116 (in English)]
Figure 26.7–26.11

Discussion and diagnosis.—Original diagnosis (Liu & Chen, 1981, p. 116): shell medium; triangular, subcircular, elliptical, or cuneiform; umbonal cavity deep. Each valve with two pseudocardinal teeth; 3b and 4b short, lamellar, nearly parallel with posterior dorsal margin; 1 and 2b connected, respectively, with AI and AII. Right valve with anterior and two posterior lamellar teeth; all teeth transversely grooved. Anisomyarian; anterior adductor scar deep, oval, with irregular grooves; posterior adductor scar weak, subcircular; pallial line entire. Hinge formula: AIII, AI, (1), 3b, PI, PIII/AII, (2b), (4b), PII [*sic*].

Type species.—*Lilingella simplex* Chen & Liu in Liu (=anonymous in original publication), 1968, p. 109, pl. 46,*2,5,7* (lectotype, designated herein) by original designation; *non* fig. 6; see also: *Lilingella simplex* Chen & Liu in Zhang, Wang, & Zhou, 1977, p. 42, pl. 2,*26,27* (both plesiotypes).

Original diagnosis of type species.—(Translation from Chinese text, Chen & Liu in Zhang, Wang, & Zhou, 1977, p. 42): Shell medium to large, with length of 16–36 mm, ratio of length to height about 2.2–2.5; beak located at one-quarter to one-fifth shell length from anterior; posterior carina strong, acute, running from umbo to posteroventral end; posteroventral end protracted to form acute point; anterior margin rounded, posterior margin truncated; posterior area narrow and long. Surface with prominent commarginal lines; posterior area smooth; hinge structure same as in genus; anterior and posterior adductor scars large, circular.

Type locality.—Gaojiatian, Liling, Hunan, south-central China.

Type occurrence.—Gaojiatian Formation, Lower Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: absent]; Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; plesiotype accession number: IV55430, IV55431.

Distribution of genus.—Lower Jurassic–Middle Jurassic; South China (Liu & J. Chen, 1981, p. 117).

Taxonomic position.—Arcticidae (by original designation).

Revision suggestion.—Pseudocardiniidae Martinson, 1961 (J. Chen & Xu, 1980, J. Chen, 1985; Liu & J. Chen, 1981).

Note 1.—The genus name *Lilingella* first appeared in Liu (= anonymous in the original publication) (1968), *Fossil Manual of Mesozoic Coal-bearing Strata in Hunan and Jiangxi Provinces,* published during the notorious Cultural Revolution in China, when scientists were prohibited from publishing papers or books with their names listed as authors. Now it is time to restore the historic truth.

Wu (1981, p. 379) designated the specimen on plate 2,*26* (Zhang, Wang, & Zhou, 1977) as the lectotype of *Lilingella simplex* Chen & Liu. However, Wu's (1981) choice is invalid, because no type species was designated by Zhang, Wang, and Zhou (1977) and all the specimens of *L. simplex* Chen & Liu in Zhang, Wang, & Zhou (1977) are plesiotypes. We herein redesignate the specimen on plate 46,*7* (Liu, 1968) as the lectotype of *L. simplex* Chen & Liu. In addition, Fang et al. (1989, p. 195) suggested that the specimen on plate 46,*6* (Liu, 1968) should be included in *Xinyuella* J. Chen & Xu, 1980 rather than in *Lilingella*.

Note 2.—Lilingella, Lilingella (Xinyuella), and *Lilingella (Hunenella)* are probably brackish-water bivalves, because they are found in association with ?*Isognomon* (or ?*Waagenoperna*) and *Planariomya*, which evidently have marine affinities. But *Lilingella (Apseudocardinia)* should be a freshwater bivalve.

Subgenus LILINGELLA (LILINGELLA)
Chen & Liu in Liu, 1968, p. 109
[in Chinese]

[*emend*. Liu & J. Chen, 1981, p. 117 (in English)]

Discussion and diagnosis.—Original diagnosis of subgenus (Liu & J. Chen, 1981, p. 117): shell medium; triangular, trapezoid, or cuneiform. Strong, acute carina extending from umbo to more or less protracted posteroventral end, ventral margin just in front slightly incurved; surface in front of carina with regular

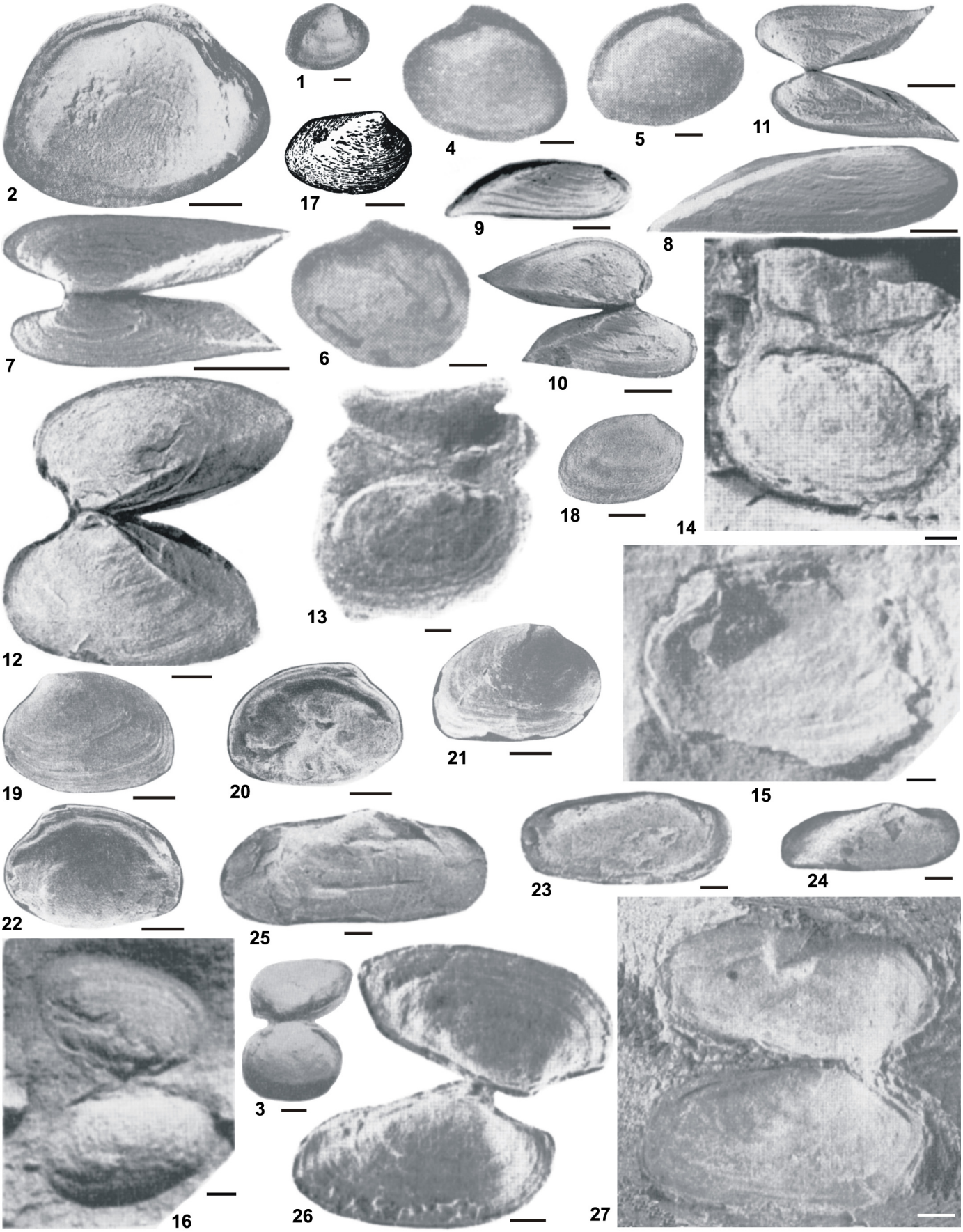

Figure 26. *For explanation, see facing page.*

concentric rugae, smooth behind carina, 1 and 2b weak, greatly diminished in forms with strongly elongate shells; 3b and 4b thin, lamellar [*sic*].

Distribution of subgenus.—Lower Jurassic; Hunan and Jiangxi, South China (Liu & J. Chen, 1981, p. 117).

Subgenus LILINGELLA (XINYUELLA) J. Chen & Xu, 1980, p. 362

[in Chinese with English diagnosis, p. 366]

[*emend*. Liu & J. Chen, 1981, p. 117 (in English)]

Figure 25.20–25.23

Name history.—Originally *Xinyuella* J. Chen & Xu, 1980, p. 362.

Discussion and diagnosis.—Original diagnosis of subgenus (J. Chen & Xu, 1980, p. 366): shell elongate cuneate, equivalve, strongly inequilateral. Umbo prominently rising above hinge margin and located at one-fifth of anterior shell. Distinct carina running from umbo toward posterior ventral end and finally forming an acute angle in posterior margin. Flank and area covered by irregular concentric wrinkles. Dental formula: AIII, AI, 1b, 3b, PI, PIII/AII, 2b, 4b, PII. All teeth with regular lateral grooves. Anterior muscle scar with irregular striae. Posterior one smooth. Pallial line simple [*sic*].

Emended diagnosis of subgenus.—(Liu & J. Chen, 1981, p. 117): Similar to *Lilingella (Lilingella),* but differs in following aspects: (1) teeth 1 and 2b diminished, 3b and 4b wery weak; (2) carina obtusely angled in transverse section; (3) posteroventral end not protracted backward, and ventral margin just in front of posteroventral end not incurved; and (4) concentric rugae extend to surface behind carina [*sic*].

Type species.—*Trigonodus*? *liuyangensis* Gu & Liu in Gu et al., 1976, p. 56, pl. 22,*21*,*22* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Gu & Liu, in Gu et al., 1976, p. 56): Shell elongate; posterior end narrow, pointed; posterodorsal margin truncated; umbo positioned at one-sixth shell length from anterior; posterior carina prominent, running from umbo to posteroventral end.

Type locality.—Chengtanjiang, Liuyang, Hunan, south-central China.

Type occurrence.—Zaoshang Formation, Lower Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 24775 (holotype); 24774 (paratype); plesiotype: 47658, 47660–47663.

Distribution of subgenus.—Lower Jurassic; Jiangxi, Hunan, and Guangdong, South China (Liu & J. Chen, 1981, p. 117).

Taxonomic position.—Pseudocardiniidae Martinson, 1961 (by original designation).

Revision suggestion.—Liu and J. Chen (1981, p. 117) relegated *Xinyuella* to a subgenus of *Lilingella* Chen & Liu in Zhang, Wang, & Zhou, 1977 (accepted herein).

Subgenus LILINGELLA (HUNANELLA) Xiong & Wang, 1979, p. 8

[in Chinese]

Figure 26.1–26.3

Name history.—Originally *Hunanella* Xiong & Wang, 1979, p. 8.

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Xiong & Wang, 1980, p. 49): shell small to medium; shape varying from oval, rounded-triangular to elliptical; equivalve or subequivalve, inequilateral; inflated. Umbo distinct, projecting high above hinge line; beak incuved, prosogyrate; posterior carina developed; posterior area narrowly triangular in form; lunule present, escutcheon absent. Surface ornamented with regular or irregular commarginal lines. Right valve with one submedian tooth (3b), two anterior lateral teeth (AI and AIII), and two posterior lateral teeth (PI and PIII); left valve with one submedian tooth (4b), one anterior lateral tooth (AII), and one posterior lateral tooth (PII); pseudocardinal teeth (3b and 4b) short, opisthocline; anterior and posterior lateral teeth (AI, AII,

Figure 26. *1–3. Lilingella (Hunanella) guanyintanensis* Xiong & Wang, scale bar 2 mm; *1,* holotype, right internal mold; *2,* umbo removed from specimen of Fig. 26.1, showing hinge; *3,* paratype, conjoined valves (adapted from Xiong & Wang, 1980, pl. 14,*4a–b,10*).——*4–6. Fengjiachongia subtrigona* Wu, scale bar 2 mm; *4,* holotype, left internal mold; *5,* paratype, left internal mold; *6,* paratype, right internal mold (adapted from Wu, 1981, plate,*9–11*).——*7–11. Lilingella (Lilingella) simplex* Chen & Liu, scale bar 5 mm; *7,* plesiotype, conjoined valves; *8,* plesiotype, right composite mold (adapted from Chen & Liu in Zhang, Wang, & Zhou, 1977, pl. 2,*26–27*); *9,* paralectotype, right composite mold; *10,* paralectotype, composite mold of conjoined valves; *11,* lectotype, composite mold of conjoined valves (designated herein; adapted from Liu [anonymous in original publication], 1968, pl. 46,*2,5,7*).——*12.* Holotype of *Indosinion carinatum* Guo, scale bar 2 mm; conjoined valves (adapted from Guo, 1985a, pl. 28,*16*).——*13–16. Yananoconcha minor* Yu & Zhang, scale bar 1 mm; *13–14,* holotype, conjoined valves; interior view (*13*), and original internal mold (*14*); *15,* paratype, right interior view; *16,* paratype, internal mold of conjoined valves (adapted from Yu & Zhang, 1980, pl. 104,*8,11,7,10*).——*17–22. Lilingella (Apseudocardinia) hupehensis* (Grabau), scale bar 5 mm; *17,* diagrammatic drawing of holotype, right valve (adapted from Grabau, 1923b, p. 218, fig. 4); *18,* photograph of holotype (adapted from Gu in Gu et al., 1976, pl. 97,*25*); *19–22,* type material of *Lilingella (Apseudocardinia) sichuanensis* (Liu & Zhu) [=*Lilingella (Apseudocardinia) hupehensis* (Grabau)]; *19,* left lateral view; *20,* interior view of Fig. 26.19; *21,* right lateral view; *22,* interior view of Fig. 26.21 (adapted from Liu & Zhu in Cai & Liu, 1978, pl. 121,*1a–b,1d–e*).——*23–25. Weiyuanella elliptica* (J. Chen), scale bar 2 mm; *23,* holotype, right internal mold; *24–25,* paratype, right internal molds (adapted from J. Chen in Ma et al., 1976, pl. 14,*24–26*).——*26–27. Zhifangia typica* Liu, scale bar 2 mm; *26,* holotype, internal mold of conjoined valves; *27,* paratype, conjoined valves (adapted from Liu in Liu & Li, 1980, pl. 100,*28,26*).

and AIII) long, lamellar and laterally striated; dental formula: AIII, AI, 3b, PI, PIII/AII, 4b, PII. Adductor scars developed; anterior one kidneylike, accompanied by pedal scar at upper side; posterior one larger, oval in form; pallial line entire.

Emended diagnosis of subgenus.—(Liu & J. Chen 1981, p. 117): Subgenus characterized by oval to elliptical outline, weak and rounded carina, absence of concentric rugae, usually nodelike pseudocardinal teeth 1 and 2b, and prominent short lamellar 3b and 4b [*sic*].

Type species.—*Hunanella guanyintanensis* Xiong & Wang, 1979, p. 10, pl. 1,*1–2* (holotype), *3–4* [=*Hunanella guanyintanensis* Xiong & Wang, 1980, p. 52, pl. 14,*1–3*,*4a–b* (holotype), *5–11*]; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Xiong & Wang, 1980, p. 52): Shell small, length and height subequal; roundly triangular; gibbous; umbo broad, projecting high above hinge line; beak incurved, prosogyrate, positioned anteriorly; lunule well developed; dorsal margins short and curved, anterodorsal margin oblique; posterodorsal margin oblique and straight; anterior margin brordly rounded; ventral margin curved; carina well developed, extending from umbo to posteroventral end; surface behind carina narrowly triangular; whole surface ornamented with fine commarginal lines.

Type locality.—Guanyintan, Qiyang, Hunan, south-central China.

Type occurrence.—Zaoshang Formation, Lower Jurassic.

Repository of type material.—Xi'an Institute of Coal-Geology and Exploration, Academy of Coal Science of China, Xi'an, Shaanxi, China; accession number: G76318 (holotype); G760313, 760322, 760323.

Distribution of subgenus.—Lower Jurassic; South China (Liu & J. Chen, 1981, p. 118).

Taxonomic position.—Neomiodontidae (by original designation).

Revision suggestion.—Pseudocardiniidae Martinson, 1961 (J. Chen & Xu, 1980; Chen, 1985; Liu & J. Chen, 1981); Liu and J. Chen (1981, p. 117) relegated *Hunanella* to a subgenus of *Lilingella* Chen & Liu in Zhang, Wang, & Zhou, 1977 (accepted herein).

Note.—Xiong and Wang (1980, p. 49) once again proposed *Hunanella* as a new genus (in Chinese) after they erected the genus in 1979.

Subgenus LILINGELLA (APSEUDOCARDINIA) Liu & Zhu in Cai & Liu, 1978, p. 390

[in Chinese]

[*emend*. Liu, 1984 (in Chinese)]

Figure 26.17–26.22

Name history.—Originally *Apseudocardinia* Liu & Zhu in Cai & Liu, 1978, p. 390.

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Liu, 1984, p. 536; slightly abridged): shell thin; small to medium, with length less than 30 mm; oval, triangular, quadrilateral, elliptical, or cuneiform; moderately to strongly inflated; posterior carina well developed; posterior area depressed; umbonal region protruding; beak usually small, prosogyrate or orthogyrate, weakly or strongly projecting above hinge line, positioned anteriorly; shell margin in front of beak distinctly incurved. Surface ornamented with growth lines and commarginal rugae; lunule narrow and shallow; escutcheon not developed; ligament external, opisthodetic; posterior ligament grooves long and shallow, weakly curved; each valve with a long-lamellar nymph extending posteriorly from beak along dorsal margin. Hinge plate broad, with well-developed teeth; left valve with two anterior and two posterior, long-lamellar lateral teeth; left valve with one short, rodlike submedian tooth, and one anterior and one posterior lateral tooth; all anterior teeth extending from behind beak into near anterior end distally and gradually becoming thicker; posterior lateral teeth extending along posterior part of ligament groove to middle or middle-upper part of posterior margin; lateral teeth regularly crenulated; umbonal cavity deep; internal surface smooth; pallial line simple; anterior adductor scar deep, kidneylike, with irregular striations; posterior adductor scar larger and shallower, oval, with few weak, radial striations.

Type species.—*Cyrena hupehensis* Grabau, 1923b, p. 218, fig. 4; subsequently designated by Liu & Zhu in Liu, 1984, p. 539, pl. 1,*1*,*10*,*11*; pl. 2,*1–5*; pl. 4,*1–3*; pl. 5,*20* (=*Apseudocardinia sichuanensis* Liu & Zhu in Cai & Liu, 1978, p. 392, pl. 121,*1a–e*; text-fig. 73; by original designation); see also: *Pseudocardinia hupehensis* (Grabau), Gu in Gu et al., 1976, p. 351, pl. 97,*25* (holotype), *26–28*.

Original diagnosis of type species.—(Grabau, 1923b, p. 218): Shell medium, moderately convex, elongate with beaks in anterior third. Umbos not prominent, a very faint excavation occurring beneath beaks, below which shell margin is straight and sloping diagonally forward, passing into round anterior end. Ventral margin rounded, on larger radius than front; posterior margin more sharply rounded below, obliquely subtruncate in upper part. Hinge line straight for about half length of shell behind beak, or about one-third of entire length of shell. Very faint umbonal ridge extending from beak to posterior ventral margin, posterior dorsal region thus outlined being less strongly convex than rest of shell, being sometimes even flattened, but not concave. Greatest convexity of valve behind beaks and somewhat dorsad of median longitudinal line. Center part of shell gently arched but near ends, curvature of shell becoming rather abrupt. Dorsoventrally curvature of shell is rather regular. Surface marked by fine growth lines, supplemented in anterior-ventral region by wrinkles. Hinge structure unknown. Muscular impressions dorsad of median longitudinal line, very faintly marked on internal mold [*sic*].

Original diagnosis of type species.—(Translation from Chinese text, Liu & Zhu in Cai & Liu, 1978, p. 392; slightly abridged): Shell small to medium, long-elliptical; with largest shell height at one-third to one-half shell length from anterior; hinge margin curved, length equal to ~six-sevenths shell length; anterior margin rounded, widely curving, passing into dorsal and ventral margins; posterior margin shortly rounded, curving or round-obtusely passing into dorsal margin; posteroventral end slightly protracted, with posteroventral angles ~80°–85°; ventral margin long, slightly curved. Fairly inflated, with largest inflation at upper-middle part;

posterior ridge narrow; posterior area weakly protruded, narrow-triangular in form; umbonal region broad and protruded; beak small, prosogyrate, slightly projecting above hinge line, positioned at one-third to one-quarter shell length from anterior; surface with growth lines or rugae; ligament external, opisthodetic; nymphs long. Right valve with two anterior and two posterior lamellar lateral teeth; left valve with one pseudocardinal tooth, and one anterior and one posterior lateral lamellar tooth; pseudocardinal tooth of left valve short, sticklike, opisthocline; umbonal cavity deep; internal shell surface smooth; anterior adductor scar fairly deep, beanlike or kidneylike; posterior adductor scar shallow, larger, oval in form; pallial line entire. Measurements: 14–21 mm long, 9.5–15 mm high, 8–12 mm wide, height to length ratio 0.62–0.70.

Type locality.—Xiangxi, Zigui, Hubei, China.

Type occurrence.—Ziliujing Formation, Lower Jurassic–Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology (holotype lacking accession number; plesiotypes: 24342, 25343). [Holotype of *Apseudocardinia sichuanensis* Liu & Zhu in Cai & Liu, 1978 deposited in Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China, accession number: Sbi375.

Distribution of subgenus.—?Upper Triassic, Lower Jurassic–Middle Jurassic, abundant in Lower Jurassic; South China (Liu & Zhu in Cai & Liu, 1978, p. 392).

Taxonomic position.—Pseudocardiniidae Martinson, 1961 (by original designation, Liu & Zhu in Liu, 1984, p. 536).

Revision suggestion.—Liu and J. Chen (1981, p. 118) relegated *Apseudocardinia* to a subgenus of *Lilingella* Chen & Liu in Zhang, Wang, & Zhou, 1977.

See also.—*Pseudocardinia hupehensis* (Grabau), according to Gu in Gu et al., 1976, p. 351, pl. 97,*25* (holotype: fig. 4, Grabau 1923b, p. 218), *26–28*.

Genus FENGJIACHONGIA Wu, 1981, p. 377

[in Chinese]

Figure 26.4–26.6, 27

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Wu, 1981, p. 377): shell small; equivalve, inequilateral; subtriangular; umbo situated at midlength or slightly anterior; hinge line curved; beak small, projecting above hinge line; posterior carina not distinct; posterior area narrow; surface ornamented with weak growth lines only; pallial line entire. Dental formula: AIII, AI, 3a, 3b, 5b, PI, PIII/AII, (2a), 2b, 4b, PII; in right valve tooth 3b large and stout, opisthocline; 5b weak, opisthocline; AI laterally striated; AIII joining with 3a; posterior lateral teeth separate; in left valve submedian tooth 4b well developed, narrow, opisthocline, but 2b undeveloped; only one anterior and posterior lateral tooth, anterior one joining with 2b.

Type species.—*Fengjiachongia subtrigona* Wu, 1981, p. 378, pl. *9* (holotype), *10–11*; text-fig. 2; by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Wu, 1981, p. 378): Shell small, with length of about 8–10 mm; equivalve, inequilateral; subtriangular; moderately inflated; beak high, prosogyrate, located at two-fifths shell length from anterior; carina undeveloped; posterior end rounded; posterior area narrow; anterodorsal margin slightly incurved, posterodorsal margin curving, passing into posterior margin; ventral margin more widely curved. Surface ornamented with growth lines only; lunule and escutcheon not seen; adductor scars large; anterior one elliptical in form, situated near anterior extremity of hinge plate, fairly deep; posterior one also elliptical in form, shallower, located below posterior end of hinge plate, pallial line entire.

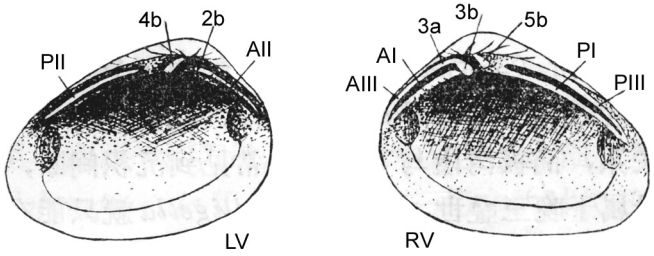

Figure 27. Diagrammatic drawing of hinge of *Fengjiachongia subtrigona* Wu, no scale (adapted from Wu, 1981, p. 378, text-fig. 2, showing hinge).

Type locality.—Fengjiachong, Liling, Hunan, south-central China.

Type occurrence.—Dabakou Member, Paijiachong Formation, Lower Jurassic.

Repository of type material.—China University of Geosciences, Beijing; accession number: HL0128 (holotype); HL0119, 0121–0127, 0205, 0369, 0370.

Distribution of genus.—Lower Jurassic; Hunan, South China (Wu, 1981, p. 377).

Taxonomic position.—Arcticidae (by original designation).

Revision suggestion.—Junior synonym of *Lilingella (Hunanella)* Xiong & Wang, 1980.

Note.—*Fengjiachongia* Wu was misspelled as *Fengjiachonia* in Wu (1981, p. 377).

Genus HAMICONCHA Huang, Wei, & J. Chen in Liu & J. Chen, 1981, p. 120

Published in USA; see Liu & J. Chen, 1981, p. 120, pl. 7,*9*,*10* for figures and original diagnosis of the type species of the genus.

Genus XINJIANGCONCHA Wei, 1984, p. 38

[in Chinese]

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Wei, 1984, p. 38): shell small to medium, inflated; equivalve, subequilateral; pointed oval to rounded triangular, with pointed anterior end, posterior end broadly rounded; umbo small and pointed, situated slightly anterior, orthogyrate, slightly incurved. Posterior umbonal ridge wide and rounded, not

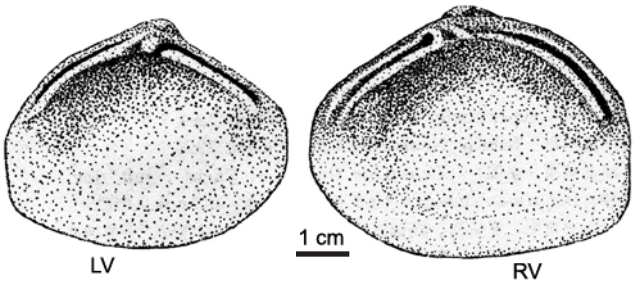

Figure 28. Diagrammatic drawing of hinge of *Indosinion dianense* Guo & J. Chen (adapted from Guo & J. Chen in Guo, 1988, p. 130, text-fig. 9).

prominent. Surface with irregular concentric growth lines. Interior structure unknown.

Type species.—*Xinjiangconcha lingulaiformis* Wei, 1984, p. 39, pl. 9,*12* (holotype), by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Wei, 1984, p. 39): Shell small, strongly inflated; higher than long, subequilateral; pointed oval or *Ligula*-like; umbo small and pointed, situated slightly anterior, orthogyrate, slightly incurved; anterior shorter, posterior longer, posterior umbonal ridge not prominent. Surface with fine, dense and irregular concentric growth lines, also with radial traces of an outer radially fibrous prismatic shell layer.

Type locality.—Shawuan, Xinjiang, northwestern China.

Type occurrence.—Xishanyao Formation, Middle Jurassic.

Repository of type material.—Geological Survey Department of Bureau of Petroleum of Xinjiang Autonomous Region; accession number: XBB-0300 (holotype).

Distribution of genus.—Middle Jurassic; Xinjiang, northwestern China (Wei, 1984, p. 38).

Taxonomic position.—Pseudocardiniidae (by original designation).

Revision suggestion.—Junior synonym of *Hamiconcha* Huang, Wei, & J. Chen in Liu & J. Chen, 1981.

Genus INDOSINION
Guo & J. Chen in Guo, 1985a, p. 215

[in Chinese]

Figure 26.12, 28

Homonymy.—*non Indosinion* Guo & J. Chen in Guo, 1988, p. 129.

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1985a, p. 215): shell fairly small, subtriangular, subtrapezoidal, elliptical; equivalve, subequilateral to inequilateral; moderately inflated. Anterior margin semiorbicular, ventral one arcuate, posterior margin suborbicular or obliquely truncated. Umbo near center or anterior, beak weakly incurved, slightly prosogyrate; posterior umbonal carina commonly developed. Surface covered by concentric growth lines. Hinge teeth well developed, consisting of cardinal teeth, anterior and posterior laterals. Two cardinals under umbo in each valve, upper ends of 3a and 3b weakly joined together in right valve, 3a weak, weakly joined up with AIII; 2a of left valve nodular, joined up with AII; 4b inclined forward (but in his text-fig. 9, 3a and 3b not joined together, in face, 3a joined up with AI and AIII in right valve; 2a not joined up with AII, 4b joined up with PII in left valve). Anterior and posterior laterals long and lamellar, subparallel to hinge margin, left valve with one anterior and one posterior lateral tooth, right valve with two laterals on each side. Hinge formula: AIII, AI, 3a, 3b, PI, PIII/AII, 2a, 4b, PII. Anterior adductor scar distinct, posterior one obscure.

Type species.—*Indosinion carinatum* Guo, 1985a, p. 216, pl. 28,*16* (holotype) (by new designation herein); *non Indosinion dianense* Guo & J. Chen, *sp. nov.* in Guo, 1988, p. 130, pl. 5,*10* (holotype), *11*; text-fig. 9; original designation by Guo (1985a) and later designation by Guo and J. Chen in Guo, 1988; but according to Art. 69.3 of the ICZN (1999), their designations are invalid.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1985a, p. 216): Shell elongate oval, height about two-thirds length; dorsal and ventral margins arcuate, anterior one semiorbicular, posterior margin truncated; posteroventral angle distinct, nearly at right angle, posterodorsal angle indistinct, obtusely and broadly rounded; umbo subrounded, slightly salient above hinge margin, situated about one-third shell length back from anterior end; posterior umbonal carina narrow and acute, edgelike, becoming obscure toward posteroventral angle; corselet with two radial ridges; surface covered by growth lines; hinge with posterior lamellar teeth, narrow and long, subparallel to hinge margin, two in right valve, one in left valve.

Type locality.—Gaopushan, Lanping, Yunnan, southwestern China.

Type occurrence.—Maichuqing Formation, upper Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0343 (holotype).

Distribution of genus.—upper Upper Triassic; southwestern China and Southeast Asia (Guo, 1985a, p. 216).

Taxonomic position.—Neomiodontidae (by original designation).

Revision suggestion.—Pseudocardiniidae Martinson, 1961.

Note.—*Indosinion* first appeared as a manuscript name in Guo, 1985a, p. 215, with *Indosinion dianense* Guo & J. Chen designated as the type species. The latter, however, was not available in 1985, as it too was only a manuscript name. However, Guo (1985a) named, described, and figured two new species, *I. carinatum* Guo and *I. humeritenue* Guo, under the genus name *Indosinion* Guo, and we interpret these as validating *Indosinion* Guo, 1985a, with *I. carinatum* Guo, 1985a, as type species. Guo and J. Chen (in Guo, 1988, p. 129) once again proposed *Indosinion* as a new genus and described a new species *Indosinion dianense* Guo & J. Chen, which was illegally designated as the type species.

Genus WEIYUANELLA
Xu, 1984, p. 520

[in Chinese]

Figure 26.23–26.25

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Xu, 1984, p. 520): shell fairly small,

oval-triangular to elliptical, longer than high; equivalve; weakly to strongly inflated. Umbo projecting above hinge line, positioned near anterior end; beak prosogyrate; posterior ridge generally present; lunule and escutcheon present; ligament external, opisthodetic. Right valve with two anterior and two posterior lateral teeth; left valve with one anterior and one posterior lateral tooth; no submedian teeth; all teeth without lateral striations; both anterior and adductor scars oval-circular in form, nearly equal in size, but anterior one deeper; one buttress present at upper-posterior side of anterior adductor scar; shell surface ornamented with commarginal lines only.

Type species.—Unionites? *ellipticus* J. Chen in Ma et al., 1976, p. 225, pl. 14,*24* (holotype), *25–29*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Chen in Ma et al., 1976, p. 225): Shell medium; fairly inflated; elliptical, with length about two times of height or more; umbo broad; beak prosogyrate, slightly projecting above hinge line, positioned at one-third shell length from anterior; hinge margin weakly curved, nearly parallel to ventral margin; anterior margin rounded; posterior margin slightly truncated; posterodorsal and posteroventral angles not prominent; posterior carina well developed, obtuse-angular in transverse section; surface with fine commarginal lines; sometimes with fine radial lines in composite molds. Right valve with two anterior and two posterior lateral lamellar teeth; left valve with one anterior and one posterior lateral tooth; posterior teeth long, extending backward into posterodorsal end or more; no submedian teeth. Measurements: 13 mm long and 5.5 mm high in mean size; 20 mm long and 9 mm in maximum size; 9.5 mm long and 4.5 mm high in minimum size.

Type locality.—Xishujie, Weishan, Yunnan, southwestern China.

Type occurrence.—Baijizu Formation, Upper Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 26069 (holotype); 260700–26073.

Distribution of genus.—Upper Triassic; Southeast Asia (Xu, 1984, p. 521).

Taxonomic position.—Pachycardiidae (by original designation).

Revision suggestion.—Pseudocardiniidae Martinson, 1961.

Family ?PSEUDOCARDINIIDAE Martinson, 1961
Genus ZHIFANGIA
Liu in Liu & Li, 1980, p. 21

[in Chinese]

Figure 26.26–26.27

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Liu in Liu & Li, 1980, p. 21): shell small; subelliptical; equivalve, inequilateral; ligament external, possibly opisthodetic. Hinge without subumbonal teeth but with well-developed anterior and posterior lamellar teeth; right valve with two anterior and two posterior teeth; anterior teeth fine and short, starting from below umbo; lower one extending into anterodorsal end, where it is strengthened, and sometimes more distantly along shell margins; upper one finer and weaker; posterior teeth distinctly elongate; left valve with one anterior and one posterior lateral tooth; all teeth smooth in both valves. Anterior adductor scar nearly equal with posterior one in size, both situated near dorsal margins; but anterior one slightly deeper, oval in form, its longer axis nearly vertical; posterior one shallower, obscure, its long axis nearly parallel to posterodorsal margin. Shell moderately inflated; posterior carina not prominent; surface ornamented with growth lines and rugae; growth lines in umbonal region becoming slightly warped.

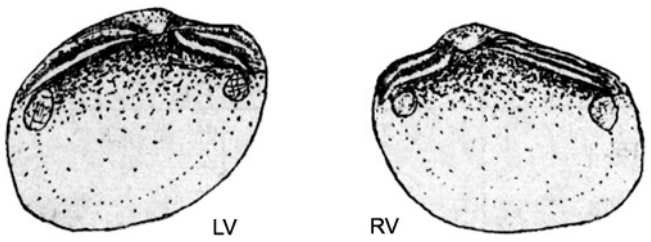

Figure 29. Diagrammatic drawing of hinge of *Yananoconcha*, no scale (adapted from Yu & Zhang, 1980, p. 40, text-fig. 11).

Type species.—Zhifangia typica Liu in Liu & Li, 1980, p. 22, pl. 100,*26–27*,*28* (holotype); by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Liu in Liu & Li, 1980, p. 22): Shell small, subelliptical, with height to length ratio about 0.5; umbonal region broad and flat; beak incurved, slightly prosogyrate, projecting above hinge line, positioned at about one-third shell length from anterior; margin in front of beak slightly incurved; anterodorsal margin straight, slightly oblique; anterodorsal angle distinct; anterior margin weakly curved or nearly straight; posterodorsal margin long, nearly straight, becoming slightly oblique backward; posterior margin nearly vertical; ventral margin long and broadly curved, joining posterior margin by a rounded right angle, its middle part nearly straight. Shell moderately inflated; posterior carina broad and not distinct; surface with coarse commarginal rugae and dense growth lines.

Type locality.—Zhifang, Tongchuan, Shaanxi, North China.

Type occurrence.—Upper Member, Ermaying Formation, Middle Triassic.

Repository of type material.—China University of Geosciences, Beijing; accession number: Sh0101 (holotype); Sh0103, 0107.

Distribution of genus.—Middle Triassic; Shaanxi, North China.

Taxonomic position.—?Pachycardiidae (by original designation).

Revision suggestion.—The genus may with some doubt be related to Pseudocardiniidae Martinson, 1961 based on the dentition.

Family KIJIDAE Kolesnikov, 1977
Genus YANANOCONCHA
Yu & Zhang, 1980, p. 39

[in Chinese]

Figure 25.37, 26.13–26.16, 29

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Yu & Zhang, 1980, p. 39): shell small;

test thin; inequilateral; elliptical, quadrate-oval to oval; umbo fairly broad, positioned at one-third to one-fourth shell length from anterior; hinge line curved; beak slightly projecting above hinge line. Anterior adductor scar deep, oval-circular in form; posterior adductor scar weak; surface ornamented with coarse and regular commarginal rugae and dense growth lines; ligament external, opisthodetic. Hinge provided with anterior and posterior lamellar teeth; teeth without lateral striations; two anterior teeth in right valve, starting below beak; upper one slightly curved, nearly parallel to hinge line; lower one distinctly curved upward in posterior part, but anterior part curved, and nearly parallel to upper one; two teeth close to each other but not joined; between them is a long and curved socket, which is deep at posterior end and shallower anteriorly; two posterior lamellar teeth in right valve, fine and long, parallel to dorsal margin, starting farther away from beak than anterior teeth; two anterior lamellar teeth in left valve, starting below umbo; upper one sometimes poorly developed, but lower one fairly strong; one posterior tooth in left valve, long and stout, parallel to dorsal margin.

Type species.—*Yananoconcha minor* Yu & Zhang, 1980, p. 40, pl. 104,*4*,*7–10*,*11* (holotype), *15*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Yu & Zhang, 1980, p. 40): Shell small; test thin; oval-circular to elliptical; posterior end higher than anterior end; anterior margin rounded, evenly passing into ventral margin; ventral margin long and broadly curved, joining posterior margin in an angle of about 110º; anteroventral end broadly obtuse; anterodorsal end rounded, right-angular. Shell not inflated; umbo broad; beak slightly projecting above hinge line, positioned at about one-third to one-quarter shell length from anterior; hinge line long and slightly curved, its length about three-quarters shell length. Surface ornamented with growth lines; hinge structure same as in genus diagnosis; anterior adductor scar rather distinct in internal molds.

Type locality.—Wenjiagou, Yan'an, Shaanxi, North China.

Type occurrence.—Zaoyuan Member, Yan'an Formation, Middle Jurassic.

Repository of type material.—Institute of Geology, Chinese Academy of Geosciences, Beijing; accession number: M0276 (holotype); M0175, 0192, M0314.

Distribution of genus.—Middle Jurassic; Shaanxi, North China (Yu & Zhang, 1980, p. 40).

Taxonomic position.—Anthracosoidea (by original designation; family position not designated in original text).

Revision suggestion.—?Kijidae Kolesnikov, 1977.

Genus KIJA Lebedev, 1958
Subgenus KIJA (WUCHANGELLA) Wang, 1993, p. 728

[in Chinese with English description, p. 736]

Figure 30.5–30.7

Discussion and diagnosis.—Original diagnosis of subgenus (Wang, 1993, p. 736): shell medium, about 28–49 mm in length, ovate, elliptical, or trigonal; 2 anterior and 2 posterior lateral teeth in each valve, anterior lateral tooth keeping to inner side in left valve; transverse ridges sturdy; carina absent; anterior laterals short, extending posteriorly not beyond umbo and anteriorly to anterior dorsal end; posterior laterals long, extending from umbo to posterior end [*sic*].

Original diagnosis of subgenus.—(Translation from Chinese text, Wang, 1993, p. 728): Shell medium to fairly large. Hinge provided with anterior and posterior lamellar teeth; each valve with two teeth in anterior and two in posterior; lower anterior tooth in left valve with strong lateral grooves; all anterior lateral teeth short, starting below umbo and extending forward into anterodorsal end; posterior lateral teeth starting behind umbo, fairly away from beak, extending backward into posterodorsal end.

Type species.—*Kija (Wuchangella) hubeiensis* Wang, 1993, p. 729, pl. 2,*1* (holotype), *2–4*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Wang, 1993, p. 729): Shell medium, broadly oval; fairly inflated, with largest inflation at umbonal region. Umbo small and pointed, highly projected above hinge margin; beaks incurved, prosogyrate, positioned at about one-third shell length from anterior; posterior carina rounded, prominent. Anterior margin rounded; posterior margin straight, truncated; ventral margin long, weakly curved; posterior shell higher than anterior; posteroventral angle distinct, about 60º. Hinge structure as in subgenus. Surface ornamented with closely spaced growth lines and regular commarginal rugae.

Type locality.—Chefu, Puxi, Hubei, south-central China.

Type occurrence.—Wuchang Formation, Lower Jurassic.

Repository of type material.—University of Geosciences of China, Beijing; accession number: TJ103-8 (holotype); TJ103-51, 103-88.

Distribution of subgenus.—Lower Jurassic; South China (Wang, 1993, p. 729).

Taxonomic position.—Kijidae Kolesnikov, 1977 (by original designation).

Note.—We retranslate Wang's (1993) Chinese diagnosis of *Kija (Wuchangella)* Wang, because his English diagnosis (p. 736) does not coincide well with his Chinese diagnosis (p. 728).

Genus DAYECONCHA Wang, 1993, p. 730

[in Chinese with English description, p. 736]

Figure 30.8–30.10

Discussion and diagnosis.—Original diagnosis (Wang, 1993, p. 736): Shell about 7–14 mm long, elliptical, ovate, or trigonal; test thin, with ligament external and opisthodetic; umbo prominently rising above hinge margin; carina absent; each valve with 2 anterior and 2 posterior lateral teeth; shell moderately inflated; shell surface marked with growth lines and rugae [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Wang, 1993, p. 730): Shell thin; small, with shell length about 7–14 mm; shape varying from elliptical, oval to rounded-triangular; equivalve, inequilateral; moderately inflated. Umbo projecting high above hinge line. Surface ornamented with growth lines. Hinge margin consisting of two parts that intersect each other below umbo at obtuse angles. Hinge paleoheterodont, provided with anterior and posterior lamellar teeth; anterior lateral teeth short, two in each valve; posterior lateral teeth narrow and long, parallel to hinge line, two in each valve.

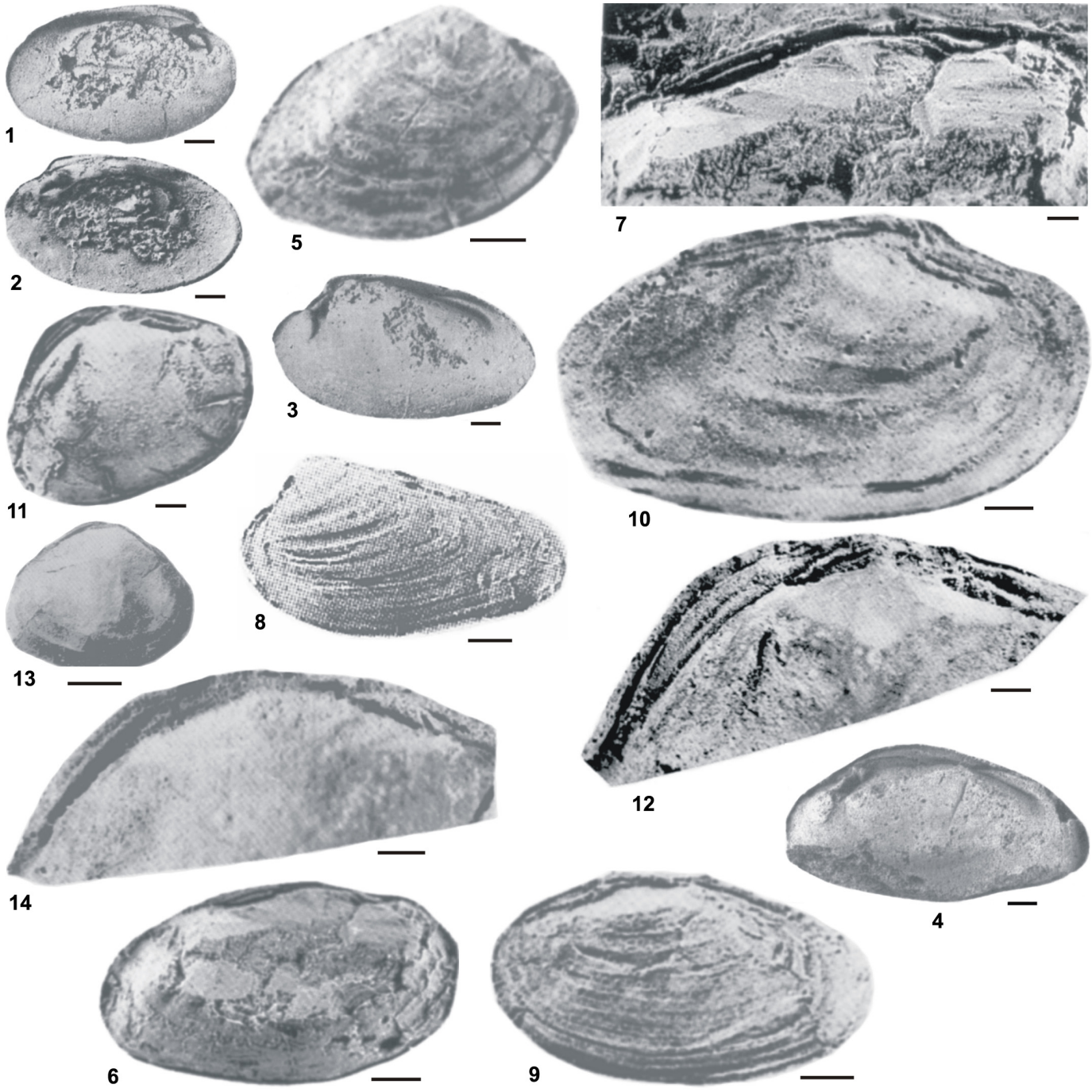

Figure 30. *1–4. Weixiella diana* Guo & J. Chen, scale bar 2 mm; *1,* holotype, right internal mold; *2,* latex cast of Fig. 30.1; *3,* paratype, left internal mold; *4,* paratype, right internal mold (adapted from Guo & J. Chen in Guo, 1985a, pl. 27,*8a–b,9–10*).——*5–7. Kija (Wuchangella) hubeiensis* Wang; *5,* holotype, right valve, scale bar 5 mm; *6,* paratype, right internal mold, scale bar 5 mm; *7,* enlarged hinge of Fig. 30.6, scale bar 2 mm (adapted from Wang, 1993, pl. 2,*1,2a–b*).——*8–10. Dayeconcha elongata* Wang; *8,* holotype, left valve, scale bar 2 mm; *9,* paratype, left composite mold, scale bar 2 mm; *10,* paratype, right composite mold, scale bar 1 mm (adapted from Wang, 1993, pl. 3,*7,12a,14*).——*11–14. Hubeiconcha triangularis* Wang; *11,* holotype, left internal mold, scale bar 2 mm; *12,* enlarged hinge of Fig. 30.11, scale bar 1 mm; *13,* paratype, right internal mold, scale bar 5 mm; *14,* enlarged hinge of Fig. 30.13, scale bar 1 mm (adapted from Wang, 1993, pl. 3,*27a–b,29a–b*).

Type species.—*Dayeconcha elongata* Wang, 1993, p. 730, pl. 3,*7* (holotype), *8–14*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Wang, 1993, p. 730): Thin shelled; small to medium; elongate; elliptical; both anterodorsal and posterodorsal ends rounded; posteroventral angle about 70°. Shell moderately inflated; posterior shell higher than anterior. Umbo fairly broad, projecting high above hinge line; beak prosogyrate, incurved. Hinge as in genus. Surface ornamented with closely spaced growth lines and irregular commarginal rugae.

Type locality.—Jinshandian, Daye, Hubei, south-central China.

Type occurrence.—Middle part of Wuchang Formation, Lower Jurassic.

Repository of type material.—University of Geosciences of China, Beijing; accession number: TJ207-30 (holotype); TJ207-22, 207-35, 207-36, 207-75, 207-346, 207-348, 209-55.

Distribution of genus.—Lower Jurassic; South China (Wang, 1993, p. 730).

Taxonomic position.—Kijidae Kolesnikov, 1977 (by original designation).

Note.—We retranslate Wang's (1993) Chinese diagnosis of *Dayeconcha* Wang, because his English diagnosis (p. 736) does not coincide with his Chinese diagnosis (p. 730).

Genus HUBEICONCHA Wang, 1993, p. 732

[in Chinese with English description, p. 736]

Figure 30.11–30.14

Discussion and diagnosis.—Original diagnosis (Wang, 1993, p. 736): Shell about 10–25 mm long, subrotund or trigonal. Test thin, with ligament external and opisthodetic; umbo small, generally low, prominently rising above hinge margin. Dental formula: AIII, AI, 3a, 1, 3b, PI, PIII/AIV, AII, 2a, 2b, PII, PIV; cardinal 1 trigonal, with sturdy transverse ridges, present at posterior end of anterior lateral AI; teeth 3a and 3b joining under umbo and tooth 2b weak, sloping down to posterior dorsal end. Regular transverse grooves occurring in all laterals. Posterior laterals starting from posterodorsal end and above posterior muscle scar, almost no space between cardinals and posterior lamellars. Anterior muscle scar ovate, with irregular striae; posterior muscle scar fusiform. Pallial line simple. Shell surface unornamented except for growth lines and rugae [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Wang, 1993, p. 732): Shell rather thin; medium; equivalve, inequilateral; beak small, acute and low, slightly projecting above hinge line; posterior carina generally not prominent. Surface with growth lines only. Dental formula: AIII, AI, 3a, 1, 3b, PI, PIII/AIV, AII, 2a, 2b, 4b, PII, PIV; among them, tooth 1 stout and strong, triangular, with 5–7 lateral grooves; 3a short-lamellar, 3b long-lamellar; apices of 3a and 3b fused below beak, inverted-V shape; 2b weak, short, sticklike, opisthocline; posterior lateral teeth starting near posterodorsal end, extending into upper side of posterior adductor scar, without an edentulous space between cardinal and posterior teeth; all anterior and posterior lateral teeth with fine crenulations. Dimyarian; anterior adductor scar oval, with irregular oblique striae, accompanied by two pedal scars at upper side; posterior adductor scar spindlelike; pallial line entire.

Type species.—*Hubeiconcha triangularis* Wang, 1993, p. 733, pl. 3,*27* (holotype), *28–34*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Wang, 1993, p. 733): Shell medium, rounded-triangular; diagonally expanded, with posterior end distinctly higher than anterior; anterior end narrow; posterior margin truncated; moderately inflated; posteroventral angle about 50°; posterior carina rounded, not prominent. Umbo small and acute; beak prosogyrate, incurved, slightly projecting above hinge margin, positioned at about one-third shell length from anterior. Surface ornamented with numerous closely spaced growth lines and few commarginal rugae. Hinge structure as in genus.

Type locality.—Chefu, Puxi, Hubei, south-central China.

Type occurrence.—Wuchang Formation, Lower Jurassic.

Repository of type material.—University of Geosciences of China, Beijing; accession number: TJ102-92 (holotype); TJ101-51, 101-93, 101-156, 101-158, 101-174, 101-176, 102-07.

Distribution of genus.—Lower Jurassic; South China (Wang, 1993, p. 733).

Taxonomic position.—Veneroida (by original designation; superfamily position and family position not designated).

Revision suggestion.—?Kijidae Kolesnikov, 1977.

Note.—We retranslate Wang's (1993) Chinese diagnosis of *Hubeiconcha* Wang, because his English version (p. 736) does not coincide with his Chinese diagnosis (p. 732).

Family TRIGONODIDAE Modell, 1942

[=Pachycardiidae Cox, 1961, p. 331]

Genus WEIXIELLA Guo & J. Chen in Guo, 1985a, p. 187

[in Chinese with English diagnosis, p. 268]

Figure 30.1–30.4

Discussion and diagnosis.—Original diagnosis (Guo & J. Chen in Guo, 1985a, p. 268): shell elongate-ovate, equivalve, inequilateral, with moderate convexity. Umbo broadly rounded, slightly protruded above hinge margin, incurved and prosogyrous beak, near anterior end. Surface covered with growth lines. Anterior teeth situated under umbo, 2 in right valve, slightly joined at upper end; anterior one shortly lamellar, opisthocline; posterior one subtriangular, coarse; 2 in left valve, anterior one obliquely triangular, opisthocline, relatively strong, somewhat elongate; posterior one low, weak, obscure, obliquely triangular. Posterior teeth rather elongate lamellar, 2 in left valve and 1 in right, parallel with adjacent margin. Anterior adductor muscle scar somewhat deep, posterior one obscure [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Guo & J. Chen in Guo, 1985a, p. 187): Shell elongate-oval; equivalve, inequilateral; moderately inflated; umbo low, broadly rounded; beaks incurved, slightly prosogyrate, weakly projecting above hinge margin, situated near anterior end. Surface with growth lines. Pseudocardinal teeth well developed, rather strong, right valve with two below umbo; anterior one short-lamellar,

opisthocline; posterior one large and stout, subtriangular in form; apices slightly fused, socket between them to accommodate pseudocardinal tooth of left valve; pseudocardinal tooth below umbo in left valve, opisthocline, rather strong, oblique-triangular, socket on each side for corresponding teeth of right valve; another pseudocardinal tooth behind umbo in left valve weak and low, oblique-triangular, prosocline; posterior lamellar teeth, two in left valve and one in right valve, subparallel to dorsal margin, upper one in left valve weaker. Anterior adductor scar subcircular, deeper dorsally, posterior margin thickened to form short buttress; posterior adductor scar not distinct.

Type species.—*Weixiella diana* Guo & J. Chen in Guo, 1985a, p. 187, pl. 27,*8* (holotype), *9–10*.

Original diagnosis of type species.—(Translation from Chinese text, Guo & J. Chen in Guo, 1985a, p. 187): Shell elongate-oval, with height slightly less than two-thirds length; moderately inflated. Anterior and posterior margins rounded; dorsal and ventral margins arched. Umbo broad; subcircular, slightly projecting above hinge margin; beak small, incurved, located about one-quarter shell length from anterior. Surface ornamented with growth lines only. Right valve with two subumbonal pseudocardinal teeth, posterior one subtriangular in form, stout and strong, slightly prosocline; anterior one opisthocline, short-lamellar; two teeth joining at apices; left valve with two pseudocardinal teeth, anterior one below umbo, stout and strong, oblique-triangular in form, and slightly elongate; posterior one weak and low, not distinct, oblique-triangular in form, prosocline; posterior lamellar teeth, two in left valve and one in right valve; upper one in left valve weakly developed. Anterior adductor scar subcircular, upper part deeper, posterior margin thickened to form short buttress; posterior adductor scar not distinct.

Type locality.—Weixi, Yunnan, southwestern China.

Type occurrence.—Maichujing Formation, Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy 0323 (holotype); IVy 0324–0325.

Distribution of genus.—Upper Triassic; Yunnan, southwestern China (Guo, 1985a, p. 187).

Taxonomic position.—Pachycardiidae (by original designation).

Note.—We retranslate the Chinese diagnosis of *Weixiella* Guo & J. Chen in Guo, 1985a, because the English version (p. 268) does not coincide well with the Chinese diagnosis (p. 187).

Superfamily TRIGONIOIDOIDEA Cox, 1952
Family TRIGONIOIDIDAE Cox, 1952
Subfamily MARTINSONELLINAE Sha, 1993, p. 290

[in Chinese]

Synonymy.—First appeared in Sha, Ph.D. thesis, 1989.

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Sha, 1989, Ph.D. thesis, p. 68): Ornament of only submedian V-shaped ribs on shell surface.

Diagnosis.—V-shaped ribs are restricted to area between umbo and middle of shell.

Type occurrence.—Upper Jurassic–Lower Cretaceous (Sha, Ph.D. thesis, 1989, p. 68), but Sha (2007, p. 62) regarded all the trigonioidids, including the subfamily, to be Cretaceous (the same below).

Taxonomic position.—Trigonioididae (by original designation).

See also.—Sha and Fürsich, 1993, p. 152; Sha, 2007, p. 63.

Genus CYOTRIGONIOIDES Guo, 1981b, p. 63

[in Chinese]

Figure 31.27–31.28

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1981b, p. 63): Transversely elliptical, cuneiform, subrounded, subtriangular and rhomboidal in outline. Thin or medium shell. Umbo small and low, slightly incurved and prosogyrate, situated anterior of midpoint of dorsal margin. Posterior umbonal ridge indistinct. Except for growth lines, ornament of V-shaped ribs on umbonal area, of which angle is fairly large. Ligament opisthodetic. Anterior adductor scar large, relatively deep and rounded buttress, and tiny, deep, and rounded pedal scar respectively placed in posterior and posterodorsal areas of adductor scar; posterior adductor scar indistinct. Two anterior lamellar teeth in each valve, two posterior teeth in left valve and one in right, no median tooth; dental formula: 5, 3, PIII/4, 2, PII, PIV (5a, 3a, 3b/4a, 2a, 2b, 4b in original text). All teeth smooth and subparallel to dorsal margins, but anterior ones short and posterior ones long.

Type species.—*Cyotrigonioides puerensis* Guo, 1981b, p. 64, pl. 3,*5a–b* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1981b, p. 64): Transversely elliptical in outline. Anterior and posterior ends rounded, dorsal and ventral margins subparellel to each other. Umbo widely obtuse, low, incurved, and slightly prosogyrate, placed at one-fourth to one-fifth shell length from anterior end. Posterior umbonal ridge narrow and convex in umbonal area, sharply widened and flattened posteriorly. Ornament of indistinct V-shaped ribs on umbonal area, approximately consisting of 5 wide ribs of posterior branch and 6 relatively fine ones of anterior branch. Shell surface smooth except for commarginal growth lines. Two anterior teeth in each valve, two posterior teeth in left valve and one in right. All teeth lamellar, but anterior ones short and posterior ones long. Anterior adductor scar large, subrounded, and deep, associated with buttress on posterior area and tiny, rounded, and deep pedal scar in posterodorsal area of adductor scar.

Type locality.—Zhaobishan, Pu'er, Yunnan, southwestern China.

Type occurrence.—Jingxing Formation, Lower Cretaceous.

Repository of type material.—The Geological Museum of China, Beijing (holotype accession number: 780411c/4).

Distribution of genus.—Middle Jurassic–Lower Cretaceous; China (Guo, 1981b, p. 63); Lower Cretaceous (Sha, 2007, p. 62).

Taxonomic position.—Nakamuranaiadidae (by original designation).

Revision suggestion.—Ma (1989, p. 260) suggested that *Cyotrigonioides puerensis* Guo is conspecific with *Danlengiconcha elongata* Liu, the type species of *Danlengiconcha* Liu (in Cai & Liu, 1978). However, the latter has radial threads in the posterodorsal area (Cai & Liu, 1978, p. 375) but the former does not (Guo, 1981b, p. 64).

Genus SINONAIA
Guo, 1981b, p. 66
[in Chinese]

Figure 31.1–31.4

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese in Guo, 1981b, p. 66): Transversely cuneiform in outline. Anterior part short and anterior margin broadly rounded, posterior part long and gradually narrowed posteriorly, posterodorsal part wide. Umbo obtuse, placed at near anterior end of dorsal margin. Posterior umbonal ridge remarkable. V-shaped ribs prominent, but no anterior and posterior chevron (reversed V-shaped) ribs. The angle of V-ribs is wide and tie of apices of angles prosocline. Subradial ribs of anterior branch of V-ribs relatively fine and densely spaced, but those on posterior branch relatively wide and sparsely arranged. Concentric growth lines fine and densely spaced. Hinge plate moderately wide but anterior part wider, providing two anterior teeth in each valve, two posterior teeth in left valve and one in right, forming dental formula: 5, 3, PIII/4, 2, PII, PIV (5a, 3a, 3b/4a, 2a, 2b, 4b in original text). Among them, 5a (5), 4a (4), and 3a (3) short lamellar and subparallel to hinge line, 2a (2) beneath umbo obliquely triangular and weakly crenulated, posterior teeth long lamellar and also subparallel to hinge line.

Type species.—*Sinonaia jingdongensis nuanliensis* Guo, 1981b, p. 67, pl. 2,*7a–b* (holotype), *8a–b* (by new designation herein); *non Sinonaia moheiensis* Guo *sp. nov.* in Guo, 1988, p. 125, pl. 7,*1* (holotype), *2*, text-fig. 6, by original designation in Guo, 1981b and later designation in Guo, 1988; but according to Article 69.3 of the ICZN (1999), Guo's designations are invalid.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1981b, p. 67): Transversely cuneiform in outline. Anterior part fairly short and anterior margin rounded, posterior part very long and gradually narrowed posteriorly, posterodorsal part obviously wide and posterodorsal margin truncated. Umbo low and obtuse, placed at about one-sixth shell length from anterior end. Posterior umbonal ridge extending, broadening, and flattening from umbo to posteroventral corner. Ornament of V-shaped ribs 100°–120° angle. Subradial ribs of anterior branch of submedian V-shaped ribs (~17), fine and densely spaced, but posterior ones (~18) wide and sparsely arranged. Tie of apices of V-shaped ribs prosocline. Two radial furrows displaced on area between posterior umbonal ridge and hinge line and subradial ribs cut by furrow near posterior umbonal ridge. Two anterior teeth in each valve, 5a (5) thin, 4a (4), and 3a (3) strong, but all short lamellar and subparallel to hinge line, 2a (2) obliquely triangular, crenulated and situated beneath umbo, 5a (5) thin, 4a (4) and 3a (3) strong; two posterior teeth in left valve and one in right, long lamellar and subparallel to hinge line. Anterior adductor scar elliptical, deep, and distinct. Pallial line distributed relatively far from ventral margin.

Type locality.—Nuanli, Jinggu, Yunnan, southwestern China.

Type occurrence.—Jingxing Formation, Lower Cretaceous.

Repository of type material.—The Geological Museum of China, Beijing; accession number: 783592e/52 (holotype); 793368/30.

Distribution of genus.—Lower Cretaceous; Southeast Asia, including Yunnan, southwestern China (Guo, 1981b, p. 67).

Taxonomic position.—Nippononaiadidae (by original designation).

Revision suggestion.—Ma (1989) merged *Sinonaia jingdongensis nuanliensis* Guo and *S. tenuilonga* Guo into the same species: *Nippononaia (Eonippononaia) nuanliensis* (Guo) (Ma, 1989, p. 262, pl. 4,*5,7–9*); that is, *Sinonaia* was regarded as a junior synonym of subgenus *Nippononaia (Eonippononaia)* Guo by Ma (1989). However, the submedian V-shaped ribs of *Nippononaia (Eonippononaia)* do not reach ventral margin, while those of *Sinonaia* do (Sha & Fürsich, 1993; Sha, 2007).

Note.—Based on species *Sinonaia moheiensis* Guo, 1988, a new subfamily Sinonaiinae was proposed by Guo (1998, p. 291), but according to Article 69.3 of the ICZN (1999), Guo's designations are invalid. Sinonaiinae is not included in this list because it was

Figure 31. *1–4. Sinonaia jingdongensis nuanliensis* Guo, scale bar 5 mm; *1–2,* holotype, left valve; *1,* left lateral view; *2,* interior view; *3–4,* paratype, left valve; *3,* left lateral view; *4,* dorsal view (adapted from Guo, 1981b, pl. 2,*7a–b,8a–b*).——*5–10. Peregrinoconcha yunnanensis* Chen & Lan, scale bar 5 mm; *5,* holotype, right valve; *6,* paratype, right valve; *7,* paratype, left internal mold; *8,* paratype, right composite mold; *9,* paratype, right internal mold; *10,* paratype, left composite mold (adapted from Chen & Lan in Gu et al., 1976, pl. 43,*14–16*, pl. 47,*5–7*).——*11–12. Nippononaia (Eonippononaia) diana* Guo, scale bar 2 mm; *11,* holotype, left valve; *12,* paratype, right valve (adapted from Guo, 1981b, pl. 2,*1–2*).——*13–14. Nippononaia (Eomartinsonella) liaoxiensis* Yu, scale bar 10 mm; left lateral (*13*) and dorsal (*14*) views of holotype (adapted from Yu Xi-han, 1987, pl. 2,*3a,3c*).——*15–18. Nippononaia (Arctonaia) sinensis* (Nie), scale bar 5 mm; *15,* holotype, left external mold; *16,* paratype, conjoined valves; *17,* plesiotype, left valve; *18,* plesiotype, left valve (adapted from Nie in Gu et al., 1976, pl. 95,*25,23–24,27*).——*19–20. Multiplicanaia tujingziensis* Yu & Zhang, scale bar 2 mm; *19,* holotype, left internal mold; *20,* paratype, right internal mold (adapted from Yu et al., 1984, pl. 9,*3–4*).——*21–23. Trigonioides (Didymotrigonioides) didymoscriptus* Gu, scale bar 5 mm; *21,* holotype, conjoined valves; *22,* paratype, dorsal view; *23,* paratype, left composite mold (adapted from Gu in Gu et al., 1976, pl. 110,*1–3*).——*24–26. Danlengiconcha elongata* Liu, scale bar 5 mm; *24–25,* holotype, a bivalved specimen; *24,* left lateral view; *25,* dorsal view; *26,* paratype, right internal mold (adapted from Cai & Liu, 1978, pl. 119,*9a–b*, pl. 120,*1*).——*27–28.* Holotype of *Cyotrigonioides puerensis* Guo, scale bar 5 mm; *27,* lateral view of conjoined valves; *28,* enlargement of hinge of Fig. 31.27 (adapted from Guo, 1981b, pl. 3,*5a–b*).

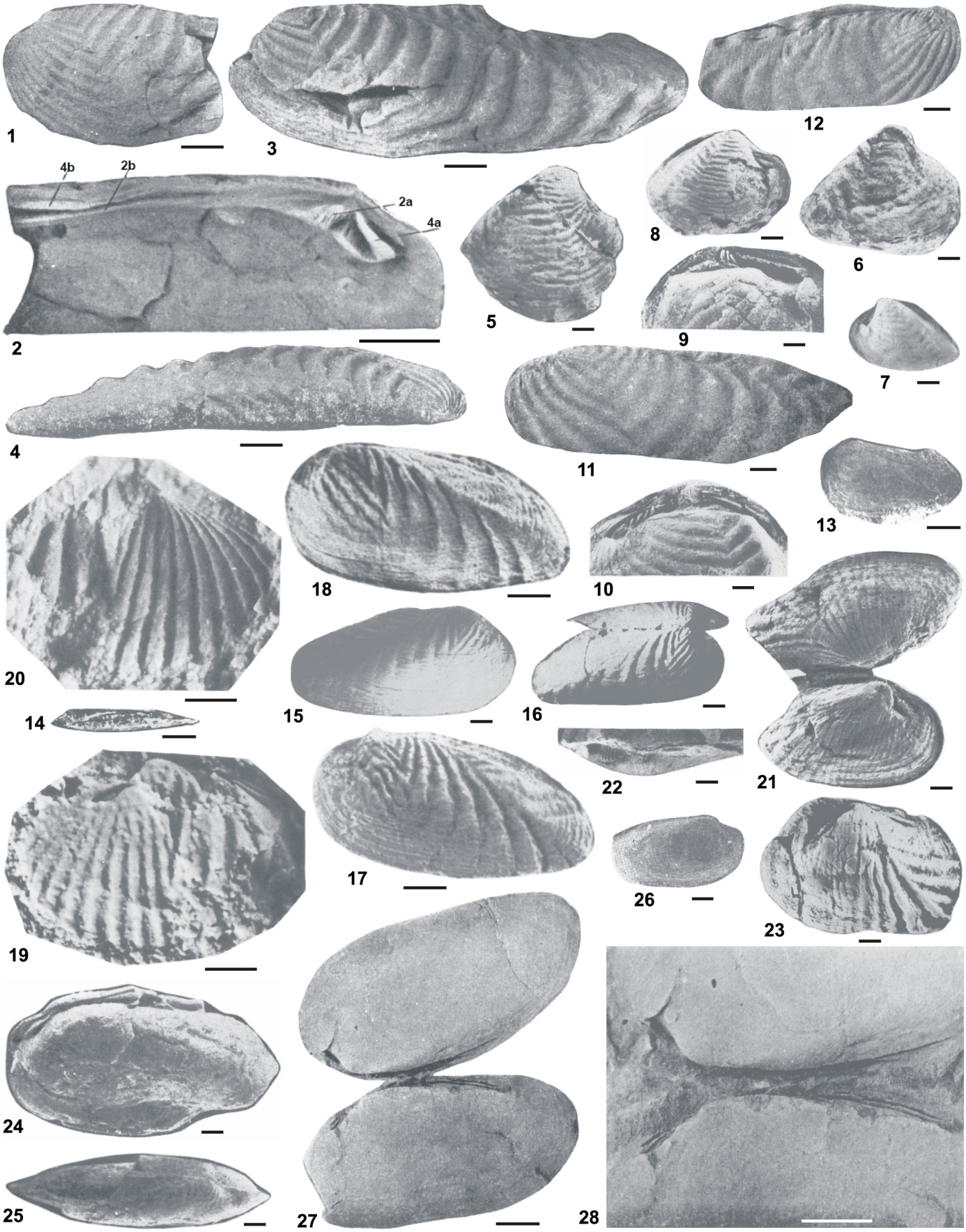

Figure 31. *For explanation, see facing page.*

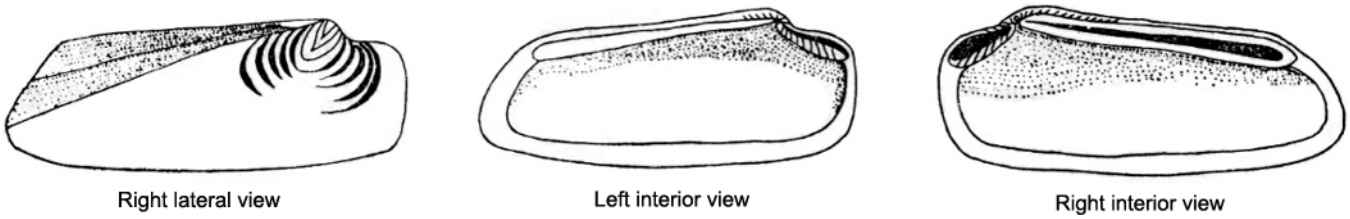

Figure 32. Diagrammatic drawing of *Danlengiconcha elongata* Liu, showing hinge and ornamentation, no scale (adapted from Cai & Liu, 1978, p. 374, text-fig. 70).

not published in China. If *Sinonaia moheiensis* Guo, 1988, is considered sufficiently different from *Sinonaia jingdongensis nuanliensis* Guo, 1981b, or *Nippononaia (Eonippononaia) nuanliensis* (Guo) to warrant its allocation to a different genus, which is different from all previously described forms, it is necessary to propose a new generic name for *Sinonaia moheiensis* Guo, 1988, and a new subfamilial name for Sinonaiinae Guo, 1998.

Genus MULTIPLICANAIA
Yu & K. Zhang in Yu et al., 1984, p. 50

[in Chinese]

Figure 31.19–31.20

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Yu & K. Zhang in Yu et al., 1984, p. 50): shell small and thin. Subtrapezoid to rounded triangular in outline. Moderately inflated. Umbo very high and prosocline, placed near middle of dorsal margin. Ornament of radial ribs forming three V-shaped ribs on median of flank, no anterior or posterior (reversed) V-shaped ribs. Angle of V-shaped ribs small, ~25°. Anterior branch of V-shaped ribs consisting of about 11 ribs relatively fine, densely spaced, and shortening anteriorly; posterior branch composed of 6 relatively wide ribs. Hinge teeth composed of anterior and posterior lamellar teeth. Anterior lamellar teeth distinctly crenulated; posterior lamellar teeth long, subparallel to hinge line, relatively weakly crenulated. Dental formula: 5, 3, PIII/4, 2, PII, PIV (5a, 3a, 3b/4a, 2a, 2b, 4b in original text).

Type species.—*Multiplicanaia tujingziensis* Yu & Zhang in Yu et al., 1984, p. 51, pl. 9,*3* (holotype), *4*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Yu & K. Zhang in Yu et al., 1984, p. 51): Same as for genus.

Type locality.—Ximalin, Wanquan, Hebei, North China.

Type occurrence.—Tujingzi Formation, Lower Cretaceous.

Repository of type material.—Tianjin Institute of Geology, Chinese Academy of Geological Sciences, Tianjin, North China; accession number: T8161 (holotype); T8162.

Distribution of genus.—Lower Cretaceous; Hebei, North China (Yu & Zhang in Yu et al., 1984, p. 51).

Taxonomic position.—Trigonioididae (by original designation).

Revision suggestion.—Gu and Yu (1999, p. 39) suggested that *Multiplicanaia* is a junior synonym of *Martinsonella* Hong because type species is based on juvenile specimens.

Subfamily DANLENGICONCHINAE
Sha, 1993, p. 290

[in Chinese]

Synonymy.—First appeared in Sha, Ph.D. thesis, 1989.

Discussion and diagnosis.—Original diagnosis (translation from Ph.D. thesis of Sha, 1989, p. 68): Ornament of submedian V-ribs with V angle becoming larger ventrally, occurring on umbo immediately below, i.e., not reaching adult ventral margin. Radial threads occurring on posterior area.

New diagnosis.—Ornament of V-shaped ribs on middle-upper area and radial threads on posterior area.

Type occurrence.—Upper Jurassic–Lower Cretaceous (Sha, Ph.D. thesis, 1989, p. 68); Lower Cretaceous (Sha, 2007, p. 62).

Taxonomic position.—Trigonioididae (by original designation).

See also.—Sha and Fürsich, 1993, p. 152; Sha, 2007, p. 63.

Genus DANLENGICONCHA
Liu in Cai & Liu, 1978, p. 374

[in Chinese]

[*emend.* Liu, 1984, p. 558 (in Chinese)]

Figure 31.24–31.26, 32

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Liu in Cai & Liu, 1978, p. 374): small to medium, subrounded triangular, oval, elliptical and quadrilateral in outline. Equivalve but inequilateral, moderately to fairly inflated. Posterodorsal area slightly flattened, sculptured with radial lines. Umbonal region wide and feebly convex, beak not large, incurved and prosogyrate, projecting above and placed at anterior part of hinge line. Distinctly depressed immediately anterior of umbo. Except for concentric lines and rings covering entire shell surface, ornament of V-shaped ribs on and around umbonal area; but only ribs on umbonal area meet each other ventrally, forming V-shaped sculpture, others vanishing toward ventral area. Opisthodetic ligament inserted in slender ligament groove relatively long. In right valve, anterior lamellar pseudocardinal teeth 3a (3) strong, 5a (5) fine and feeble; posterior lateral (lamellar) tooth 3b (PIII) and 5b (PV) edgelike. Only one strong, lamellar, anterior, pseudocardinal tooth, 2a (2), and one long, edgelike, posterior, lateral (lamellar) tooth 2b (PII). All teeth parallel to hinge line and extending from point beneath umbo to anterodorsal and posterodorsal corners. Anterior pseudocardinal teeth distinct, but posterior lamellar teeth feebly crenulated. Umbonal cavity shallow to fairly deep and inner

shell surface smooth. Anterior and posterior adductor scars both shallow, anterior one relatively deep and oval in outline.

Emended diagnosis of genus.—(Translation from Chinese text, Liu, 1984, p. 558): Small to medium. Elongate-oval, elliptical and quadrilateral in outline. Moderately inflated. Posterior umbonal ridge undeveloped. Umbonal area evenly inflated, beak not large, prosogyrate, slightly projecting above hinge line and placed at anterior part of hinge line. V-shaped ribs distributed on and around umbonal area, but only 2 to 3 ribs on umbo meet each other ventrally, forming V-shaped sculpture, and others vanish toward ventral area; ornament of subradial threads and ribs on posterodorsal area, and other part of shell surface covered with concentric growth lines or rings. Posterodorsal radial rib near umbonal area intersecting with subradial ribs on posterior branch of submedian V-shaped ribs, forming reversed chevron (V-shaped) ribs. Two anterior pseudocardinals and two original laterals (lamellar teeth); dental formula: 5, 3, PIII, PV/4, 2, PII, PIV (5a, 3a, 3b, 5b/4a, 2a, 2b, 4b in original text). Anterior adductor scar not deep and oval in outline, posterior adductor scar large but shallow.

Type species.—*Danlengiconcha elongata* Liu in Cai & Liu, 1978, p. 375, pl. 119,*9a–b* (holotype); pl. 120,*1*; text-fig. 70; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Liu in Cai & Liu, 1978, p. 375): Medium. Transversely quadrilateral in outline and shell length two times shell height. Dorsal margin slightly arcuate and anterodorsal margin much shorter than posterodorsal one. Anterior margin broadly rounded, posterior margin subtruncated, ventral margin long and slightly convex, posteroventral corner sharp, ~75°–85°. Moderately inflated, middle-dorsal part of shell most inflated. Posterior umbonal ridge fine and more or less distinct. Posterodorsal area long, narrow, and flat, on which ornament of radial lines extends from umbo to posterior margin. Umbonal area wide and relatively convex, beak large and almost prosogyrate, projecting above dorsal margin, and placed at about one-fourth shell length from anterior end. Eight pairs of subradial ribs gathering ventrally, but only three pairs of ribs on umbonal region meet each other ventrally, forming V-shaped sculpture. All other parts of shell surface covered with concentric lines. Two lamellar anterior pseudocardinals and two edgelike posterior lateral (lamellar) teeth in right valve, only one anterior pseudocardinal and one long edgelike posterior lateral (lamellar) tooth in left. All teeth originate beneath umbo and extend to anterodorsal and posterodorsal corners. Among them, 3a (3) and 2a (2) strong, 5a (5) slender. Anterior pseudocardinals relatively crenulated and posterior lamellar teeth feebly striated. Umbonal cavity shallow and inner shell surface smooth. Both anterior and posterior adductor scars shallow, but anterior one relatively deep and oval in outline. Pallial line incompletely preserved.

Type locality.—Jintianchang, Meishan, Sichuan, southwestern China.

Type occurrence.—Penglaizhen Formation, Upper Jurassic (Liu in Cai & Liu, 1978, p. 374); Lower Cretaceous (Sha, 2007, p. 62).

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: Sbi348 (holotype); Sbi349.

Distribution of genus.—Upper Jurassic–Lower Cretaceous; southwestern China (Liu in Cai & Liu, 1978, p. 375); Lower Cretaceous (Sha, 2007, p. 62).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Nippononaiadidae (Ma, 1989, p. 260) or Danlengiconchinae Sha (Sha, 1989, Ph.D. thesis, 1993, 2007; Sha & Fürsich, 1993).

Note.—The musculature of *Danlengiconcha* is much more similar to that of Unionoidea than to that of Trigonioidoidea, according to Chen Jin-hua's observation (2009) of type material. Thus, the superfamily assignment of *Danlengiconcha* and Danlengiconchinae may require reassessment.

See also.—Liu (1984, p. 558) made a revision on hinge of left valve of type species.

Subfamily PEREGRINOCONCHINAE Gu, Chen, & Lan in Ma et al., 1976, p. 246

[in Chinese]

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Gu, Chen, & Lan in Ma et al., 1976, p. 246): equivalve, subequilateral. Ornament of V-shaped ribs on whole juvenile shell surface, and V-ribs only distributed on dorsal-middle flank or around umbo. Hinge plate long but narrow, both anterior and posterior lamellar teeth subparallel to dorsal margin. Dental formula: (7), 5, 3, PIII, PV, PVII, (PIX)/4, 2, 1', PII, PIV, (PVI) [(7a), 5a, 3a, 3b, 5b, 7b, (9b)/4a, 2a, 2', 2b, 4b, 6b in original text]. Median denticle 2' (1') is radially crenulated, edge and sides of lamellar teeth respectively crenulated with inverted-V shape, vertical crenulations, and feebly oblique grooves. Anterior and posterior teeth connected by interdentum. Anterior adductor scar deep and rounded. Minute but deep pedal scar placed on posterodorsal area and separated from adductor scar. Inner shell surface smooth.

Type occurrence.—Upper Jurassic (Gu, Chen, & Lan in Ma et al., 1976, p. 276); Lower Cretaceous (Sha, 2007, p. 62).

Taxonomic position.—Originally family Peregrinoconchidae Gu, Chen, & Lan in Ma et al., 1976, p. 246. Unionoidea (by original designation).

Revision suggestion.—Guo (1981) and Sha (1993, p. 290) relegated Peregrinoconchinae to a subfamily of Trigonioididae.

Genus PEREGRINOCONCHA Chen & Lan in Gu et al., 1976, p. 58

[in Chinese]

Figure 31.5–31.10

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Chen and Lan in Gu et al., 1976, p. 58): Medium sized. Triangular or ovally triangular. Equivalve, inequilateral, or subequilateral. Posteroventral corner slightly gaped in some individuals. Beak orthogyrate or slightly prosogyrate, outer ridge (posterior umbonal ridge) distinct, groove immediately beneath outer ridge distinct or indistinct. Lunule large. Ornament of V-shaped ribs, of which two to three ribs of posterior branch usually merged into one rib on area along groove; V-shaped ribs cover whole juvenile shell surface, but in adult individuals, V-shaped ribs only distributed around umbo or dorsal-middle part of shell.

Siphonal area (posterodorsal area) long and narrow, and mostly smooth or having a groove, except early growth stage with chevron ribs. Hinge plate long and narrow, providing lamellar teeth subparallel to dorsal margin: two to three anterior pseudocardinals and three to four posterior lamellar teeth in right valve, two anterior pseudocardinals, three lamellar teeth and one median denticle in left. Median denticle irregularly crenulated, inverted-V-shaped crenulations on edges of and vertical fine crenulations on sides of lamellar teeth. Anterior adductor scar deep and rounded, associated with minute and separated pedal retractor scar, posterior adductor scar large. Inner margin smooth.

Type species.—*Peregrinoconcha yunnanensis* Chen & Lan in Gu et al., 1976, p. 59, pl. 43,*14* (holotype), *15–16*; pl. 47,*5–7*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Chen & Lan in Gu et al., 1976, p. 59): Triangular in outline. Umbo prominently projecting above hinge line. Outer ridge (posterior umbonal ridge) sharp, associated with shallow furrow immediately beneath ridge. Concentric growth ridges on flank surface wide and round, usually every two to three ridges merged into one and curved upward in area anterior to outer ridge, forming ornamentation pattern of V-shaped ribs. Middle-ventral part only covered by concentric growth wrinkles. Siphonal area (posterodorsal area) long, narrow, and smooth, nearly meeting flank at right angles.

Type locality.—Heping, Jinggu, Yunnan, southwestern China.

Type occurrence.—Jingxing Formation, Upper Jurassic (Gu, Chen, & Lan in Ma et al., 1976, p. 276); Lower Cretaceous (Sha, 2007, p. 62).

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 24943 (holotype); 24944, 24945, 25005–25007.

Distribution of genus.—Upper Jurassic; Yunnan and Qinghai of China, ?Thailand (Chen & Lan in Gu et al., 1976, p. 59); Lower Cretaceous (Sha, 2007, p. 62).

Taxonomic position.—Peregrinoconchinae (by subsequent designation, Gu, Chen, & Lan in Ma et al., 1976, p. 246).

Subfamily TRIGONIOIDINAE Cox, 1955
Genus NIPPONONAIA Suzuki, 1941
Subgenus NIPPONONAIA (EONIPPONONAIA) Guo, 1981b, p. 65

[in Chinese]

Figure 31.11–31.12

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Guo, 1981b, p. 65): elliptical, elongate elliptical, and cuneiform in outline. Umbo incurved and prosogyrate, placed near anterior end of dorsal margin. Posterior umbonal ridge developed or indistinct. Ornament of V-shaped ribs and anterior and posterior reversed chevron (V-shaped) ribs, but anterior chevron ribs sometimes absent; concentric growth lines cutting off subradial fine ribs and densely spaced. Two short lamellar anterior teeth in each valve, two long lamellar posterior teeth in left valve and one in right; dental formula: 5, 3, PIII/4, 2, PII, PIV (5a, 3a, 3b/4a, 2a, 2b, 4b in original text). All teeth smooth and subparallel to hinge line. Opisthodetic ligament long and narrow. Nymph of right valve developed, thin and long, obliquely meeting posterodorsal margin.

Type species.—*Nippononaia (Eonippononaia) diana* Guo, 1981b, p. 65, pl. 2,*1* (holotype), *2*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1981b, p. 65): Elongate elliptical and cuneiform in outline. Anterior part very short and anterior margin rounded; posterior part fairly long and gradually pointed posteriorly. Umbo low, but wide and obtuse, placed at about one-sixth shell length from anterior end. V-shaped ribs developed and almost occupying all of shell surface except posterodorsal area. Ribs wide, rounded, and sparsely spaced. Anterior branch of V-shaped ribs consisting of about 11 relatively fine ribs, posterior branch composed of ~14 ribs, relatively wide. Seven to eight pairs of ribs meet each other at nearly right angles, forming V-shaped ribs, other obliquely meeting ventral margin [note: not true]. Line connecting apices of V-shaped ribs prosocline. Ribs on the posterodorsal area wide, short and knotlike, forming chevron (reversed V-shaped) ribs. No anterior chevron (reversed V-shaped) ribs. Growth lines fine and densely spaced, cutting off subradial ribs.

Type locality.—Mengyuan, Mengla, Yunnan, southwestern China.

Type occurrence.—Jingxing Formation, Lower Cretaceous.

Repository of type material.—The Geological Museum of China, Beijing; accession number: 761466/28 (holotype); 761466a/28.

Distribution of subgenus.—Lower Cretaceous; Asia (Guo, 1981b, p. 65).

Taxonomic position.—Nippononaiadidae (by original designation).

Subgenus NIPPONONAIA (ARCTONAIA) Yu Xi-han, 1987, p. 121

[in Chinese]

Figure 31.15–31.18

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Yu Xi-han, 1987, p. 121): shell thick and medium sized. Oval-rounded or long elliptical in outline. Except for irregular concentric lines, median V-shaped ribs developed posteriorly, chevron (reversed V-shaped) radial ribs obtuse or disappearing, but opisthodetic ligament long and narrow. Anterior and posterior adductor scars subequal in size, anterior one deep and subrounded. Two pedal scars placed on posterior part of adductor scars, upper one relatively large, deep, and rounded, distinctly separated from adductor scar, placed on distinctly edgelike buttress; lower one tiny and shallow. Posterior adductor scar shallow and suboval-rounded, associated with tiny and shallow pedal scar. Pallial line simple and complete. Inner marginal crenulations undeveloped in anterior part.Two anterior pseudocardinals in each valve, 5a (5), 2a (2), and 4a (4) developed, short lamellar, 3a (3) short and small, obtusely edgelike. Teeth normally smooth, but sometimes feebly crenulated. Two posterior teeth in each valve too, but all smooth, 2b (PII), 4b (PIV), and 3b (PIII) long and lamellar, 5b (PV) small and edgelike. No median tooth.

Type species.—*Nippononaia sinensis* Nie in Gu et al., 1976, p. 360, pl. 95,*23–24*,*25* (holotype), *26–28*; by original designation, Yu Xi-han, 1987.

Original diagnosis of type species.—(Translation from Chinese text, Nie in Gu et al., 1976, p. 360): Medium sized and transversely elliptical in outline. Umbo situated at ~one-fourth to one-fifth of shell length from anterior end. Posterior end obtusely pointed. Siphonal area (posterodorsal area) narrow. Except for feeble concentric lines, submedian V-shaped radial ribs developed. Anterior branch of submedian V-shaped ribs, consisting of 9 to 12 narrow ribs limited to middle-dorsal part and gradually vanishing ventrally. Posterior branch composed of 7 to 10 fairly wide ribs, among which 3 to 5 ribs reach ventral margin. The angle of V-shaped ribs directed toward posteroventral area ~30°. Distinct ribs on siphonal area (posterodorsal area).

Type locality.—Yanzhangzi, Jianchang, Liaoning, northeastern China.

Type occurrence.—Binggou Formation, Shahai Formation, Upper Jurassic (Yu Xi-han, 1987, p. 121); Lower Cretaceous (Sha, 2007, p. 62).

Repository of type material.—China University of Geosciences, Beijing (lacking accession number of type material; plesiotypes: NIGP 19520, 19521, 25290, 25291).

Distribution of subgenus.—Upper Jurassic; Zhejiang, Shandong, and Liaoning of China (Yu Xi-han, 1987, p. 118, 119); Lower Cretaceous (Sha, 2007, p. 62).

Taxonomic position.—Nippononaiadidae (by original designation).

Revision suggestion.—Subgenus name rejected by J. Chen (1999, p. 104) because he restudied the type species *Nippononaia sinensis* Nie and insisted it should be a member of *Nippononaia* Suzuki.

Note.—Koreanaia (Eokoreanaia) Sha in Sha and Fürsich, 1993, p. 154 is an invalid name, because its type species is *Nippononaia sinensis* Nie in Gu et al., 1976, which has been designated as the type species of *Nippononaia (Arctonaia)* Yu, 1987.

Subgenus NIPPONONAIA (EOMARTINSONELLA) Yu Xi-han, 1987, p. 123

[in Chinese]

Figure 31.13–31.14, 33.10–33.12

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Yu Xi-han, 1987, p. 123): shell thin and small to medium. Oval-rounded to elliptical in outline and moderately inflated. Umbo slightly projecting above hinge line situated at anterior of dorsal center. Except for irregular concentric lines on shell surface, median V-shaped ribs limited on umbonal area. Angle of V-ribs slightly directed to posteroventral side. Few forms ornamented with feeble radial ribs on posteroventral margin area. Interior structures (hinge, muscle scar, pallial line, and marginal crenulation) as in subgenus *Nippononaia (Arctonaia)* Yu above.

Type species.—Nippononaia (Eomartinsonella) liaoxiensis Yu Xi-han, 1987, p. 124, pl. 2,*3a–d* (holotype), *4–6*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Yu Xi-han, 1987, p. 124): Shell thin and medium. Transversely oval-rounded in outline and slightly inflated. Shell surface dominated by concentric lines and submedian V-shaped ribs, of which each branch comprises 7 to 8 ribs, limited on umbonal area. The angle of V-ribs ~25°, slightly directed toward posteroventral area. 5 to 7 feeble radial ribs on posteroventral area, of which few may extend to pallial line. Inner margin of posterior end crenulated.

Type locality.—Xinlitun, Yixian, Liaoning, northeastern China.

Type occurrence.—Fuxin Formation, Lower Cretaceous.

Repository of type material.—Shenyang Institute of Geology and Mineral Resources, Shenyang, Liaoning, northeastern China; accession number: SG140278 (holotype); SG140279–140281.

Distribution of subgenus.—Lower Cretaceous; northeastern China (Yu Xi-han, 1987, p. 118, 119).

Taxonomic position.—Nippononaiadidae (by original designation).

Revision suggestion.—Subgenus name rejected by J. Chen and Jiang (1990, p. 14), because all species of *Nippononaia (Eomartinsonella)* listed by Yu Xi-han (1987), including the type species *N. (E.) liaoxiensis* Yu, should be regarded as intraspecific variations of *Nippononaia yanjiensis* Gu (in Gu et al., 1976, p. 361, pl. 106,*20–26*).

Genus TRIGONIOIDES Kobayashi & Suzuki, 1936 Subgenus TRIGONIOIDES (FUJIANOTRIGONIOIDES) Sha, 1981

[in Chinese]

Figure 33.1–33.9

Name history.—Unpublished Master's thesis, not formally published but mentioned by Gu and Sha, 1989, p. 134.

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Sha, 1981, Master's thesis, p. 61): shell small to relatively large. Transversely elongate to square-rounded in outline. Angle of submedian V-shaped ribs slightly more than 20° near beak and around 8°–5° on ventral area. Except for area around beak, posterior oblique radial ribs meet the last one or two (occasionally three) radial ribs of posterior branch of V-ribs, forming subplumed or chevron ornamentation. Hinge plate moderately wide, anterior pseudocardinals originating from area below and close to beak, submedian denticles originating from area below or slightly anterior to beak. Dental formula: (7), 5, 3, 1a, 1b, (1c), (PI), PIII, (PV)/(6), 4, 2, 1'a, (1'b), PII, PIV. Hinge teeth mostly strongly and regularly crenulated on one or two sides. Pseudocardinals 7, 6, 5, and posterior lamellar teeth subparallel to hinge margin. Pseudocardinal 3 prominently high, with about 10, occasionally 12 pairs of crenulations. Angle between 3 and hinge margin ~25°–30°. The most posterior submedian denticle subvertical to oblique with hinge margin, and ratio of submedian denticle to anterior pseudocardinal about one-third to one-half in 1a/3. 1c undeveloped and smooth, only occurring in one or two individuals of type species. PV rarely present, 7 and PI usually absent, the three teeth undeveloped or feeble and smooth. 1b undeveloped to obvious.

Type species.—Trigonioides (Fujianotrigonioides) huaituensis Sha, 1981, p. 65, pl. 1,*1* (holotype), *2–5*; by original designation.

Original diagnosis of type species.—(Translations from Chinese text, Sha, 1981, unpublished Master's thesis, p. 65): Relatively large. Oval or elliptical in outline. Ratio of height to length ~2/3. Shell moderately thick and inflated. Umbo medium sized, placed

at middle or just anterior of midpoint of hinge line. Posterior umbonal ridge obtuse or absent. Tie of apices of angles of submedian V-shaped ribs acline or slightly ophisthocline. Angles of submedian V-ribs near umbo slightly larger than 20°, gradually becoming smaller ventrally, ~10° on middle part and ~8° and even smaller on ventral area. Anterior branch of submedian V-ribs consisting of at least 15 radial ribs, but posterior one composed of about 10 ribs. Anterior oblique radial ribs fine and densely spaced, feebly visible on anterior middle-upper part only, gradually replaced by concentric lines, strengthening with ontogeny, from middle to ventral areas. Posterior obliquely radial wide ribs consisting of 11 ribs, intersecting the last one or two radial ribs of posterior branch of submedian V-ribs, forming one or two groups of semifeathered or chevron ornamentation. Four to six anterior teeth in each valve, 1, occasionally 2 posterior lamellar teeth in right valve and 2 in left; dental formula: (7), 5, 3, 1a, 1b, (1c), (PI), PIII/(6), 4, 2, 1'a, (1'b), PII, PIV. 1c only occasionally present, embryonic, smooth, and opisthocline if present; 7 and PI mostly absent, embryonic or weak and smooth if present; 6 sometimes absent, weak and usually smooth, occasionally crenulated on posterior side; 3 and 4 stout and strongly crenulated; 2 relatively large, strongly crenulated; 1a and 1'a relatively small with distinct crenulations; ratio between 1a and 3 ~0.4 to 0.5; 1b short and small, crenulated on anterior and posterior sides or only anterior side, acline or opisthocline when 1c absent; 1'b smooth or crenulated on anterior side, sometimes embryonic; PII and PIV lamellar or ridgelike, smooth or crenulated. Whole inner margin crenulated.

Type locality.—Fengshan, Chushutang, Dayanli, and Zhangshugang of Huaitu, Ninghua, Fujian, eastern China.

Type occurrence.—Shaxian Formation, Lower Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 72466 (holotype); 72467–72470.

Distribution of subgenus.—Cretaceous; South China (Sha, 1981, unpublished Master's thesis, p. 65).

Taxonomic position.—Trigonioididae (by original designation).

Revision suggestion.—Junior synonym of subgenus *Trigonioides (Trigonioides)* Kobayashi & Suzuki (Sha & Fürsich, 1993, p. 152).

Subgenus TRIGONIOIDES (DIVERSITRIGONIOIDES) Gu in Gu et al., 1976, p. 358

[in Chinese]

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Gu in Gu et al., 1976, p. 358): posterior branch of V-shaped ribs wide and rare, but anterior ribs relatively fine and more, forming pronounced comparison.

Type species.—*Trigonioides diversicostatus* Hoffet, 1937, p. 14, pl. 3,*1–6*; by original designation, Gu in Gu et al., 1976, p. 358.

Type occurrence.—Cretaceous.

Distribution of subgenus.—Cretaceous; southwestern China, Laos, and Thailand (Gu in Gu et al., 1976, p. 358).

Taxonomic position.—Trigonioididae (by original designation).

Note.—See Hoffet (1937) for figures and original diagnosis of type species.

Subgenus TRIGONIOIDES (DIDYMOTRIGONIOIDES) Gu in Gu et al., 1976, p. 359

[in Chinese]

Figure 31.21–31.23

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Gu in Gu et al., 1976, p. 359): ornament of double V-shaped ribs, i.e., W-shaped ribs. Posterior branch of V-ribs also bifurcated secondary ribs forming chevron (reversed V-shaped) ribs with primary radial ribs.

Type species.—*Trigonioides (Didymotrigonioides) didymoscriptus* Gu in Gu et al., 1976, p. 359, pl. 110,*1* (holotype), *2–3*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Gu in Gu et al., 1976, p. 359): Medium and elliptical in

Figure 33. *1–9. Trigonioides (Fujianotrigonioides) huaituensis* Sha, scale bar 10 mm; *1–2,* holotype, bivalved specimen; *1,* left lateral view; *2,* right lateral view; *3,* paratype, right interior view, showing six anterior teeth; *4–5,* paratype, left valve; *4,* exterior; *5,* interior; *6–7,* paratype, bivalved specimen; *6,* left lateral view; *7,* right lateral view; *8–9,* paratype, right valve; *8,* exterior; *9,* interior, showing hinge (adapted from Sha, 1981, unpublished Master's thesis, p. 65, pl. 1,*1a–b,2–3b,4a–b,5a–b*).——*10–12. Nippononaia (Eomartinsonella) liaoxiensis* Yu, scale bar 10 mm; *10–11,* left and right lateral views of internal mold, holotype; *12,* paratype, right lateral view (adapted from Yu Xi-han, 1987, pl. 2,*3b,3d,6*).——*13–15.* Holotype of *Linotrigonioides cancellatus* Guo, scale bar 5 mm; left valve; *13,* lateral view; *14,* dorsal view; *15,* interior view, showing hinge (adapted from Guo, 1987a, pl. 1,*9a–c*).——*16.* Holotype of *Eotrigonioides antiqua* (Gu & Ma), scale bar 2 mm; right lateral view (adapted from Gu & Ma in Ma et al., 1976, pl. 17,*8*).——*17–21. Trigonioides (Xizangotrigonioides) naquensis* (Gu); *17,* holotype, right valve, scale bar 10 mm; *18–19,* paratype, bivalved specimen, scale bar 5 mm; *18,* dorsal view; *19,* posterior view; *20,* paratype, left valve, scale bar 10 mm; *21,* paratype, right valve, scale bar 5 mm (adapted from Gu in Gu et al., 1976, pl. 110,*16,13–15,17*).——*22–27. Lioplicatounio hunanensis* (Zhang); *22,* holotype, left internal mold, scale bar 10 mm (adapted from Zhang, 1979, pl. 1,*2*); *23–25,* plesiotypes, scale bar 10 mm; bivalved specimen, 23, left lateral view, *24,* right lateral view, and *25,* dorsal view; *26,* plesiotype, left internal mold, scale bar 5 mm; *27,* plesiotype, right internal mold, scale bar 5 mm (adapted from Ma, 1983, pl. 2,*12a–c,14,15*).——*28–29.* Holotype of *Enotrigonioides alatus* Guo, scale bar 5 mm; conjoined valves; *28,* left lateral view; *29,* right lateral view (adapted from Guo, 1987a, pl. 3,*1a–b*).——*30–34. Yunnanoconcha chuxiongensis* Gu & Ma, scale bar 10 mm; *30–32,* holotype, bivalved specimen; *30*, left lateral view, *31,* right lateral view, and *32*, dorsal view; *33,* paratype, left interior view; *34,* paratype, right interior view (adapted from Gu & Ma in Ma et al., 1976, pl. 10,*46a–c,47–48*).

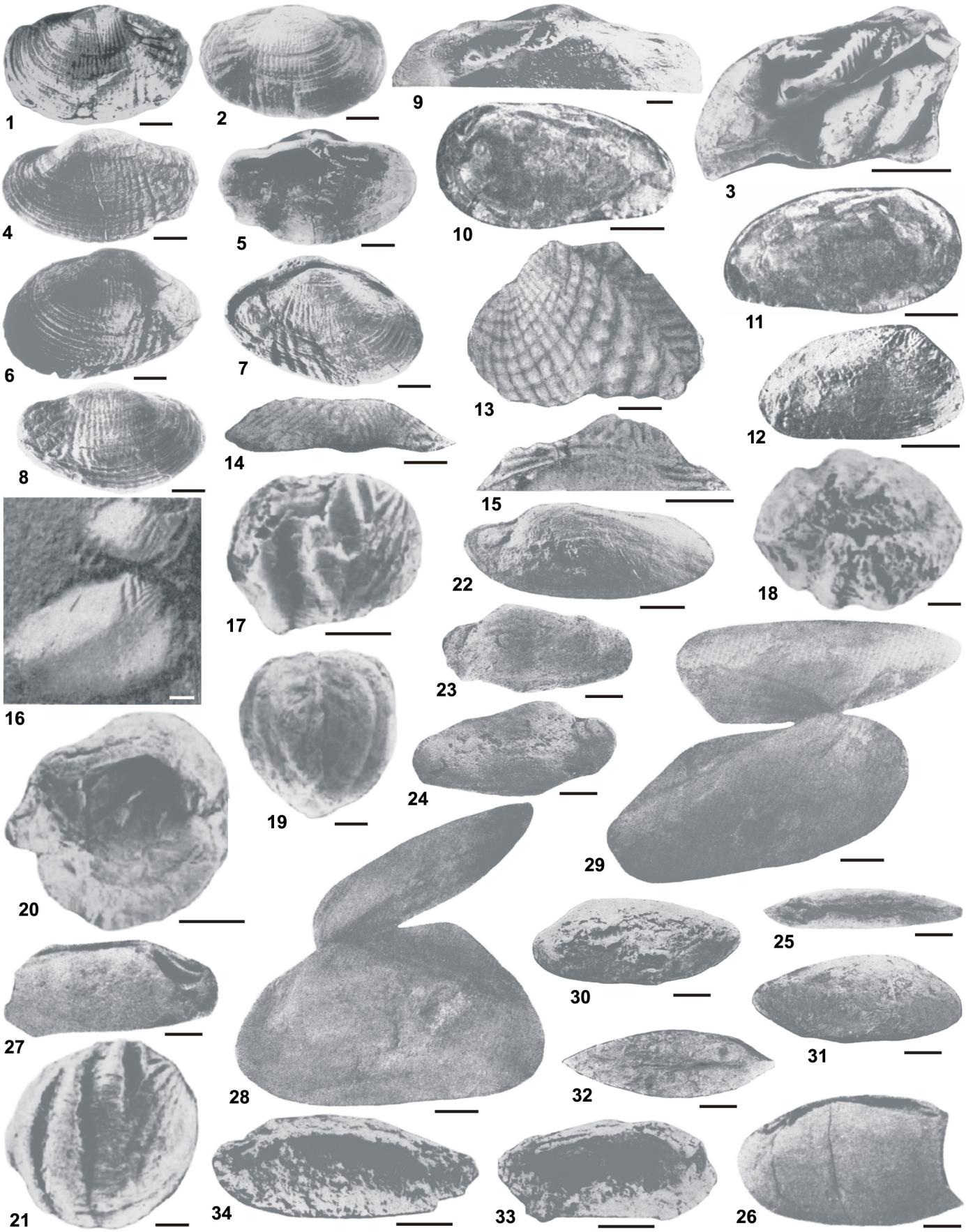

Figure 33. *For explanation, see facing page.*

outline. Moderately inflated. Slope of siphonal area (posterodorsal area) relatively slow. Radial ribs gradually widened from anterior to posterior and forming W-shaped ribs on middle-anterior area. On posterodorsal area, secondary ribs cut off primary ribs.

Type locality.—Dapo, Pingnan, Guangxi, South China.

Type occurrence.—Yongfu Group, Lower Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25540 (holotype); 25541.

Distribution of subgenus.—Lower Cretaceous; eastern Guangxi, South China (Gu in Gu et al., 1976, p. 359).

Taxonomic position.—Trigonioididae (by original designation).

Revision suggestion.—Gu (1989, p. 156) suggested that the subgenus name should be abandoned because there is no basis for its separation from *Trigonioides*.

Subgenus TRIGONIOIDES (XIZANGOTRIGONIOIDES) Guo, 1986, p. 342

[in Chinese]

Figure 33.17–33.21

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Guo, 1986, p. 342): shell very thick and inflated. Subspherical in outline. Umbo wide and obtuse, beak incurved and placed just anterior of midpoint of dorsal margin. Ornament of a (anterior reversed V-shaped ribs), b (anterior branch of submedian V-shaped ribs), c (posterior branch of submedian V-shaped ribs), and d (posterior reversed V-shaped ribs) four groups of acline ribs, b and c groups of ribs fairly developed and occupying most of shell surface, c groups of ribs particularly wide; a and d groups of ribs short, knotlike and tumorlike. Hinge teeth heavy.

Type species.—*Trigonioides (Diversitrigonioides) naquensis* Gu in Gu et al., 1976, p. 359, pl. 110,*13–15*,*16* (holotype), *17*; by original designation, Guo, 1986.

Original diagnosis of type species.—(Translation from Chinese text, Gu in Gu et al., 1976, p. 359): Medium. Square-rounded to rhombus in outline. Slope of siphonal area (posterodorsal area) relatively steep. Posterior branch of V-shaped ribs, consisting of ~8 ribs, stout and widely spaced, posterior subradial ribs, comprising more than 15 ribs, widenly spaced posteroventrally.

Type locality.—Bianba, Xizang (Tibet), China.

Type occurrence.—Duoni Formation, Lower Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25545 (holotype); 25543, 25544, 25546.

Distribution of subgenus.—Lower Cretaceous; Xizang, China.

Taxonomic position.—Trigonioididae (by original designation).

Genus AMERICUNIO Guo, 1986, p. 342

[in Chinese]

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1986, p. 342): suboval in outline. Relatively inflated. Equivalve but inequilateral. Anterior and posterior margins subsemicircle and posterodorsal margin substraight. Anterior end relatively narrow but posterior end relatively wide. Umbo slightly projecting, incurved beak small and sharp, situated at around two-fifths shell length from anterior end. Ornament of subradial ribs that formed anterior and posterior reversed V-shaped ribs on anterior and posterior areas respectively, and V-shaped ribs on median area. Anterior and posterior lamellar teeth sometimes feebly regularly crenulated. Anterior teeth long, one in left and probably another one beneath umbo; two in right; posterior teeth longer than anterior ones, two in left and one in right; dental formula: 5, 3, PIII/4, (2), PII, PIV (a5, a3, p3/a4, (a2), p2, p4 in original text).

Type species.—*Nippononaia asinaria* Reeside, 1957, p. 651, text-fig. 1–2; by original designation, Guo, 1986.

Distribution of genus.—Aptian, Cretaceous; North America (Guo, 1986, p. 342).

Taxonomic position.—Trigonioididae (by original designation).

Revision suggestion.—*Americunio* is a junior synonym of *Yeniella* Modell (1964, p. 106).

Note.—See Reeside (1957) for figures and original diagnosis of type species.

Subfamily AMERICUNIONINAE Guo, 1986, p. 342

[in Chinese]

Discussion and diagnosis.—Original diagnosis of subfamily (translation from Chinese text, Guo, 1986, p. 342): description as for *Americunio* Guo above.

Type occurrence.—Aptian, Cretaceous; North America.

Taxonomic position.—Trigonioididae (by original designation).

Revision suggestion.—Subfamily name is rejected because *Americunio* and *Yeniella* are congeneric.

Genus EOTRIGONIOIDES Ma, 1989, p. 265

[in Chinese]

Figure 33.16

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Ma, 1989, p. 265): shell relatively small, obliquely rhombus, subrounded, triangular and trapezoid in outline. Ornament of M-shaped and V-shaped radial threads on dorsal area, but ventral area is only covered by concentric lines. Proposed dental formula: 5, 3, PIII/(6), 4, 2, PII, PIV (5a, 3a, 3b/(6a), 4a, 2a, 2b, 4b in original text). No crenulation observed. Muscle scar system, pallial line and others same as those of Trigoniodidae Cox. Interior ventral margin smooth.

Type species.—*Trigonioides (Wakinoa?) antiqua* Gu & Ma in Ma et al., 1976, p. 238, pl. 17,*8*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Gu & Ma in Ma et al., 1976, p. 238): Shell small. 7 mm long and 5 mm high. Obliquely rhombus in outline. Anterior margin rounded, ventral margin convex, posterodorsal margin short

and convex, posterior margin subtruncated, posteroventral corner relatively extended posteriorly. Umbo prosogyrate and placed at anterior part of dorsal margin. Posterior umbonal ridge prominent in umbonal area but gradually flattened posteroventrally. Angle of intersection between flank and siphonal area (posterodorsal area) ~90°. Angle of posteroventral corner about 60°. V-shaped ribs on umbonal area distinct, and line of apices of V-ribs prosocline. Subradial ribs on siphonal (posterodorsal) area wide and rare, forming narrow chevron (reversed V-shaped) ribs with posterior branch of submedian V-shaped ribs. Anterior subradial ribs meet anterior branch of submedian V-shaped ribs, forming wide chevron (reversed V-shaped) ribs. Anterior reversed chevron ribs finer and more densely spaced than those of posterior ones and only occur on area beyond one-half height of ventral margin. Inner marginal crenulations appear on anterior and posterodosal margins. Anterior adductor scar distinct, associated with another minute pedal scar on posterodorsal area.

Type locality.—Pupeng, Xiangyun, Yunnan, southwestern China.

Type occurrence.—Gaofengsi Formation, Upper Jurasic–Lower Cretaceous (Ma, 1989, p. 265); Lower Cretaceous (Sha, 2007, p. 62).

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 26124 (holotype).

Distribution of genus.—Upper Jurassic–Lower Cretaceous; southwestern China (Ma, 1989, p. 265); Lower Cretaceous (Sha, 2007, p. 62).

Taxonomic position.—Trigonioididae (by original designation).

Genus LINOTRIGONIOIDES Guo, 1987a, p. 155

[in Chinese]

Figure 33.13–33.15, 34

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1987a, p. 155): subtriangular in outline. Medium size and moderately inflated. Subequilateral. Umbo situated at anterior by middle of hinge line, incurved and prosogyrate. Outer ridge (posterior umbonal ridge) developed. Ornament of four groups of oblique ribs, b and c groups of oblique ribs (anterior and posterior branch of submedian V-shaped radial ribs) meet each other ventrally, forming V-shaped ribs, and two groups of ribs cut off each other, forming netlike and tumor-like sculptures; d groups of ribs (posterior radial ribs) distributed on depressed posterodorsal area and intersected with c group of of ribs, forming chevron (posterior reversed V-shaped) ribs, a group of ribs (anterior radial ribs) meet b group of ribs, forming chevron (anterior reversed V-shaped) ribs. Two anterior and posterior teeth [a4 (4), a2 (2) , p2 (PII), p4 (PIV)] in left valve, except for a2, which is short and small, all teeth lamellar and parallel to hinge margin, length of posterior teeth approximately 1.5 times that of posterior teeth. On the basis of shapes of dental grooves, a3 (3) and p3 (PIII) relatively wide and strong. Lateral teeth smooth. Dental formula: 5, 3, PIII/4, 2, PII, PIV (a5, a3, p3/a4, a2, p2, p4 in original text).

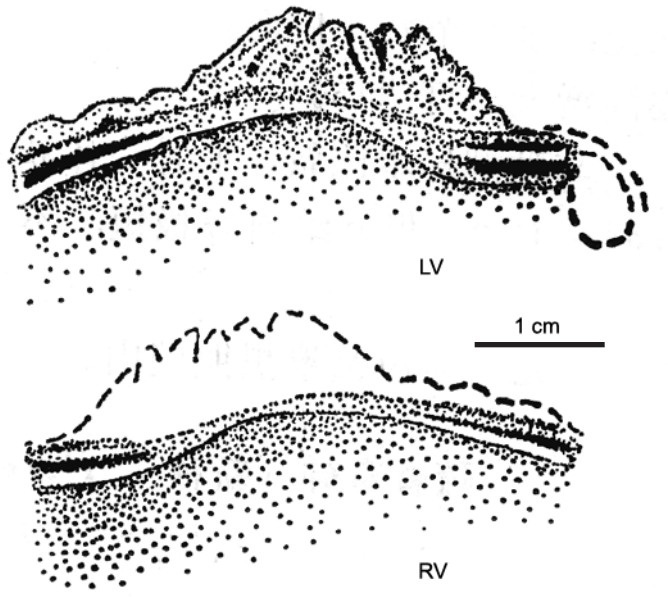

Figure 34. Drawing of *Linotrigonioides cancellatus* Guo, showing hinge (adapted from Guo, 1987a, p. 155, text-fig. 7).

Type species.—*Linotrigonioides cancellatus* Guo, 1987a, p. 155, pl. 1,*9a–c* (holotype); text-fig. 7; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1987a, p. 155): Medium, holotype about 24 mm long and 19 mm high. Subtriangular in outline. Moderately thick and inflated. Anterior margin narrowly rounded, posterior part relatively broad, posterior margin truncated, posterodorsal cover and posteroventral corner distinct. Umbo situated slightly anteriorly at middle of length of shell, incurved and prosogyrate. Posterior umbonal developed, edgelike, extending from umbo to posteroventral corner, and cut off by c group of oblique ribs (posterior branch of submedian V-shaped ribs), shell surface between umbo and venter slightly depressed, causing a ventral sinus. Posterodorsal area relatively broad and depressed. Ornament of four groups of oblique ribs: c group of ribs (posterior branch of submedian V-shaped ribs) consisting of ~9 wide ribs and group of ribs (anterior branch of submedian V-shaped ribs) composed of ~15 ribs cut off each other, forming netlike and tumor-like ornamentation; group of ribs (anterior radial ribs) meet b group ribs (anterior branch of submedian V-shaped ribs), forming chevron (anterior reversed V-shape) ribs; d group of ribs, posterior radial ribs distributed on posterodosal area, meet c group of ribs (posterior branch of submedian V-shaped ribs), forming chevron (posterior reversed V-shaped) ribs. Hinge structure as in description of genus above.

Type locality.—Manzhaoying, Mingle, Jingu, Yunnan, southwestern China.

Type occurrence.—Jingxing Formation, Lower Cretaceous.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0568 (holotype).

Distribution of genus.—Lower Cretaceous; Yunnan, southwestern China (Guo, 1987a, p. 155).

Taxonomic position.—Trigonioididae (by original designation).

Family NAKAMURANAIIDAE
Guo, 1981b, p. 61
[in Chinese]

Discussion and diagnosis.—Original diagnosis of family (translation from Chinese text, Guo, 1981b, p. 61): transversely elliptical, subrhombus, subtriangular, subrounded in outline. Umbo situated near anterior end (most) to center (rare) of dorsal margin. Posterior umbonal ridge not prominent. Shell surface smooth, or ornament of V-shaped ribs, sub-V-shaped ribs, and subradial ribs. Hinge teeth relatively fine and thin. Anterior teeth short lamellar, two teeth in each valve, subparallel to each other; posterior teeth long lamellar, two in left valve and one in right, also subparallel to each other. No median denticle and crenulation except for rare exception having feeble crenulations. Opisthodetic ligament narrow. Nymph of right valve developed, but narrow and thin. Anterior adductor scar relatively distinct, associated with one minute but deep pedal scar occurring on posterodorsal area of anterior adductor scar.

Type occurrence.—Middle Jurassic–Cretaceous (Guo, 1981b, p. 62); Lower Cretaceous (Sha, 2007, p. 62).

Taxonomic position.—Trigonioidoidea (by original designation).

Genus YUNNANOCONCHA
Gu & Ma in Ma et al., 1976, p. 219
[in Chinese]

Figure 33.30–33.34

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Gu & Ma in Ma et al., 1976, p. 219): transversely elliptical to elongate and narrow acute lancelike in outline. Umbo situated at one-third shell length from anterior end. Posterior umbonal ridge distinct to obtusely rounded. Escutcheon narrow and long, lunule indistinct. Posterior outer ligamental furrow relatively long. Only shell surface bearing growth lines. All hinge teeth lamellar. Two anterior pseudocardinals in left and one in right valve (sometimes another embryonic tooth 5a (5) occurs in right valve), parallel to each other; one posterior lamellar in right and two in left valve, and their apices seem to be crenulated in waves. Anterior adductor scar deep and associated with a minute pedal scar placed at posterodorsal area, posterior adductor scar relatively shallow.

Type species.—*Yunnanoconcha chuxiongensis* Gu & Ma in Ma et al., 1976, p. 219, pl. 10,*43–45*,*46a–c* (holotype), *47–49*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Gu & Ma in Ma et al., 1976, p. 219): Shell transversely elongate and length 2.45–2.59 times height. Anterior margin roundly convex, dorsal margin convexly curved, posterior margin narrowly rounded, ventral margin convex, and posterior part rostrumlike. Umbo obtuse, prosogyrate, and incurved, placed at about one-fourth shell length from anterior end. Posterior umbonal ridge pronounced, extending from umbo to posteroventral corner. Lunule indistinct but escutcheon distinct. Posterior ligament furrow particularly long. Shell surface covered with concentric growth lines. One anterior pseudocardinal (sometimes associated with another embryonic tooth on its dorsal part) and one posterior tooth in right valve, two anterior pseudocardinals and two posterior teeth, parallel to each other, in left valve. All teeth lamellar. Anterior adductor scar deeper than posterior one.

Type locality.—Zhuxichong, Chuxiong, Yunnan, southwestern China.

Type occurrence.—Puchanghe Formation, Lower Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25941 (holotype); 25938–25940, 25942–25944.

Distribution of genus.—Cretaceous; Asia (Gu & Ma in Ma et al., 1976, p. 219).

Taxonomic position.—Unionidae? (by original designation).

Revision suggestion.—Junior synonym of *Nakamuranaia* Suzuki, as suggested by Ma (1989, p. 255). Sha and Fürsich (1993, p. 152) assigned genus to Nakamuranaiadidae as a junior synonym of *Nakamuranaia* Suzuki.

Genus ENOTRIGONIOIDES
Guo, 1987a, p. 152
[in Chinese]

Figure 33.28–33.29

Name history.—Originally *Plicatounio (Enotrigonioides)* Guo, 1987a, p. 152.

Discussion and diagnosis.—Original diagnosis (Guo, 1987b, p. 118): shell medium, subtrapezoidal or subelliptical in outline,

Figure 35. *1–4. Rongxiania rongxianensis* Liu, scale bar 5 mm; *1,* lectotype, right valve, showing hinge; *2,* paralectotype, hinge fragment of left valve, showing anterior pseudocardinal tooth; *3,* paralectotype, hinge fragment of right valve, showing transverse microcrenulations on anterior pseudocardinal tooth; *4,* paralectotype, left valve (adapted from Liu, 1984, pl. 7,*16*; pl. 16,*13,10–11,7*).——*5. Lioplicatounio hunanensis* (Zhang), scale bar 10 mm; paratype, left internal mold (adapted from Zhang, 1979, pl. 1,*1*).——*6–10. Pseudohyria (Pseudohyrioides) cangxiensis* Ma, scale bar 10 mm; *6–7,* holotype, left internal mold; *6,* lateral view; *7,* dorsal view; *8,* paratype, dorsal view of Fig. 35.7; *9,* paratype, right internal mold; *10,* paratype, right composite mold (adapted from Ma, 1984, pl. 12,*3a–b,1b,5,9*).——*11–15. Weichangella caelata* Yu & Yao, scale bar 5 mm; *11,* holotype, right internal mold; *12,* external mold of Fig. 35.11; *13,* paratype, left composite mold; *14,* paratype, left composite mold; *15,* external mold of Fig. 35.14 (adapted from Yu & Yao, 1980, pl. 1,*2–6*).——*16–19. Pseudohyria (Liotrigonioides) levis* Guo; *16–18,* holotype, left valve; *16,* left lateral view, scale bar 5 mm; *17,* left interior view, scale bar 5 mm; *18,* local enlargement of Fig. 35.17, showing anterior teeth, scale bar 10 mm; *19,* paratype, right interior view, scale bar 5 mm (adapted from Gu et al., 1976, pl. 114,*9,11–13*).——*20–22. Acclinoplicatounio nananensis* Ma & Huang, scale bar 5 mm; *20,* holotype, left internal mold; *21–22,* paratype, right internal molds (adapted from Ma & Huang in Huang & Ma, 1979, pl. 1,*12–14*).——*23–24. Plicatounio (Guangxiplicatounio) fortis* Yao & Yu; holotype, right internal mold; *23,* lateral view, scale bar 20 mm; *24,* enlarged hinge of Fig. 25.23, showing posterior pseudolaterals with fine transverse microcrenulations, scale bar 10 mm (adapted from Yao & Yu, 1986 pl. 1,*4*; pl. 2,*3*).

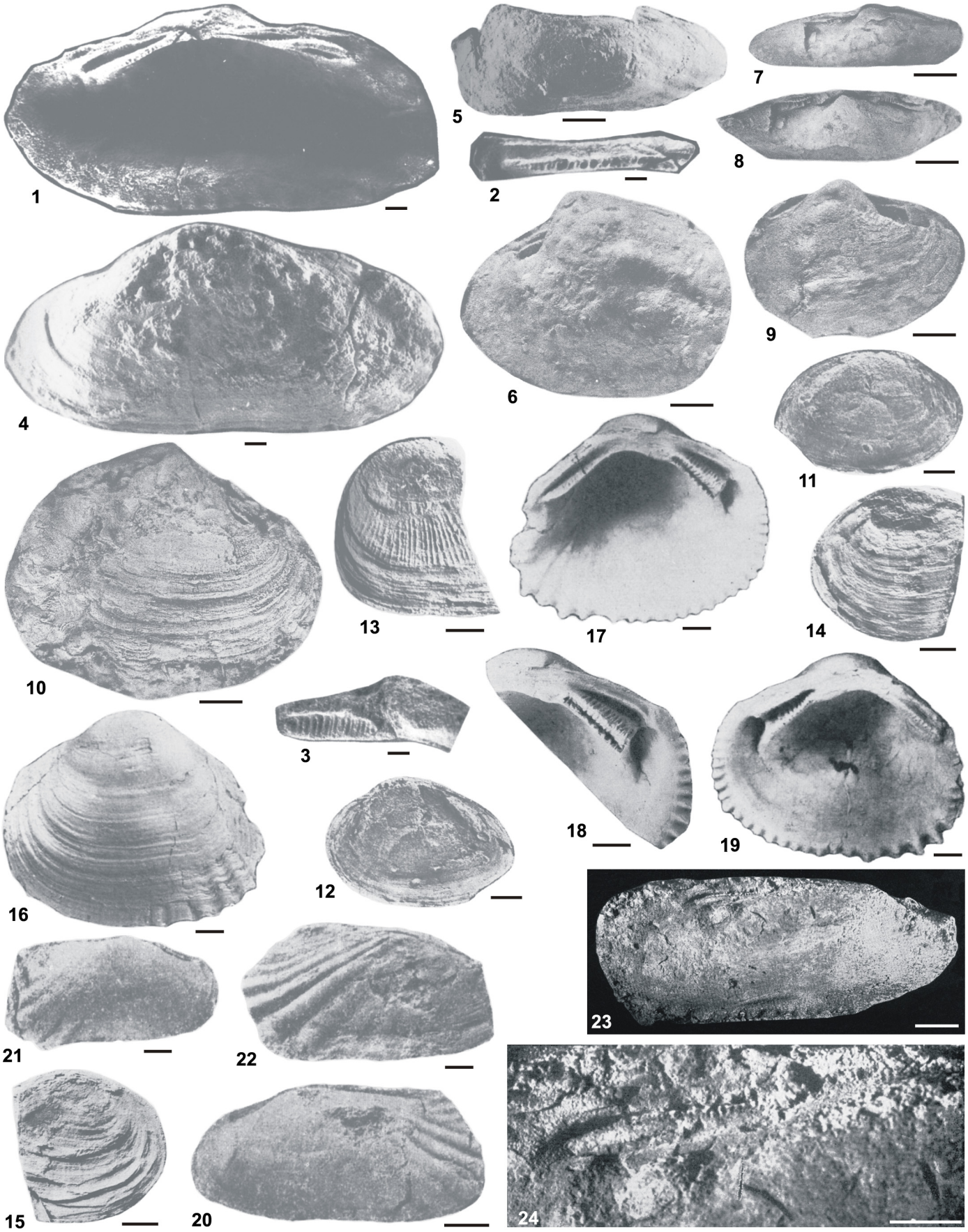

Figure 35. *For explanation, see facing page.*

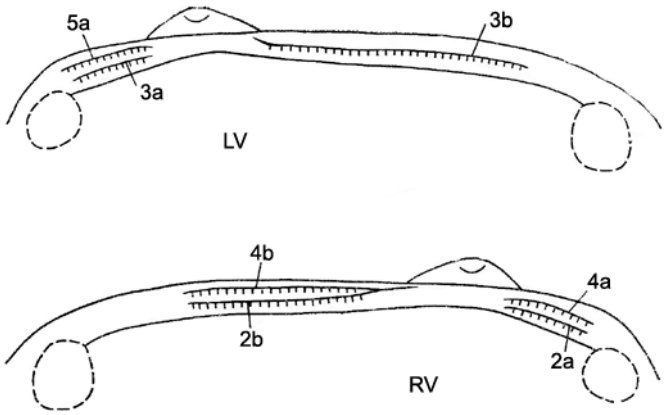

Figure 36. Diagrammatic drawing of hinge of *Plicatounio (Guangxiplicatounio) fortis* Yao & Yu, no scale (adapted from Yao & Yu, 1986, p. 229, text-fig. 2c–d).

inequilateral rounded in front, elongated and obliquely truncated in rear, and broadly arcuated on ventral margin, moderately inflated. Umbos large, gently inflated, slightly incurved and prosogyrous, located more or less anteriorly; carinae broad and blunt. Surface ornamented with concentric lines of growth and few radial furrows running from umbo to posterior margin on posterodorsal area. Anterior teeth unknown; posterior teeth smooth, without crenulations on dental sides, 2 in left valve and 1 in right. Distinguished from *Nakamuranaia* by radial furrows on posterodorsal part instead of radiate plications in *Plicatounio s.s.* [*sic*].

Original diagnosis of genus.—(Translation from Chinese text, Guo, 1987a, p. 152): Subtrapezoidal in outline. Anterior part short and anterior margin rounded, posterior part long and high, posterior margin subtruncated, posterodorsal part winglike. Moderately inflated. Umbo placed near anterior end. Posterior umbonal ridge distinct. Except for growth lines, ornament of radial furrows running from umbo to posterior margin on posterodorsal area. Posterior teeth long, lamellar, and smooth, two in left valve and one in right, resembling those of *Unio* and *Nakamuranaia*.

Type species.—Plicatounio (Enotrigonioides) alatus Guo, 1987a, p. 152, pl. 3,*1a–b* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1987a, p. 153): Subtrapezoidal in outline. Anterior part short and anterior margin relatively narrowly rounded, posterior part long and posterior margin obliquely truncated, ventral margin broadly rounded. Umbo slightly incurved and prosogyrate, situated at about one-third shell length from anterior end. Posterior umbonal ridge on umbonal area distinct, widely rounded near umbonal region, but broadened and becoming somewhat indistinct posteriorly. Shell surface covered with concentric growth lines. Two shallow furrows appearing near umbonal ridge on posterodorsal area. Posterior teeth, two in left valve and one in right, smooth and long lamellar.

Original diagnosis of type species.—(Guo, 1987b, p. 118): Shell medium, subtrapezoidal or subelliptical in outline, inequilateral, length nearly equal to twice height, broadly rounded in front, obliquely truncated in rear, forming posterodorsal angle ~130° and rounded posteroventral angle, with low posterodorsal wing, dorsal margin nearly straight, ventral side broadly arched, moderately inflated. Umbos slightly inflated, obtuse, rounded, and distinct, slightly incurved and prosogyrous, projected slightly above hinge margin, situated at a point about one-third length from anterior extremity; carinae at first distinct but broadened and becoming somewhat indistinct toward posteroventral angle. Surface ornamented with concentric growth lines. Posterior area obliquely triangular with 2 shallow furrows extending from umbo to posterior margin, one of them near carina and another dividing area into 2 nearly equal parts. Posterior teeth smooth, without crenulations on dental sides, subparallel with posterodorsal margin, 2 in left valve and 1 in right. Anterior teeth unknown [*sic*].

Type locality.—Wenwudashan, Mojiang, Yunnan, southwestern China.

Type occurrence.—Upper Member, Jingxing Formation, Lower Cretaceous.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0583 (holotype).

Distribution of genus.—Lower Cretaceous; Yunnan, southwestern China (Guo, 1987a, p. 152).

Taxonomic position.—Plicatounionidae (by original designation).

Revision suggestion.—Sha (1990, p. 479) suggested that the only type specimen of *Plicatounio (Enotrigonioides) alatus* Guo is probably a unionid. This species is provisionally referred to Nakamuranaiidae according to Chen Jin-hua's suggestion (personal communication, autumn 2007).

Family PLICATOUNIONIDAE Kobayashi, 1968
Genus LIOPLICATOUNIO Ma, 1983, p. 672

[in Chinese with English description, p. 675]

Figure 33.22–33.27, 35.5

Name history.—Originally *Plicatounio (Lioplicatounio)* Ma, 1983, p. 672.

Discussion and diagnosis.—Original diagnosis (Ma, 1983, p. 675): transversely trapezoid in outline. Ornament of 4 to 5 relatively wide radial ribs, extending from umbo to posterior. No posterior oblique lateral ridge. Hinge teeth smooth and no median denticle. Inner margin smooth [*sic*].

Type species.—Plicatounio (Plicatounio) hunanensis Zhang, 1979, p. 193, pl. 1,*1,2* (holotype); by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Zhang, 1979, p. 193): Relatively large. Transversely elongate, length (as long as more than 66 mm) more than two times height. Dorsal and ventral margins subparallel to each other. Umbo area wide and flat, umbo situated at about one-third shell length from anterior end, slightly projecting beyond hinge line. Anterior margin narrowly rounded and convex. Posterior margin truncated, angle between posterior and hinge margins (posterdorsal corner) is ~150°, posterodorsal corner rounded. Posterior umbonal ridge widely rounded and indistinct, disappearing in area of ~one-third shell length from posterior end. Ornament of 4 to 5 feeble, wide and flattened radial ribs on posterior area, intervals between every 2 ribs narrow and shallow. Ribs gradually vanishing toward umbo.

Concentric ornamentations distinct near ventral margin. One long posterior lamellar tooth without crenulation visible on area posterior of umbo. Anterior adductor scar situated on anterodorsal area, strong and oval-rounded.

Type locality.—Dapuqingtang, Hengyang, Hunan, South China.

Type occurrence.—Dongtang Formation, Upper Cretaceous.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: K01 (holotype); K02.

Distribution of genus.—Upper Jurassic–Upper Cretaceous; China and North Africa (Ma, 1983, p. 672). However, genus probably limited in Asia (Sha, 1990, p. 479; Sha & Fürsich, 1993, p. 155, 156) and found in Cretaceous as all the trigonioidids including genus were suggested to be (Sha, 2007, p. 62).

Taxonomic position.—Plicatounionidae (by original designation).

Revision suggestion.—Ma (1989, p. 280) suggested that *Plicatounio (Lioplicatounio)* is a junior synonym of *Monginella* Starobogatov.

Genus PLICATOUNIO Kobayashi & Suzuki, 1936 Subgenus PLICATOUNIO (GUANGXIPLICATOUNIO) Fang, 2007a, p. 267

[in Chinese and English]

Figure 35.23–35.24, 36

Synonymy.—Plicatounio (Guangxiconcha) Yao & Yu, 1986, p. 228 (in Chinese with English description, p. 235).

Discussion and diagnosis.—Original diagnosis of subgenus (Yao & Yu, 1986, p. 235): shell large to very large, thick shelled and depressed on middle part. Transversly elongate elliptical in outline, ventral margin broadly and slightly sinuated. Umbo broad and prosogyrate or orthogyrate, placed at ~one-fourth shell length from anterior end and projecting beyond hinge line. External ligament opisthodetic. Lunule and escutcheon distinct. Posterior umbonal ridge obtusely rounded and distinct. Maximum convexity of shell situated near middle part of ridge. Except for growth lines, ornament of strong and widely, spaced four or five radial ribs on posterior half of shell. Hinge plate relatively wide, providing four hinge teeth in each valve. Two anterior cardinals (pseudocardinals) narrow, long, and regularly acutely crenulated on both sides, subparallel to anterodorsal margin. Two lateral (posterior lamellar) teeth very long, lamellar, and regularly, strongly, and vertically crenulated, subparallel to posterodorsal margin. No median cardinals (submedian teeth). Adductor scars well impressed. Inner ventral margin clearly crenulated [sic].

Type species.—Plicatounio (Guangxiconcha) fortis Yao & Yu, 1986, p. 230, pl. 1,*4* (holotype); pl. 2,*3*,*6*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Yao & Yu, 1986, p. 230): Shell very large (169 mm long and 69 mm high) and depressed in middle part of shell. Transversely elongate, length 1.5 times height. Umbo relatively wide, incurved, and prosogyrate, situated at one-fourth shell length from anterior end. Anterior part roundly convex, posterior part elongate. Posterodorsal margin straight, subparallel to ventral margin with broad and gentle curve. Posterior umbonal ridge obtusely rounded. Middle part of shell, anterior to ridge, prominently depressed. Middle-dorsal part most inflated. Ornament as many as ~25 radial ribs on entire shell surface, of which posterior 4 especially wide. Inner marginal crenulations wide, rounded, and sparsely spaced. On right internal mold, one lamellar tooth and two grooves, reflecting two lamellar teeth in left valve. Trace on left internal mold shows left posterior lamellar 4b (PIV) very remarkable, but 2b (PII) unexposed, 4b(PIV) is 50 mm long and 3b(PIII) narrow and long, tightly closing to hinge margin, crenulations on posterior lamellar teeth sharp and vertical, grooves wider than ridges.

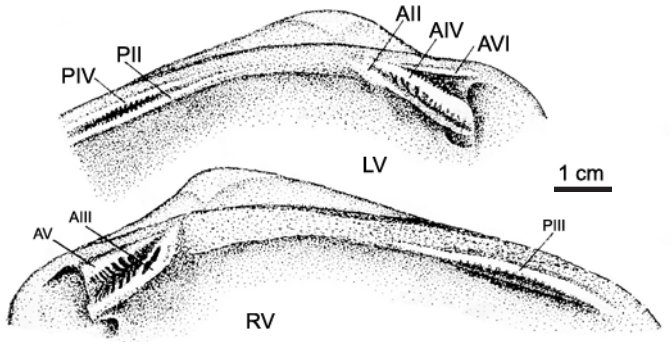

Figure 37. Drawing of *Plicatounio (Tamuraia) tamurai* Guo (=*Plicatounio naktongensis* Tamura, 1977) (adapted from Guo, 1987b, p. 19, text-fig. 11).

Type locality.—Napai, Shanxu, Fusui, Guangxi, South China.

Type occurrence.—Xinlong Formation, Lower Cretaceous.

Repository of type material.—The Institute of Geology, Chinese Academy of Geological Sciences, Beijing; accession number: K1006 (holotype); K1009.

Distribution of subgenus.—Lower Cretaceous; Southeast Asia (Yao & Yu, 1986, p. 228).

Taxonomic position.—Plicatounionidae (by original designation).

Note.—The subgenus name *Guangxiconcha* is preoccupied by *Guangxiconcha* Zhang (in Zhang, Wang, & Zhou, 1977, p. 492) for a genus of Lunulacardiidae. Therefore, a new subgenus name *Plicatounio (Guangxiplicatounio)* is proposed to replace *Plicatounio (Guangxiconcha)* Yao & Yu, 1986, *non Guangxiconcha* Zhang in Zhang, Wang, & Zhou, 1977 (Fang, 2007a).

See also.—Guangxiconcha Zhang in Zhang, Wang, & Zhou, 1977.

Subgenus PLICATOUNIO (TAMURAIA) Guo, 1987b, p. 18

[in Chinese with English description, p. 119]

Figure 37

Discussion and diagnosis.—Original diagnosis of subgenus (Guo, 1987b, p. 119): elongate elliptical in outline. Inequilateral and elongate posteriorly. Anterior part short and anterior margin

rounded, posterior margin subtruncated or subrounded. Moderately inflated. Umbo large and broad, more or less incurved and prosogyrous, situated relatively close to anterior end. Posterior umbonal ridge usually feebly developed, distinct near umbonal area, wide and blunt near posteroventral corner. Ornament of two suites of radial ribs, anterior ones radiating from umbo, posterior ones subparallel to each other, obliquely intersected with former ones at posterior umbonal ridge nearby. Hinge plate medium in breadth, providing 2 to 3 anterior teeth in left valve and 2 in right, 2 posterior teeth in left valve and 1 in right; dental formula: 5, 3, PIII/(6), 4, 2, PII, PIV. All teeth lamellar, with more or less regular crenulations, and subparallel to dorsal margin. Inner margin crenulated. Anterior adductor scar, associated with a minute pedal scar on buttress behind anterior adductor scar deep; posterior adductor scar faint [*sic*].

Type species.—*Plicatounio (Tamuraia) tamurai* Guo, 1987b, p. 19, text-fig. 11 (=*Plicatounio naktongensis* Tamura, 1977, p. 115, pl. 3,*1–4*; Guo designated fig. 3a–b as the lectotype) (*non Plicatounio naktongensis* Kobayashi & Suzuki, 1936, p. 252, pl. 28,*1–4*,*8*); by original designation.

Distribution of subgenus.—Middle Cretaceous; Japan (Guo, 1987b, p. 20).

Taxonomic position.—Plicatounionidae (by original designation).

Revision suggestion.—Sha (1990, p. 479) suggested that *Plicatounio (Tamuraia)* is a junior synonym of *Plicatounio (Guangxiconcha)* Yao & Yu, 1986.

See also.—*Plicatounio (Guangxiplicatounio)* [=*Plicatounio (Guangxiconcha)* Yao & Yu].

Note.—See Tamura (1977, p. 115, pl. 3,*1–4*) for figures and original description of type species.

Genus RONGXIANIA
Liu, 1984, p. 569

[in Chinese]

Figure 35.1–35.4

Name history.—Originally *Plicatounio (Rongxiania)* Liu, 1984, p. 569.

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Liu, 1984, p. 569): shell thick. Medium to very large. Elongate elliptical oval, triangular and so forth in outline. Equivalve but inequilateral. Dorsal margin broadly arcuate, ventral margin long and straight or slightly curved dorsally, both anterior and posterior margin convexly rounded. Inflated, but posterodorsal area flattened. Posterior umbonal ridge wide but indistinct. Umbonal area wide, beak big, slightly prosogyrate, slightly projecting beyond hinge line and situated at center or slightly anterior to middle of dorsal margin. Ornament of many radial ribs, 5 to 6 near posterior area prominently widened and convex, concentric lines developed. External ligament posterior to umbo. Convex triangular median tooth of right valve smooth (unknown if median tooth is present), two median teeth of left valve fine, inverted-V shape. Both anterior and posterior teeth parallel to hinge line. Ratio of anterior pseudocardinal to posterior lamellar teeth more than 0.8. 3 ("3a" in original text) strong and crenulated; 5 ("5a" in the original text) relatively finer and crenulated; 2 ("2a" in original text) large and strong, crenulated. PIII ("3b" in original text) long and strong, strongly crenulated on dorsal side; PV ("5b" in original text) slightly shorter than PIII (3b), feebly crenulated; PII ("2b" in original text) and PIV ("4b" in original text) developed, on which crenulations resemble those on PIII (3b) and PV (5b). Umbonal cavity deep. Inner marginal crenulations developed, short, and wide. Pallial line deep and simple (complete). Anterior adductor scar subrounded, large but not deep, separately associated with minute pedal scar on posterodorsal part. Posterior adductor scar shallow, relatively smaller, oval-rounded. Myophore extremely feeble.

Type species.—*Plicatounio (Rongxiania) rongxianensis* Liu, 1984, p. 570, pl. 7,*16*; pl. 16,*7*,*10–11*,*13* (lectotype, designated herein); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Liu, 1984, p. 570): Shell large, 60–99 mm long, 32–46 mm high and thick. Transversely elliptical in outline. Ratio of height to length is about 0.47–0.50. Dorsal margin broadly arcuate, anterior part relatively narrower and anterior margin roundly convex, posterior part slightly broadened, posterodorsal margin subtruncated, posteroventral corner roundly pointed and slightly extended posteriorly, ventral margin long and slightly curved dorsally. Inflated (40–44 mm in inflation), posteroventral area of umbo most inflated, posterodorsal area flattened. Posterior umbonal ridge wide and obtuse but not distinct. Umbonal area wide and convex, beak big, prosogyrate, slightly projecting beyond hinge line and situated at slightly anterior to middle of dorsal margin. Ornament of 24 to 25 radial ribs, anterior ones relatively narrow, each rib only 2.5 mm wide, 6 to 7 wide ribs close to posterior end (each rib as wide as 5–7 mm on ventral margin) and convex, interval between every 2 ribs very narrow. Concentric lines and rings developed. External ligament posterior to umbo. Hinge plate wide, right median tooth convex, triangular, and smooth, 2 median teeth of left valve fine, inverted-V shape. All lamellar teeth parallel to hinge line, ratio between length of anterior pseudocardinals and posterior lamellar teeth more than 0.8. 3 ("3a" in original text) wide and strong, with very developed vertical crenulations; 5 ("5a" in original text) slightly finer, feebly crenulated; 2 ("2a" in original text) large, with strong crenulations; 4 ("4a" in original text) finer, weakly crenulated. PIII ("3b" in original text) long and strong, with very developed and regularly spaced crenulations on dorsal side; PV ("5b" in original text) slightly shorter than PIII (3b), with feeble crenulations. PII ("2b" in original text) and PIV ("4b" in original text) developed, on which crenulations resemble those on PIII (3b) and PV (5b) . Umbonal cavity deep. Inner marginal crenulations developed, wide but short. Pallial line deep and simple (complete). Anterior adductor scar not deep, large and subrounded, separated minute pedal scar situated on posterior area; posterior adductor scar shallow, relatively smaller and oval-rounded. Buttress very weak.

Type locality.—Zhengzi, Rongxian, Sichuan, southwestern China.

Type occurrence.—Jiangguan Formation, Lower Cretaceous.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: bi1961–1964; bi1964 is herein designated as lectotype.

Distribution of genus.—Lower Cretaceous; Asia (Liu, 1984, p. 570).

Taxonomic position.—Plicatounionidae (by original designation).

Genus WEICHANGELLA Yu & Yao, 1980, p. 327

[in Chinese with English diagnosis, p. 330]

Figure 35.11–35.15

Discussion and diagnosis.—Original diagnosis (Yu & Yao, 1980, p. 330): medium. Elliptical, oval, or roundly triangular in outline. Umbo broad, one-third shell length from anterior end, projecting beyond hinge line. Lunule and escutcheon indistinct. External ligament opisthodetic. Posterior umbonal ridge obtusely rounded and conspicuous. Except for concentric lines, ornament of radial ribs on shell surface. Ribs feebly seen in umbonal area, strengthened ventrally, and vanished in ventral area and replaced by concentric lines. Inner margin smooth. Internal structure unknown [*sic*].

Type species.—*Weichangella caelata* Yu & Yao, 1980, p. 328, pl. 1,*2* (holotype), *3–6*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Yu & Yao, 1980, p. 328): Approximately 32 mm long and 22 mm high. Shell relatively thick. Transversely triangular or elliptical in outline. Inequilateral. Anterior margin roundly convex, posterodorsal margin broadly rounded to slightly truncated, ventral margin broadly curved, anteroventral corner broadly obtuse, posteroventral corner slightly narrow. Umbo broadly rounded, projecting beyond hinge line, situated at around one-third or two-fifths shell length from anterior end. Moderately inflated. Posterior umbonal ridge rounded. Except for growth lines on shell surface, ornament of more than 50 fine, densely spaced, and sometimes bifurcated radial ribs on area between umbo and four-fifths shell height from ventral margin.

Type locality.—Shalingou, Weichang, Hebei, North China.

Type occurrence.—Xiguayuan Formation, Upper Jurassic (Yu & Yao, 1980, p. 328); Lower Cretaceous (Sha, 2007, p. 62).

Repository of type material.—The Institute of Geology, Chinese Academy of Geological Sciences, Beijing; accession number: WS7707, 7707-1 (holotype); WS7708, 7711, 7711-1.

Distribution of genus.—Upper Jurassic, ?Lower Cretaceous; Asia (Yu & Yao, 1980, p. 328); Lower Cretaceous (Sha, 2007, p. 62).

Taxonomic position.—Pseudohyriidae (Ma, 1989) or Plicatounionidae (Sha, 1990).

Revision suggestion.—Sha (1990, p. 478) relegated *Weichangella* to a subgenus of *Buginella* Basbold.

Family PSEUDOHYRIIDAE Kobayashi, 1968
Genus GOBIOLA Martinson, 1975
Subgenus GOBIOLA (MATSUMOTOINA) Guo, 1982, p. 145)

[in Chinese with English description, p. 146]

Name history.—Originally *Pseudohyria (Matsumotoina)* Guo, 1982, p. 145.

Discussion and diagnosis.—Original diagnosis of subgenus (Guo, 1982, p. 146): medium. Moderately inflated. Subtriangular or oval-triangular in outline. Subequilateral and shell moderately thick. Umbo incurved and prosogyrate, situated at anterior to middle of hinge line. Posterior umbonal ridge, extending from umbo to posteroventral corner, strong or weak. Shell surface covered with concentric growth lines. Flank broad, ornamented with radial ribs. Posterodorsal area between posterior umbonal ridge and posterodorsal margin narrow, broadly lanceolate, with oblique ribs intersecting with radial ribs near posterior umbonal ridge, forming reversed V-shaped ribs. Anterior and ventral areas usually smooth. Hinge plate moderately wide, with smooth teeth, two anterior teeth in each valve, two posterior teeth in left valve and one in right; dental formula: 5, 3, PIII/4, 2, PII, PIV (5a, 3a, 3b/4a, 2a, 2b, 4b in original text). 2a (2) short and lamellar, frequently cut into a number of dental laminas by opisthocline oblique grooves. Other teeth elongate, lamellar, and subparallel to dorsal margin. Anterior adductor scar deep, but posterior one shallow [*sic*].

Type species.—*Pseudohyria matsumotoi* Yang, 1979, p. 230, pl. 28,*1* (holotype), *2–8*; text-fig. 4; by original designation.

Type occurrence.—Cretaceous.

Distribution of subgenus.—Middle Cretaceous; Guangxi and Yunnan of China, Laos, and Korea (Guo, 1982, p. 146).

Taxonomic position.—Pseudohyriinae (by original designation).

Note.—See Yang (1979) for the figures and original diagnosis of type species.

Genus ACCLINOPLICATOUNIO Ma & Huang in Huang & Ma, 1979, p. 311

[in Chinese]

Figure 35.20–35.22

Name history.—Originally *Plicatounio (Acclinoplicatounio)* Ma & Huang in Huang & Ma, 1979, p. 311.

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Ma & Huang in Huang & Ma, 1979, p. 311): transversely elongate quadrilateral in outline. Ornament of four oblique ribs on posterodorsal area, obliquely intersecting with radial ribs on posterior area. Hinge teeth thin, probably all smooth.

Type species.—*Plicatounio (Acclinoplicatounio) nananensis* Ma & Huang in Huang & Ma, 1979, p. 311, pl. 1,*12–13*,*14* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Ma & Huang in Huang & Ma, 1979, p. 311): Medium. Transversely elongate quadrilateral in outline, with broad but indistinct ventral sinus. Anterior margin rounded, posterior margin nearly straight, posterodorsal margin obviously truncated, posteroventral corner slightly produced. Umbo obtuse, situated at two-fifths shell length from anterior extremity. Posterior umbonal ridge obtusely rounded. Shell surface depressed. Ornament of more than six wide radial ribs on area posterior to depression and four radial ribs on posterodorsal area. The latter ribs obliquely intersecting with former. No clearly visible radial ribs on area anterior to depression. Two posterior lamellar teeth in left valve and two anterior

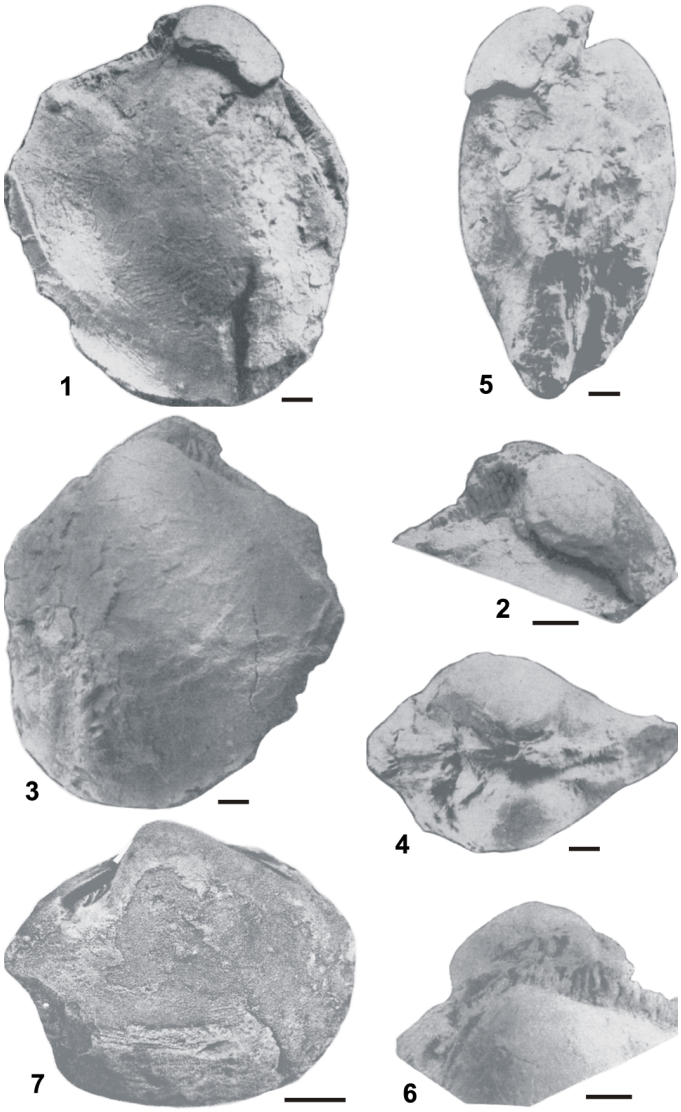

Figure 38. *1–6.* Holotype of *Songhuanaia songhuaensis* Gu, scale bar 5 mm; *1,* left lateral view; *2,* left umbonal area, showing anterior tooth; *3,* right lateral view; *4,* dorsal view; *5,* posterior view; *6,* right umbonal area, showing anterior tooth (adapted from Gu in Gu et al., 1976, pl. 114,*1–6*).——*7. Pseudohyria (Pseudohyrioides) cangxiensis* Ma, scale bar 10 mm; paratype, left internal mold (adapted from Ma, 1984, pl. 12,*1a*).

pseudocardinals in right. All teeth smooth. Feature of muscle scars same as those of genus.

Type locality.—Nanan, Ningming, Guangxi, South China.

Type occurrence.—Bali Formation, Lower Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 45598 (holotype); 45596, 45597.

Distribution of genus.—Lower Cretaceous; Guangxi, South China (Ma & Huang in Huang & Ma, 1979, p. 311).

Taxonomic position.—Pseudohyriidae (Sha, 1990, p. 479).

Genus PSEUDOHYRIA MacNeil, 1936
Subgenus PSEUDOHYRIA (PSEUDOHYRIOIDES) Ma, 1984, p. 608

[in Chinese]

Figure 35.6–35.10, 38.7

Name history.—Originally *Pseudohyrioides* Ma, 1984, p. 608.

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Ma, 1984, p. 608): medium. Subrounded, transversely oval to obliquely triangular in outline. Umbo projecting. Posterior umbonal ridge remarkably or obtusely rounded, sometimes with depressed area posterior to ridge, extending from umbo to posteroventral margin. Flank surface covered with irregularly spaced growth lines only, but ornament of about four oblique plicae on siphonal area (posterodorsal area), intersecting with posterior umbonal ridge, sometimes forming prominent tumorlike convex at intersections. Pseudoheterodont. Dental formula of subgenus: 5, 3, 1a, (PI), PIII/6, 4, 2, PII, PIV (5a, 3a, 1a, (1b), 3b/(6a), 4a, 2a, 1'a, 2b, 4b in original text). 6a (6) relatively weak, lamellar, probably smooth, 2a (2), 3a (3), 4a (4), 5a (5), 2b (PII), 3b (PIII) and 4b (PIV) all lamellar platelike, crenulated, and angles between hinge teeth and hinge margin not large, no more than 30°, but length different; 1'a and 1a short, 1a also crenulated, angle between 1a and hinge line larger than former (~45°), (1b) (PI) usually absent. Anterior adductor scar deep, semicircular, and associated with isolated minute pedal scar on posterodorsal area, posterior adductor scar shallow and indistinct. Umbonal cavity very deep. Inner margin of flank smooth, but inner margin of siphonal area (posterodorsal area) crenulated, no crenulation seen on other inner margins. Pallial line simple (complete).

Type species.—Pseudohyrioides cangxiensis Ma, 1984, p. 609, pl. 12,*1a–b*,*3a–b* (holotype), *5*,*6a–b*,*7*,*8a–b*,*9*; pl. 13,*1a–2b*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Ma, 1984, p. 609): Medium. Subrounded to transversely oval in outline. Posterior part mostly higher than anterior one. Anterior margin rounded, or obviously roundly convex, posterodorsal angle less than 90°, posteroventral and ventral margin all broadly convex. Umbo fairly large, projecting, distinctly prosogyrate and incurved, situated at center of hinge margin. Concavity anterior to umbo distinct, posterior umbonal ridge prominent. Flank surface only covered with irregular concentric lines, ornament of about four radial ribs, very strong, intersecting with posterior umbonal ridge at ~45°, forming tubercles. In some specimens, turberculate ornamentation clear, but radial ribs poorly preserved. Hinge plate narrow, with developed hinge teeth, angle between hinge teeth and dorsal margin not large; 1'a triangular papilla with crenulations, 1a lamellar, 1b inverted-V shape, sometimes undeveloped, 2a (2), 3a (3), 4a (4), 6a (6), 5a (5), 2b (PII), 3b (PIII) and 4b(PIV) all lamellar and crenulated, 6a (6) and anterior side of 5a (5) uncrenulated. Anterior adductor scar deep, semicircular, without arborescent structure, associated with distinct minute pedal scar on posterodorsal area; posterior adductor scar shallow and indistinct.

Except for posterior inner margin, which is crenulated, all inner margins smooth.

Type locality.—Beimengou, Cangxi, Sichuan, southwestern China.

Type occurrence.—Hanyangpu Formation, Lower Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 58650 (holotype); 58648, 58652–58658.

Distribution of subgenus.—Lower Cretaceous; southwestern China (Ma, 1984, p. 609).

Taxonomic position.—Peregrinoconchidae (by original designation); Pseudohyriidae (by subsequent designation, Ma, 1989).

Subgenus PSEUDOHYRIA (LIOTRIGONIOIDES) Guo, 1986, p. 344

[in Chinese]

Figure 35.16–35.19

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Guo, 1986, p. 344): subtriangular and subtrapezoid in outline. Inflated and subequilateral. Shell relatively thick. Umbo situated anterior of middle point of hinge line, beak incurved and prosogyrate. Except for posteroventral area that sometimes has radial ribs, shell surface covered with distinct concentric growth lines; when shell layer with growth lines is removed, radial ribs are exposed. Inner margin crenulated. Three anterior teeth in left valve and two in right, two posterior teeth in left valve and one in right, no median denticle; dental formula: 5, 3, PIII/(6), 4, 2, PII, PIV (a5, a3, p3/(a6), a4, a2, p2, p4 in original text). All teeth subparallel to hinge margin. Laterals of teeth deeply crenulated. Anterior adductor scar deep and distinct, posterior adductor scar indistinct.

Type species.—Pseudohyria (Liotrigonioides) levis Guo, 1986, p. 344 [=*Pseudohyria* aff. *gobiensis* in Gu et al., 1976, p. 364, pl. 11*4*,*7*,*8–12* (holotype, original designation, Guo, 1986, p. 345), *13*]; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1986, p. 344): Subtriangular, subtrapezoid, and subrectangular in outline. Anterior margin subsemicircular, posterior margin truncated, ventral margin broadly arcuate, posteroventral corner obtusely rounded, posterodorsal corner indistinct, broad, and obtuse. Umbo obtuse, large, and rounded, situated just anterior of midpoint of dorsal margin, beak small, incurved, and prosogyrate. Posterior umbonal ridge widely rounded, and widened and flattened posteriorly. Shell surface covered with clear growth lines and wrinkles, posteroventral area sometimes with several radial ribs. Hinge teeth very well preserved. Hinge plate wide, providing three anterior teeth in left valve and two in right, one posterior tooth in both left and right valves. a5 (5) wide, strong, and relatively densely crenulated on posterior side, a3 (3) more slender than a5 (5), sparsely, and widely crenulated on anterior and posterior sides, a6 (6) low and thin, a4 (4) wide and strong, strongly and deeply crenulated on both anterior and posterior sides, a2 (2) fine, thin, low, and fairly short, sparsely and widely crenulated on anterior side. Posterior teeth relatively longer than anterior ones. Both anterior and posterior side of p3 (PIII), anterior side of p2 (PII), and posterior sides of p4 (PIV) finely crenulated. Anterior adductor scar fairly deep and distinct. Inner margin, particularly inner posteroventral margin, crenulated.

Type locality.—Baituwazi, Huaide, Jilin, northeastern China.

Type occurrence.—Upper part of Nenjiang Formation, Upper Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25575 (holotype); 25574, 25576.

Distribution of subgenus.—Upper Cretaceous; Asia (Guo, 1986, p. 344).

Taxonomic position.—Unionidae (by original designation).

Revision suggestion.—Gu and Yu (1999, p. 44) insisted on Gu's (in Gu et al., 1976) identification of *Pseudohyria* aff. *gobiensis* MacNeil; that is, the type species of the subgenus was still assigned to *Pseudohyria* by them, thus rejecting the subgenus name *Liotrigonioides*.

Genus SONGHUANAIA Gu in Gu et al., 1976, p. 365

[in Chinese]

Figure 38.1–38.6

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Gu in Gu et al., 1976, p. 365): shell thick and medium to large. Subtrapezoid to subsquare-rounded in outline. Fairly inflated. Umbonal region wide and projecting greatly, posterior umbonal ridge swelled. Except for wavy growth lines, flank area ornamented with radial ribs, fine on anterior area compared with wide ones on posterior area, siphonal area (posterodorsal area) sculptured with obliquely radial ribs. Pseudoheterodon and hinge plate wide. Number of pseudocardinals unknown because they are incompletely exposed. Robust pseudocardinal with irregular radial crenualtions gathering toward umbo visible in right valve, crenulations on anterior side of pseudocardinal(s) in left valve regularly spaced and parallel to each other. Posterior lamellar teeth narrow and long, two teeth in left valve, and probably one in right, relatively finely crenulated on lateral sides. Umbonal cavity deep, inner marginal crenulations gently wavy. Anterior adductor scar strong, associated with distinct pedal scar on posterodorsal and posteroventral area.

Type species.—Songhuanaia songhuaensis Gu in Gu et al., 1976, p. 365, pl. 114,*1–5*,*6* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Gu in Gu et al., 1976, p. 365): Medium. Subtrapezoid in outline. Inflated. Umbonal region wide and convex, umbo prominently prosogyrate, and posterior umbonal ridge swelled. Radial ribs relatively distinct, wide but rare on posteroventral area, ornament of five to six obliquely radial ribs on siphonal area (posterodorsal area). Concentric growth lines curved dorsally in radial groves but curved ventrally on radial ribs, forming wavy sculpture. Hinge teeth and muscle scars of inner structure same as those of genus.

Type locality.—Huaide, Jilin, northeastern China.

Type occurrence.—Nenjiang Formation, Upper Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25573 (holotype).

Distribution of genus.—?uppermost Lower Cretaceous, Upper Cretaceous; Asia (Gu in Gu et al., 1976, p. 365).

Taxonomic position.—Trigonioididae (by original designation).

Revision suggestion.—Gu (1998, p. 269) suggested that *Songhuanaia* is a junior synonym of *Plicatotrigonioides* Martinson. But Gu and Yu (1999, p. 54) provisionally retained this genus name. Sha and Fürsich (1993, p. 152) and Sha (2007, p. 66) assigned the genus to family Pseudohyriidae as a junior synonym of subgenus *Pseudohyria (Pseudohyria)* MacNeil, 1936.

Order LUCINOIDA Fleming, 1828
Superfamily LUCINOIDEA Fleming, 1828
Family LUCINIDAE Fleming, 1828
Genus PALAEOLUCINA
Chao, 1927, p. 20

[in English]

Type species.—Palaeolucina carbonaria Chao, 1927, p. 20, pl. 2,*2–9* (syntype) by original designation; by monotypy.

Type locality.—Lincheng coal field, Hebei, North China.

Type occurrence.—Houkou limestone, Taiyuan Formation, upper Carboniferous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology.

Distribution of genus.—upper Carboniferous; North China.

Taxonomic position.—Lucinidae (by original designation).

Note.—It is unnecessary to give the original diagnosis and figure of the holotype, because the genus was included in the *Treatise* by Cox et al. (1969, p. 512).

Family MACTROMYIDAE Cox, 1929
Genus EOLUCINA
Ding, 1982, p. 228

[in Chinese]

Figure 39.8–39.10

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Ding, 1982, p. 228): shell thick, medium to large, lucinoform; beak small and protruding, prosogyrate; lunule and escutcheon developed. Siphonal area with folding sulcus. External ligament, opisthodetic; hinge plate wide and thick, lucinoid formula: 3a, 3b, PI, PIII/(4a), 2, 4b, PII; 3a very strong, bifid, forwardly inclined; anterior adductor and pedal muscle scars ovate, with furrows.

Type species.—Eolucina sinensis Ding, 1982, p. 228, pl. 161,*1* (holotype), *2–7;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Ding, 1982, p. 228): Shell medium to large, lucinoform, equivalve, inequilateral; shell thick, posterior part thicker than anterior; rather inflated, flattened spheroid, slightly longer than high; posterodorsal margin obliquely truncate; greatest convexity at middle-upper part of shell; umbo subcentral, beak small and protruding, prosogyrate; lunule and escutcheon developed. Siphonal area with folding sulcus. External ligament opisthodetic, with nymph; hinge plate wide and thick, lucinoid formula: 3a, 3b, PI, PIII/(4a), 2, 4b, PII; 3a very strong, obliquely triangular, bifid, forwardly inclined; 4a lamellar, forwardly inclined, weak or absent; 2, 4b, and 3b weak, lamellar, backwardly inclined or acline; no anterior laterals; posterior laterals far behind nymph, PI strongest, PII second, PIII weakest. Anterior adductor scar oval, with furrows, ridge occurring under scar; pedal muscle scar ovate, with furrows, situated under 3a and behind scar; posterior adductor scar and pallial line unknown. Surface ornamented with concentric ridges and lines.

Type locality.—Shijiaoxia, Xinshao, Hunan, China.

Type occurrence.—Shetianqiao Formation, Frasnian, Upper Devonian.

Repository of type material.—Regional Geological Survey Team of Hunan Province, China; accession number: HBI 160 (holotype); HBI 161–166.

Distribution of genus.—Upper Devonian; Hunan, South China (Ding, 1982, p. 228).

Taxonomic position.—Mactromyidae (by original designation).

Order HIPPURITOIDA Newell, 1965
Superfamily MEGALODONTOIDEA Morris & Lycett, 1853
Family MEGALODONTIDAE Morris & Lycett, 1853
Genus QUEMOCUOMEGALODON
Yao, Sha, & Zhang in Yao et al., 2003, p. 395

[in Chinese with English description, p. 399]

Figure 39.1–39.7

Discussion and diagnosis.—Original diagnosis (Yao, Sha, & Zhang in Yao et al., 2003, p. 399): shell medium to very large, slightly inequivalve, longer than high, subtriangular to longitudinally ovate; strongly inflated; umbos situated at anterior or near center of hinge margin, beaks prosogyrate and curved; lunule cordate to semi-orbicular, but not well defined anteriorly; shell wall very thick; posterior umbonal [cardinal in original text] ridge from umbo to posterior-ventral corner on each valve; posterior area well developed; hinge plate very massive, two cardinal teeth in left valve, right valve usually 2 teeth, but occasionally 3, forming formula: 3a, 3b, (5b)/2, 4b, shape and size of teeth and position in hinge plate variable, but most originated far away from beak and hinge margin; cavity small and shallow; anterior adductor scar small and deep, rather close to dorsal margin, posterior adductor scar large, shallow, and situated at slightly raised platform; ligament external, opisthodetic, nymph heavy; surface smooth except for commarginal ribs and lines [*sic*].

Type species.—Quemocuomegalodon orientus Yao, Sha, & Zhang in Yao et al., 2003, p. 396, pl. 1,*1a–c* (syntype, holotype in original text), *2*; pl. 2,*1a–d* (syntype, holotype in original text); pl. 3,*1–2*;

pl. 5,*3*; pl. 6,*3* (syntypes, paratypes in original text); by original designation.

Original diagnosis of type species.—(Yao, Sha, & Zhang in Yao et al., 2003, p. 400): Shell large to very large. Transversally ovate, length always larger than height of shell; inequivalve, left valve slightly larger than right valve, inequilateral; umbo elevated, subcentral or slightly posterior; beak prosogyrous and curved; anterodorsal margin substraight, rounded anterior-ventral corner slightly extended anteriorly; ventral margin gently curved; rounded and prominent posterior umbonal (cardinal in original text) ridge runs from umbo to posterior-ventral corner, very shallow furrow parallel to ridge anteriorly; wide and shallow lunule cordate shaped, but boundary not well defined; hinge plate very massive, slightly narrowing posteriorly, height (Hph) reaching about one-half shell height; two cardinal teeth in left valve, center cardinal tooth 2 very strong, rounded triangular shaped, large (35 mm long and 35 mm wide in holotype QMB 43a), extended obliquely, occupying anteroventral part of hinge plate, strongly protruding (~15 mm above hinge commissure in QMB 43a). Subdivided into two parts by a oblique shallow groove; posterior cardinal tooth 4b is small and ridgelike, two cardinal teeth in right valve, crescent-shaped posterior cardinal tooth 3b markedly projecting above hinge commissure 10 mm in holotype (QMV43b); anterior cardinal tooth 3a cone-tub [conical] shaped. Anterior adductor scar small but deep and elongate oval, adjacent to anterior end of hinge plate; posterior adductor scar not observed. Ligament external, opisthodetic, nymph heavy [thick], as much as 5–7 mm in thickness. Shell wall very thick, as much as 25 mm in holotype (QMB 43a) to 35 mm in paratype (QMB 02) and thick at middle part of shell. Shell surface covered by concentric ribs and lines, very prominent near anterior and ventral parts [*sic*].

Type locality.—Quemocuo, Xizang (Tibet), China.

Type occurrence.—Upper Member, Jiapila Formation, Upper Triassic.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: QMB 43 (syntype); QMB 01, 02, 08, 43, 44, 48.

Distribution of genus.—Upper Triassic; Qinghai, northwestern China (Yao et al., 2003, p. 396).

Taxonomic position.—Megalodontidae (by original designation).

Note.—The double holotypes of the type species of this genus violate the Principle of Typification (ICZN, 1999), therefore, both so-called holotypes become syntypes.

Superfamily HIPPURITOIDEA Gray, 1848
Family REQUIENIIDAE Douvillé, 1914
Genus RUTONIA
Yang, Nie, & Wu in Yang et al., 1982, p. 297

[in Chinese with English diagnosis, p. 300]

Figure 39.14–39.19

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Yang, Nie, & Wu in Yang et al., 1982, p. 297): shell large, thick, inequivalve, attached by left valve (attached valve, or AV), coiled irregularly in spiral of several whorls. Right valve (free valve, or FV) operculiform, spiral a circle. FV with two teeth and [one] socket between them, anterior tooth smaller, only one-half as long as posterior. Teeth of AV not preserved. FV with anterior muscle scar at outside of anterior tooth, and posterior one on posterior hinge plate behind posterior tooth. FV widely concave ventrally, coelome small and shallow.

Type species.—*Rutonia bangonghuensis* Yang, Nie, & Wu in Yang et al., 1982, p. 297, pl. 2,*2–3*,*6a–b*,*7a–b* (syntype); by original designation.

Original diagnosis of type species.—(Yang, Nie, & Wu in Yang et al., 1982, p. 300): Shell large, inequivalve; left valve (AV) twisted spirally for several whorls; right valve (FV) wound around once and operculate. Two left valve teeth, strong and subparallel; anterior one only one-half as long as posterior, both separated by socket; ventral margin widely concave [*sic*].

Type locality.—North of Nigari, Xizang (Tibet), China.

Type occurrence.—Jiagang Group, Cenomanian, Upper Cretaceous.

Repository of type material.—China University of Geosciences, Beijing; accession numbers of syntype: 80A003, 80A051, 80A058, 80A060.

Distribution of genus.—Cenomanian, Upper Cretaceous; Nigari, Xizang (Tibet), China.

Taxonomic position.—Requieniidae (by original designation).

Revision suggestion.—The type material is too poor to serve as a foundation for *Rutonia*, which is not distinguished from *Requienia* Matheron by form and position of the posterior adductor muscle nor by relative size of teeth. *Rutonia* is herein regarded as a junior synonym of *Requienia* Matheron.

Order VENEROIDA
H. Adams & A. Adams, 1856
Superfamily CRASSATELLOIDEA
Férussac, 1822
Family ASTARTIDAE d'Orbigny, 1844
Genus ASTARTOIDES
Wen & Lan in Gu et al., 1976, p. 86

[in Chinese]

Figure 39.20–39.22

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Wen & Lan in Gu et al., 1976, p. 86): shell thick. Very small or small. Oval or somewhat longer. Moderately inflated. Surface covered by concentric growth lines. Hinge plate wide. Left valve with large median tooth, posterior cardinal tooth, and two posterior lateral teeth; right valve with anterior and two posterior cardinal teeth (posterior one not well developed), also with one posterior lateral tooth; without anterior laterals on both valves. Umbonal cavity shallow, with fine and deep hole, nearly piercing through shell wall, showing spinose tubercle on internal molds. Adductor scars strong. Pallial sinus absent.

Diagnosis of genus.—(Wen, 2000, p. 14): Shell small, circular or subcircular, equivalve, subequilateral, weakly or moderately convex; umbo prosocline and slightly front [umbo situated to anterior of center of dorsal margin], beak prosogyrate; lunule distinct; surface

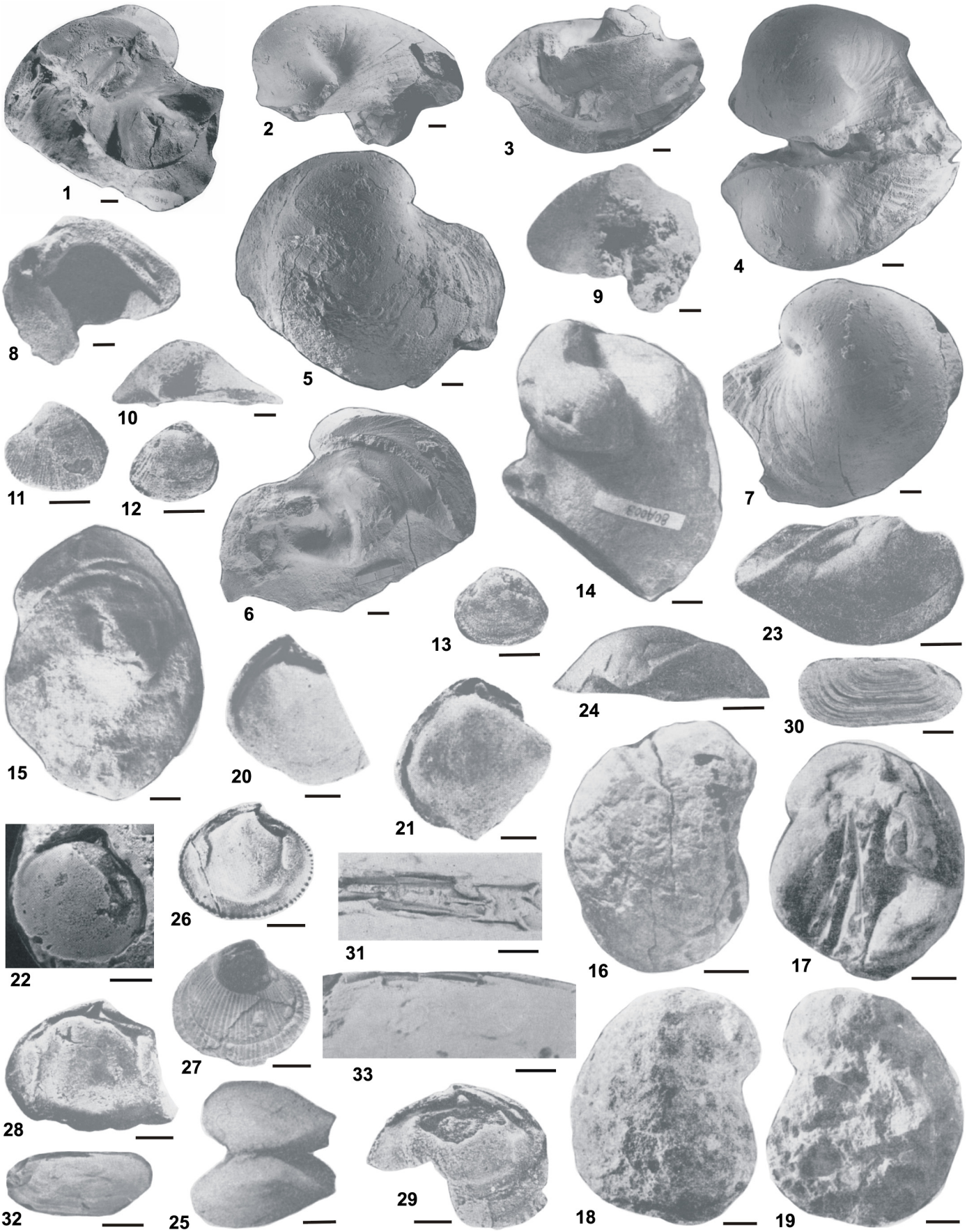

Figure 39. *For explanation, see facing page.*

ornamented with irregular concentric lines and ridges. Hinge with 2 cardinals (one broad, other thin) on each valve, broad one being in front in left valve and posterior in right valve, median cardinal on left valve; laterals developing differently, at least one posterior lateral on each valve, one anterior lateral usually on left valve. Posterior adductor scar larger than anterior one, all vertical ovate; pallial sinus not seen; umbonal cavity very shallow, with result that cast of hinge on internal molds can be exposed [shown] at all; very deep, small cave, i.e., scar of pedal elevator muscle placed at top of umbonal cavity and represented by thornlike umbonal protuberance on internal molds; inner margin smooth. Deep scar of pedal elevator is a stable and common characteristic [a constant character] for *Astartoides*, but unique for Astartidae. This genus should be still assigned to Astartidae according to shape, umbo, ornament, and basic dental formula. Distinguished from *Astarte* by less distinct cardinals, very shallow umbonal cavity, very deep scar of pedal elevator muscle, and absence of inner marginal denticulations [*sic*].

Type species.—*Astartoides gamgbaensis* Wen & Lan in Gu et al., 1976, p. 87, pl. 44,*11*,*12* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Wen & Lan in Gu et al., 1976, p. 87): Shell oval in outline, umbo situated anteriorly. Hinge formula same as for genus, anterior adductor scar very strong.

Description of type species.—(Wen, 2000, p. 14): Shell small (9.5 mm long, 9 mm high), subcircular, anteroventral margin rounded, slightly protruded; umbo pointed, prosocline, prominent over hinge line; lunule deep. Other characteristics as in genus [*sic*].

Type locality.—Jilu, Gamgba, Xizang (Tibet), China.

Type occurrence.—Upper Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 24968 (holotype); 24967 (paratype); 110702 (plesiotype).

Distribution of genus.—Upper Jurassic; southern Xizang (Tibet), China (Wen & Lan in Gu et al., 1976, p. 87).

Taxonomic position.—Astartidae (by original designation).

Genus RADIASTARTE
Chen & Liu in Liu, 1968, p. 99

[in Chinese]

Figure 39.26–39.29

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Chen & Liu in Gu et al., 1976, p. 86): shell medium size, rounded triangular. Moderately inflated. Umbo situated slightly anterior of center of hinge margin, beak prosogyrate. Surface covered with regular radial ribs. Right valve with strong triangular cardinal teeth under umbo and posterior cardinal tooth, narrow, long, arched, and slightly bifid due to slightly concave center, sometimes with weak anterior cardinal tooth; two short anterior laterals and one posterior lateral. Left valve with two cardinals, one lateral tooth on either side. Adductor scars subequal, strong, longitudinally ovate; small pedal muscle scar above posterior one. Pallial line simple, inner marginal crenulations rather strong.

Type species.—*Radiastarte yizhangensis* Chen & Liu in Liu (anonymous in original publication), 1968, p. 99, pl. 45,*7*,*8* (lectotype, subsequent designated by Chen & Liu in Gu et al., 1976) *9–10*; pl. 46,*1;* by original designation; see also: *Radiastarte yizhangensis* Chen & Liu in Gu et al., 1976, p. 86, pl. 44,*26*,*27* (lectotype), *28–31*; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Chen & Liu in Gu et al., 1976, p. 86): Same as for *Radiastarte* [*sic*].

Type locality.—Yangmeishan, Yizhang, Hunan, China.

Type occurrence.—Yangmeishan Formation, Carnian, Upper Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 24979 (holotype); 24978, 24980–24983.

Figure 39. *1–7.* Holotypes of *Quemocuomegalodon orientus* Yao, Sha, & Zhang, scale bar 10 mm; *1–3,* first holotype (left valve, QMB 44 = QMB 43a in original text), original designation by Yao, Sha, and Zhang in Yao et al., 2003; *1,* interior view; *2,* top view; *3,* ventral view (adapted from Yao et al., 2003, pl. 1,*1a–c*); *4–7,* second holotype (articulated shell, QMB 43/44 = QMB 43b in original text), original designation by Yao, Sha, & Zhang in Yao et al., 2003; *4,* top view; *5,* right lateral view; *6,* left interior view; *7,* left lateral view (adapted from Yao, Sha, & Zhang in Yao et al., 2003, pl. 2,*1a–d*).——*8–10.* Holotype of *Eolucina sinensis* Ding, scale bar 5 mm; *8,* right interior view; *9,* right exterior view; *10,* dorsal view (adapted from Ding, 1982, pl. 161,*1a–c*).——*11–13. Cardium (Tulongocardium) pluriradiatum* Chen, J. Chen, & Zhang, scale bar 5 mm; *11,* holotype, left valve; *12,* paratype, right valve; *13,* paratype, left valve (adapted from Chen, J. Chen, & Zhang in Wen et al., 1976, pl. 4,*7,6,8*).——*14–19.* Syntype of *Rutonia bangonghuensis* Yang, Nie, & Wu, scale bar 10 mm; *14,* left valve; *15,* right valve; *16–17,* right valve; *16,* exterior view; *17,* interior view; *18–19,* right valve; *18,* exterior view; *19,* interior view (adapted from Yang, Nie, & Wu in Yang et al., 1982, pl. 2,*2–3,6a–b,7a–b*).——*20–22. Astartoides gamgbaensis* Wen & Lan, scale bar 5 mm; *20,* holotype, right internal mold; *21,* paratype, right internal mold (adapted from Wen & Lan in Gu et al., 1976, pl. 44,*12,11*); *22,* plesiotype, right internal mold (adapted from Wen, 2000, pl. 5,*11*).——*23–25. Protocardia (Grypocardia) gryphaeata* Guo; *23,* holotype, right valve, scale bar 5 mm; *24,* dorsal view of Fig. 39.23, scale bar 5 mm; *25,* paratype, conjoined valves, scale bar 2 mm (adapted from Guo, 1988, pl. 5,*12a–b,15*).——*26–29. Radiastarte yizhangensis* Chen & Liu, scale bar 5 mm; *26,* lectotype, right internal mold; *27,* paralectotype, left external mold; *28,* paralectotype, right internal mold; *29,* paralectotype, left internal mold (adapted from Liu [anonymous in original publication], 1968, pl. 45,*8,7,9–10;* =Gu et al., 1976, pl. 44,*27,30,29,31*).——*30–33. Planariomya hunanensis* J. Chen & Xu, scale bar 10 mm; *30,* holotype, right valve; *31,* enlarged umbonal area of Fig. 39.30 showing so-called internal lamellar plate; *32,* paratype, left internal mold; *33,* enlarged umbonal area of Fig. 39.32 showing internal lamellar plate (adapted from J. Chen & Xu, 1980, pl. 4,*15,12,13b,13a*).

Distribution of genus.—Upper Triassic; South China (Chen & Liu in Gu et al., 1976, p. 86).

Taxonomic position.—Astartidae (by original designation).

Note.—The name *Radiastarte* first appeared in Liu [anonymous in original publication], 1968, in *Fossil Manual of Mesozoic Coal-bearing Strata in Hunan and Jiangxi Provinces,* which was published during the notorius Cultural Revolution in China, when scientists were prohibited from publishing papers or books with their names listed as authors. Now it is time to restore the historic truth.

Superfamily CARDIOIDEA Lamarck, 1809
Family CARDIIDAE Lamarck, 1809
Genus CARDIUM Linné, 1758
Subgenus CARDIUM (TULONGOCARDIUM) Chen, J. Chen, & Zhang in Wen et al., 1976, p. 31

[in Chinese]

Figure 39.11–39.13

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Chen, J. Chen, & Zhang in Wen et al., 1976, p. 31): shell small, oval to rounded triangular in outline. Strongly inflated. Slightly longer than high or height and length subequal. Beak slightly prosogyrate. Posterior umbonal carina mostly strong, with triangular siphonal area. Surface covered by numerous rounded radial costae with differing strengths on different parts of shell, without spinose tubercles; costae of siphonal area mostly stronger than those of flank, especially when with strong posterior umbonal carina. Anterior adductor scar small, located at anterodorsal part of shell; posterior one weak, pallial sinus absent.

Type species.—Cardium (Tulongocardium) pluriradiatum Chen, J. Chen, & Zhang in Wen et al., 1976, p. 32, pl. 4,*6,7* (holotype), *8*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Chen, J. Chen, & Zhang in Wen et al., 1976, p. 32): Shell small, rounded triangular in outline. Strongly inflated. Slightly longer than high. Umbo broad, prominent over hinge margin, beak slightly prosogyrate, situated slightly anterior of center on hinge margin. Posterior umbonal carina strong, with concave triangular siphonal area, forming right angle with flank at dorsal part, but angle of 110º–120º at ventral part. Surface covered by rounded costae without spinose tubercles, with rounded interspaces; flank with 40–50 fine and dense costae, becoming stronger and thicker on siphonal area. Concentric growth lines very weak, only faintly visible toward ventral margin.

Type locality.—Tulong, Nielamu, Xizang (Tibet), China.

Type occurrence.—Derirong Formation, Norian, Upper Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 30604 (holotype); 30603, 30605.

Distribution of subgenus.—Upper Triassic; Asia and Europe (Chen, J. Chen, & Zhang in Wen et al., 1976, p. 32).

Taxonomic position.—Cardiidae (by original designation).

Note.—Schneider (1995) listed this subgenus as an independent genus and placed it in his new subfamily Tulongocardiinae. *Vietnamicardium* Vu-Khuc is a junior synonym of *Tulongocardium* Chen, J. Chen, & Zhang (Schneider, 1995).

Genus PROTOCARDIA Beyrich, 1845
Subgenus PROTOCARDIA (GRYPOCARDIA) Guo, 1988, p. 128

[in Chinese]

Figure 39.23–39.25

Discussion and diagnosis.—Original diagnosis of subgenus (translation from Chinese text, Guo, 1988, p. 128): shell small, elongate elliptical, or transversely oval, moderately inflated; anterior margin rounded, ventral margin arcuate, posterior margin obliquely truncated; posteroventral angle distinct, less than 90º, posterodorsal broad and obtuse. Umbo broad and obtuse, beak incurved, rising above hinge margin, situated about two-fifths shell length back from anterior end. Posterior umbonal carina developed, keel-like, steep, and sharp, extending from umbo to posteroventral angle, bounded anteriorly by wide and shallow trough, with corresponding ventral sinus at ventral margin. Flank of shell smooth, with only growth lines; corselet covered by radial ribs; posterior margin with crenulation.

Type species.—Protocardia (Grypocardia) gryphaeata Guo, 1988, p. 128, pl. 5,*12* (holotype), *13–15;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1988, p. 128): Shell elongate oval, length ranging from 1.5 to 2 times height. Anterior margin semicircular, ventral margin arcuate, posterior margin obliquely truncated; posterodorsal angle broad and obtuse, ranging from 120º to 140º; posteroventral angle distinct, less than 90º. Umbo broad, obtuse, and flat, beak incurved, hooklike, situated about two-fifths shell length back from anterior end. Posterior umbonal carina developed, keel-like, narrow, steep, and sharp, extending from umbo to posteroventral angle. Flank of shell smooth, with only growth lines; corselet covered by about 9 radial ribs, thick and rounded; posterior margin with crenulation.

Type locality.—Yueliangping, Jianchuan, Yunnan, southwestern China.

Type occurrence.—Maichuqing Formation, upper Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0695 (holotype); IVy0696–0698.

Distribution of subgenus.—upper Upper Triassic; Yunnan, southwestern China (Guo, 1988, p. 128).

Taxonomic position.—Cardiidae (by original designation).

Superfamily HIATELLOIDEA Gray, 1824
Family HIATELLIDAE Gray, 1824
Genus PLANARIOMYA J. Chen & Xu, 1980, p. 364

[in Chinese with English description, p. 366]

Figure 39.30–39.33, 40, 41.6

Discussion and diagnosis.—Original diagnosis (J. Chen & Xu, 1980, p. 366): Shell small to medium, equivalve, inequilateral. Test thin, moderately inflated. Umbo small, turned forward, located

at one-fourth of anterior shell. Surface ornamented with concentric folds. Hinge edentulous with thickened dorsal margin. One internal lamellar plate on each side of umbonal cavity, parallel to dorsal margin. Pallial line simple [*sic*].

Type species.—Planariomya hunanensis J. Chen & Xu, 1980, p. 364, pl. 4,*12–14*,*15* (holotype), *16–17;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, J. Chen & Xu, 1980, p. 364): Description as in *Planariomya*.

Type locality.—Wangjiating, Lingling, Hunan, China.

Type occurrence.—Dabakou Member, Gaojiatian Formation, Lower Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 47697 (holotype); 47692, 47693, 47695, 47696, 47698.

Distribution of genus.—Lower Jurassic; South China (J. Chen & Xu, 1980, p. 364).

Taxonomic position.—Laternulidae (by original designation).

Revision suggestion.—So-called internal lamellar plates may be hinge teeth, in view of the fact that they are protuberances parallel to dorsal margin.Thus, "hinge edentulous" is not a correct description. It may be better to place *Planariomya* in Hiatellidae.

Superfamily ARCTICOIDEA Newton, 1891
Family ARCTICIDAE Newton, 1891
[=Cyprinidae d'Orgbigny, 1844]
Genus ANISOCARDIOIDES
Gu in Gu, Chen, & Sha, 1984, p. 163

[in Chinese with English description, p. 199]

Figure 41.12–41.13, 42

Discussion and diagnosis.—Original diagnosis (Gu in Gu, Chen, & Sha, 1984, p. 199): small, subtrigonal or ovate to elliptic, with posterior ridge. Lunule present. Hinge formula: AIII, AI, 3a, 1, 3b, PI/AII, 2a, 2b, 4b, PII; 3b and 2b often bifid or medially and ventrally depressed, 1 and 3a slender and connected with AI and AIII, AIII shorter and thinner than AI, 2a also connected with AII but more differentiated, 4b somewhat lamellar and occasionally bifid, PII gradually merged to valve margin. Pallial line slightly truncated posteriorly. Surface with concentric ornament. External form, split of 2b and 3b, and having only one posterior lateral in each valve affiliate the new genus with *Anisocardia*. However, genus distinguished by angular arrangement of 3a with 1 and their connected anterior laterals AI and AIII. *Hartwellia* differs from the new genus in peculiar tuberosity between 3a and 3b and rugose callosities on nymph. *Eriphlopsis*, Veneridae, has similar cardinals and laterals but posterior cardinal is different [*sic*].

Type species.—Anisocardioides hulinensis Gu in Gu, Chen, & Sha, 1984, p. 164, pl. 35,*10* (holotype), *11–21*; pl. 36,*2–4*; text-fig. 2; by original designation.

Original diagnosis of type species.—(Gu in Gu, Li, & Yu, 1997, p. 192): Rather small, length of largest specimen measuring 14 mm. Equivalve and inequilateral. Inflation moderate to slightly strong. Inflation of holotype measures ~3.0 mm and ratio of inflation over length ~0.50 longer than high. Shell outline rounded trigonal.

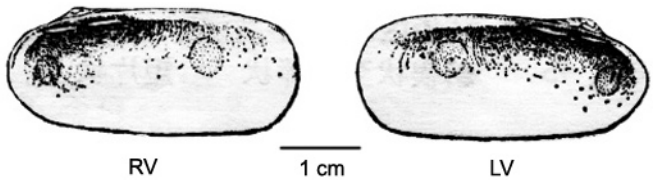

Figure 40. Diagrammatic drawing of hinge of *Planariomya hunanensis* J. Chen & Xu (adapted from J. Chen & Xu, 1980, p. 364, text-fig. 2).

Umbos incurved and prosogyrous. Post-umbonal ridge more or less prominent. Lunule depressed, escutcheon unknown. Surface ornament consists of concentric lines and irregularly spaced ridges. Cyprinoid hinge teeth represented by hinge formula: AIII, AI, 3a, 1, 3b, PI/AII, 2a, 2b, 4b, PII. As seen from right internal molds, 1 scarcely slender, slightly opisthocline, connected with AI at lower end; 3a more slender and opisthocline, connected with AIII; 3b large and evidently prosocline and bifid or depressed mesially; AI and AIII long and straight, somewhat converging anteriorly, AI stronger; PI also long and straight, of nearly the same strength as AI or even faintly stronger, originating behind narrow nymph. In left valve, 2a slightly thicker than 3a, opisthocline, connected with AII at lower end; 2b feebly prosocline but much larger and trigonal than 2a, depressed mesially to produced forked appearance (paratype of catalog No. 81911 with 2b much thinner, most probably result of deformation); 4b much more prosocline and more slender but much longer than 2a and 2b; PII straight, with nearly same length or faintly longer than anterior laterals. Anterior adductor scar nearly semiorbicular, posterior adductor scar very indistinctly outlined. Pallial line entire, slightly truncated posteriorly [*sic*].

Type locality.—Qihulin, Hulin, Heilongjiang, northeastern China.

Type occurrence.—Qihulin Formation, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 81906 (holotype); 81907–81920.

Distribution of genus.—Middle Jurassic; northeastern China (Gu in Gu, Chen, & Sha, 1984, p. 164).

Taxonomic position.—Arcticidae (by original designation).

Genus AMIODON
Ma in Ma et al., 1976, p. 274

[in Chinese]

Figure 41.14–41.18

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Ma in Ma et al., 1976, p. 274): shell medium. Transversely oval, subcordiform, or transversely quadrate in outline. Lunule and escutcheon indistinct. Posterior umbonal carina obtusely rounded or fairly prominent. Surface covered by growth lines only. Hinge formula: AIII, AI, 3a, 3b, 5b, PI, PIII/AII, 2b, 4b, PII, cardinal teeth 3a, 3b, and 5b radially arranged, 3a smaller and shorter, 3b slightly larger, 5b larger and longer; 2b and 4b arranged in herringbone pattern or chevronlike, 2b obliquely triangular, 4b subparallel to posterior dorsal margin. Lateral teeth

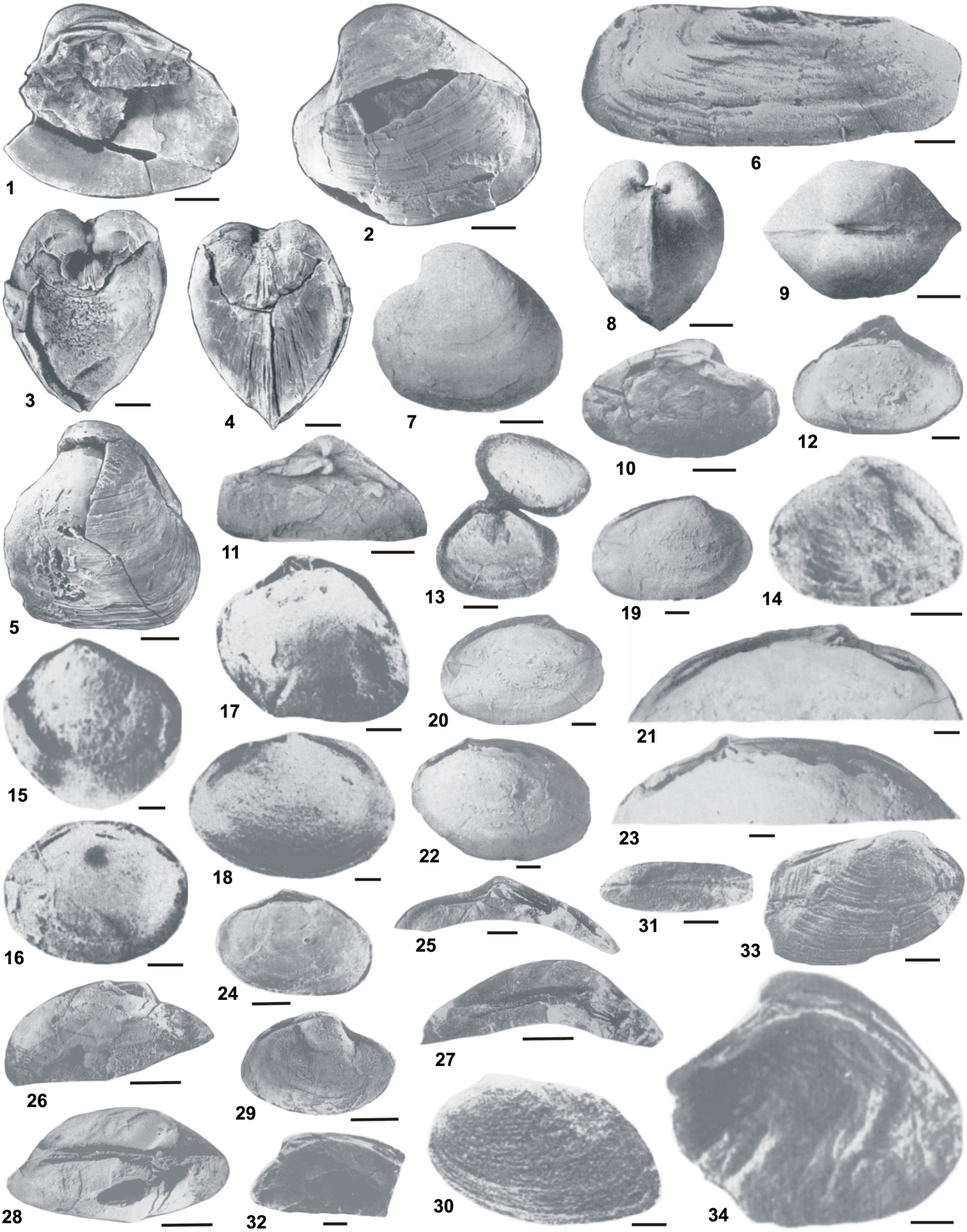

Figure 41. *For explanation, see facing page.*

lamellar, without transverse grooves. Dimyalian, anterior one larger and deeper than posterior one. Pallial line lacking sinus. Interior valve margins smooth. Lived in brackish water or littoral zone.

Type species.—*Astarte fengdengensis* Chen in Gu et al., 1976, p. 81, pl. 44,*22*,*23* (holotype) [*emend*. Ma in Ma et al., 1976, p. 274; by original designation].

Original diagnosis of type species.—(Translation from Chinese text, Chen in Gu et al., 1976, p. 81): Shell subcordiform in outline. Moderately inflated. Umbo small, incurved forward. Surface covered by growth lines, fine and dense at half of shell height, with ten stronger concentric ridges near ventral margin.

Original diagnosis of type species.—(Translation from Chinese text, Ma in Ma et al., 1976, p. 274): Shell not large. Subcordiform to oval in outline. Moderately inflated. Posterior higher than anterior. Posterior and ventral margins rounded, anterior margin narrowly rounded, dorsal margin arched, posterodorsal margin sometimes slightly truncated. Umbo small, incurved forward, situated near center. Posterior umbonal carina obtusely rounded. Surface covered by fine and closely spaced growth lines, not very regular. Concavity before umbo generally evident. Right valve with three cardinals (pl. 24,*26*), two in left valve (pl. 24,*25*); left valve with one anterior and one posterior lateral tooth (pl. 24,*24*,*29*), right valve with two laterals on each side respectively (pl. 24,*25*,*31–32*). Anterior adductor scar large and deep, posterior one small and shallow. Interior valve margins smooth.

Type locality.—Fengdeng, Yunlong, Yunnan, southwestern China.

Type occurrence.—Middle Member, Yongping Group, Middle Jurassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 24975 (holotype); 24974 (paratype); plesiotype: 26288–26298.

Distribution of genus.—Middle Jurassic; Asia (Ma in Ma et al., 1976, p. 274).

Taxonomic position.—Cyprinidae (=Arcticidae) (by original designation).

Genus DIANINA Guo, 1985a, p. 216

[in Chinese with English description, p. 270]

Figure 41.19–41.23

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1985a, p. 216): shell small, subcircular, elliptical or suboval; equivalve, inequilateral; moderately inflated; beak slightly incurved, prosogyrate, positioned at midlength nearly so; posterior carina generally undeveloped; surface with growth lines. Hinge with two submedian teeth in each valve; lateral teeth located distantly from submedian teeth, one in anterior and one in posterior in left valve, and two in anterior and two in posterior in right valve, forming dental formula: AIII, AI, 3a, 3b, PI, PIII/AII, 2, 4b, PII; all teeth smooth, without striations.

Type species.—*Dianina yunnanensis* Guo, 1985a, p. 217, pl. 42,*3a–c* (holotype), *4–5*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1985a, p. 217): Shell elongate-oval, with height as long as about two-thirds length; anterior margin rounded; ventral margin widely arched; posterodorsal margin and posterior margin nearly arched; posteroventral angle not prominent, subrounded, slightly wider than right angle; umbo subrounded; beak incurved, weakly prosogyrate, slightly projecting above hinge line, positioned at one-third shell length from anterior; posterior carina not prominent; surface with growth lines. Hinge with two submedian teeth in each valve; tooth 3a fine and weak, opisthocline; 3b strong and stout, subtriangular shaped, prosocline; 2 strong, but weaker than 3b, oblique-triangular in form; 4b thin and weak, prosocline; two lateral teeth in anterior and two in posterior in right valve, and one in anterior and one in posterior in left valve; all lateral teeth lamellar, relatively short, smooth, without lateral striations, and distant from beak.

Figure 41. *1–5. Aquilonia bashibulakeensis* Lan & Wei, scale bar 10 mm; *1,* holotype, interior view of right valve; *2,* paratype, left valve (adapted from Lan & Wei, 1995, pl. 21,*19,3*); *3–5,* paratype, articulated shell; *3,* anterior view; *4,* posterior view; *5,* lateral view (adapted from Lan & Wei, 1995, pl. 22,*22,24,25*).——*6. Planariomya hunanensis* J. Chen & Xu, scale bar 10 mm; paratype, right composite mold (adapted from J. Chen & Xu, 1980, pl. 4,*16*).——*7–11. Isocardioides yini* Fan, scale bar 10 mm; *7,* holotype, left lateral view of articulated shell; *8,* anterior view of Fig. 41.7; *9,* dorsal view of Fig. 41.7 (adapted from Fan, 1963, pl. 2,*19–21*); *10,* paratype, left interior view; *11,* paratype, right interior view (adapted from Fan, 1963, pl. 4,*8–9*).——*12–13. Anisocardioides hulinensis* Gu, scale bar 2 mm; *12,* holotype, right internal mold; *13,* paratype, internal mold of conjoined valves (adapted from Gu, Chen, & Sha, 1984, pl. 35,*10,15*).——*14–18. Amiodon fengdengensis* (Chen); *14,* holotype, left valve, scale bar 5 mm; *15,* paratype, left internal mold, scale bar 1 mm (adapted from Chen in Gu et al., 1976, pl. 44,23,22); *16,* plesiotype, right internal mold, scale bar 2 mm; *17,* plesiotype, left internal mold, scale bar 2 mm; *18,* plesiotype, left composite mold, scale bar 1 mm (adapted from Ma in Ma et al., 1976, pl. 24,25–26,29).——*19–23. Dianina yunnanensis* Guo; *19,* holotype, right internal mold, scale bar 2 mm; *20,* umbo removed from specimen of Fig. 41.19, showing hinge, scale bar 2 mm; *21,* enlarged hinge of Fig. 41.20, scale bar 1 mm; *22,* paratype, left internal mold, scale bar 2 mm; *23,* enlarged hinge of Fig. 41.22, scale bar 1 mm (adapted from Guo, 1985a, pl. 42,*3a–c; 5a–b*).——*24–29. Yunshania yunshanensis* (Li & Yu); *24,* holotype, left internal mold, scale bar 5 mm (adapted from Li & Yu, 1982, pl. 13,*11*); *25,* enlarged hinge of Fig. 41.24, scale bar 1 mm; *26–28,* paratype, articulated shell; *26,* right lateral view; *27,* hinge view; *28,* dorsal view; *29,* paratype, right internal mold, scale bar 5 mm (adapted from X. Yu in Gu, Li, & Yu, 1997, pl. 28,*5,2–4,7*).——*30–33. Gansuella xinminpuensis* Ma, scale bar 2 mm; *30–31,* holotype, left valve; *30,* left lateral view; *31,* dorsal view; *32,* paratype, right interior view; *33,* paratype, right composite mold (adapted from Ma, 1986, pl. 2,*15a–b,22,30*).——*34. Neomiodonoides subrotundus* Ma, scale bar 2 mm; paratype, right interior view (adapted from Ma, 1986, pl. 3,*13*).

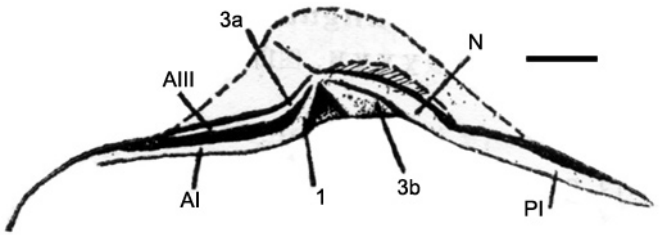

Figure 42. Diagrammatic drawing of hinge of *Anisocardioides hulinensis* Gu, scale bar on left equal to actual length of shell (adapted from Gu in Gu, Chen, & Sha, 1984, p. 165, text-fig. 2).

Type locality.—Mishaluoluodi, Jianchuan, Yunnan, southwestern China.

Type occurrence.—Huakaizuo Formation, Middle Jurassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0499 (holotype); IVy0500–0501.

Distribution of genus.—Middle Jurassic; Southeast Asia (Guo, 1985a, p. 217).

Taxonomic position.—Neomiodontidae (by original designation).

Revision suggestion.—*Dianina* probably is synonymous with *Amiodon* Ma (in Ma et al., 1976) based on their having the same dentition. Specimens referred to the two taxa were usually found together in the nonmarine Jurassic of western Yunnan, southwestern China.

Genus AQUILONIA Lan & Wei, 1995, p. 140

[in Chinese with English description, p. 189]

Figure 41.1–41.5, 43

Discussion and diagnosis.—Original diagnosis (Lan & Wei, 1995, p. 189): shell solid, inflated, square-rounded in outline, surface smooth with concentric lines, lunule generally distinct and escutcheon poorly developed. Corbiculoid dentition: AIII, AI, (3a), 1, (3b), PI, PIII/AII, (2a), (2b), (4b), PII, (PIV); 3a poorly separated from shell margin; AIII not completely separated from 3a; end of 3b slightly bifurcated; PII rather strong, elongate; PIV poorly separated from shell margin; 2a not well developed, lamellar, and generally connecting AII, 1 strong, AI and AIII strong and protuberant, external ligament on nymph [*sic*].

Type species.—*Aquilonia bashibulakeensis* Lan & Wei, 1995, p. 141, pl. 21,*1–3*,*8*,*13*,*16–18*,*19* (holotype); pl. 22,*6*,*7*,*16*,*22–25*; text-fig. 31a by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Lan & Wei, 1995, p. 141): Shell medium to large, equivalve, inequilateral. Quadrate triangular in outline, rather inflated, greatest convexity at middle part of shell. Umbo rather prominent over hinge margin, beak strongly incurved and prosogyrate, two umbos drawing very near. Lunule cordiform, sometimes well defined. Escutcheon wide, not well defined. Anterodorsal margin concave, anterior margin rounded, ventral margin gently arcuate, posterior margin truncated, posterodorsal margin arched. Surface covered by irregular concentric lines. Posterior umbonal carina low and wide, with well-defined siphonal area. External ligament with nymph. Adductor scars subequal, anterior oval, posterior orbicular. Pallial line entire, far from valve margin, interior valve margins smooth. Hinge formula: AI, AIII, (3a), 1, (3b), PI, PIII/AII, (2a), (2b), (4b), PII, PIV. Among them, 1, 2a, PI, and AII stronger; 3b slightly bifid; 3a not well separated from AI; 2a lamellar, very weak, not completely separated from AII; 3a fused with anterodorsal margin. Length approximately 71 mm; height 62–64 mm; convexity (single valve) 25 mm.

Type locality.—Bashibulake, Wuqia, Xinjiang, northwestern China.

Type occurrence.—Kukebai Formation, lower Turonian, Upper Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 117466 (holotype); 117465, 117467, 117468, 117480–117482.

Distribution of genus.—Turonian, Upper Cretaceous; southern Xinjiang, northwestern China (Lan & Wei, 1995, p. 141).

Taxonomic position.—Arcticidae (by original designation).

Genus YUNSHANIA X. Yu in Gu, Li, & Yu, 1997, p. 197

[in English]

Figure 41.24–41.29

Discussion and diagnosis.—Original diagnosis (X. Yu in Gu, Li, & Yu, 1997, p. 197): Shell medium sized. Subovate to subelliptical, moderately inflated. Post-umbonal ridge undeveloped. Lunule deeply depressed, escutcheon shallow and narrowly elongate. Adductor scars not distinctly impressed. Surface ornamented with concentric lines. Hinge teeth advanced cyrinoid or early cyrinoid with the hinge formula: AIII, AI, 3a, 1, 3b, PI/AII, 2a, 2b, 4b, PII. 1 submesial and subroundedly cone shaped; 2a, 2b, 3a, and 4b lamellar, 2a connected with AII; 3a distinctly bifid; 3b large, trigonal, markedly prosocline and bifid; anterior laterals (AI, AII, AIII) in ridged form and mutually parallel but connected with cardinals 1, 2a, and 3a respectively; one posterior lateral in each valve [*sic*].

Type species.—*Hartwellia (Hartwellia) yunshanensis* Li & X. Yu, 1982, p. 139, pl. 13,*8–10*,*11* (holotype), *12*; by original designation, X. Yu in Gu, Li, & Yu, 1997, p. 197.

Original description of type species.—(X. Yu in Gu, Li, & Yu, 1997, p. 198): Medium, length of largest specimen 22 mm. Inflation slightly large, inflation of faintly deformed internal molds of two valves (cat. No. BH0661) being about 11 mm and ratio of inflation over length 0.53. Shell outline subovate to subelliptic. Both sides narrowly rounded, posterior side slightly more cuneate, ventral margin very slightly curved to nearly straight, posterodorsal margin also very slightly curved, anterodorsal margin slightly concave. Post-umbonal ridge undeveloped. Umbos low, rounded, incurved, slightly prosogyrous, and situated scarcely anterior to middle of shell. Lunule rather deep and ovate; escutcheon shallow and narrowly elongate. Surface ornamented with irregularly concentric lines. Advanced cyprinoid to early cyrenoid hinge teeth with hinge formula: AIII, AI, 3a, 1, 3b, PI/AII, 2a, 2b, 4b, PII. 1 barely large, trigonally cone shaped, anterior end connected with AI; 2a and 2b lamellar, joined with each other at apices to form reversed-V pattern; lower end of 2a connected with AII; 3a distinctly bifid, anterior end connected with AIII; 3b fairly large, trigonal, prosocline, and distinctly bifid; 4b long, lamellar, and

slightly curved; anterior laterals (AI, AII, AIII) in ridge form and mutually parallel; posterior laterals (PI, PII) in ridged form also and situated behind nymph [*sic*].

Type locality.—South hill, Yonghong coal mine, Hulin, Heilongjiang, northeastern China.

Type occurrence.—Yunshan Formation, upper Lower Cretaceous.

Repository of type material.—Shenyang Institute of Geology and Mineral Resources, Shenyang, Liaoning, northeastern China; accession number: BH0660 (holotype); BH0656, 0661–0663.

Distribution of genus.—upper Lower Cretaceous; Wanda Hills, Heilongjiang, northeastern China (X. Yu in Gu, Li, & Yu, 1997, p. 198).

Taxonomic position.—Arcticidae (by original designation).

Family NEOMIODONTIDAE Casey, 1955
Genus GANSUELLA Ma, 1986, p. 187

[in Chinese with English diagnosis, p. 202]

Figure 41.30–41.33, 44

Discussion and diagnosis.—Original diagnosis (Ma, 1986, p. 202): shell small to medium; suborbicular to subrectangular; equivalve, inequilateral; test thin; rather flattened; umbo small, prosogyrate; posterior carina ridgelike, running from umbo to posterior ventral end; linule and escutcheon unseen; surface ornamented with regular concentric riblets. Hinge formula: AIII, AI, 3b, PI, PIII/AII, 2b, 4b, PII; left valve with triangular 2b, slender 4b, short AII, and long PII; right valve with slender 3b, and long PI and PIII; teeth AI and AIII close to other and with a socket in between; anterior adductor scar deep, with irregular striae; upper side inserted with small pedal scar; posterior adductor scar shallow and smooth; pallial line entire. Similar to *Neomiodonoides* Ma and *Limnocyrena* Martinson. But *Neomiodonoides* is distinguished by rather strong hinge, well developed 3a, rounded posterior ridge, and concentric striae on surface, [as well as] shallow adductor scars. *Limnocyrena* is characterized by slender 2b, rounded posterior diagonal ridge and concentric striae and shallow adductor scars on surface. Resembles *Neomiodon*, *Crenotrapezium*, *Cyrenopsis*, *Eomiodon,* and *Musculiopsis* in hinge structure. But *Neomiodon* and *Musculiopsis* have well-developed 3a and long AII; AI and AIII are open at each end in *Crenotrapezium* and *Cyrenopsis;* and *Eomiodon* have long AII, but PIII is missing [*sic*].

Type species.—Gansuella xinminpuensis Ma, 1986, p. 189, pl. 2,*14*,*15* (holotype), *16–30;* text-fig. 3; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Ma, 1986, p. 189): Shell 6.2–14.25 mm long, 4.3–8.85 mm high, and 4.75 mm wide (bivalved); transversely rhomboidal. Anterior margin rounded, posterodorsal margin nearly straight, posterodorsal part truncated, with obtusely rounded posterodorsal angle; posteroventral angle narrowly rounded, slightly protracted backward. Umbo small, situated in anterior fourth of shell; posterior umbonal carina ridgelike, extending from umbo to posteroventral angle, siphonal area slightly depressed. Growth lines regular, costaelike, turning sharply to dorsal on posterior carina. Left valve with one anterior and one posterior lateral tooth (pl. 2,17a,*19*,*25*), right valve with two laterals on each side (pl. 2,*20–23*,*29–30*), cardinal teeth 2b, 3b, and 4b, shown in figures 19, 22, and 25 of plate

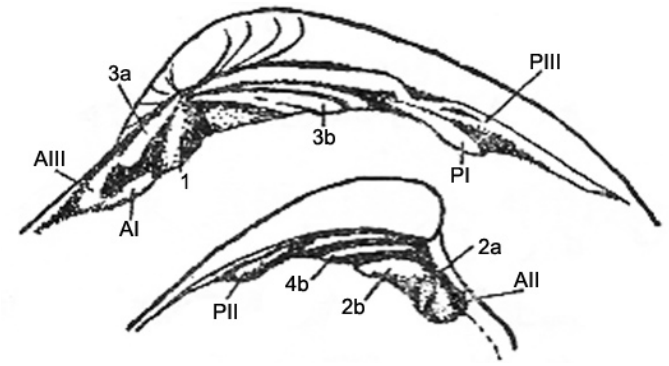

Figure 43. Diagrammatic drawing of hinge of *Aquilonia bashibulakeensis* Lan & Wei, no scale (adapted from Lan & Wei, 1995, p. 141, text-fig. 31a).

2. Anterior adductor scar deep, with a small pedal retractor scar above (pl. 2,*17*,*19*,*20*,*22*,*25*,*27*,*29*). Pallial line simple.

Type locality.—Xinminpu, Yumen, Gansu, northwestern China.

Type occurrence.—Zhonggou Formation, Lower Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 75882 (holotype); 75883–75898.

Distribution of genus.—Lower Jurassic; western Gansu, northwestern China (Ma, 1986, p. 188) [*Gansuella* may range from the Uppermost Jurassic to Lower Cretaceous].

Taxonomic position.—Neomiodontidae (by original designation).

Genus NEOMIODONOIDES Ma, 1986, p. 190

[in Chinese, with English diagnosis, p. 202]

Figure 41.34, 45.24–45.30

Discussion and diagnosis.—Original diagnosis (Ma, 1986, p. 202): shell small to medium, suborbicular to subrectangular, equivalve, inequilateral; test rather thick; umbo small, turning forward, posterior diagonal ridge rounded, surface ornamented with concentric striae. Hinge formula: AIII, AI, 3a, 3b, PI, PIII/AII, 2b, 4b, PII. All teeth smooth, hinge of left valve with strong triangular 2b, slender 4b, short AII, and long PII. Dentition of right valve with small, triangular 3a, slender 3b, long PI and PIII. AI and AIII are closed at each end, with socket in between.

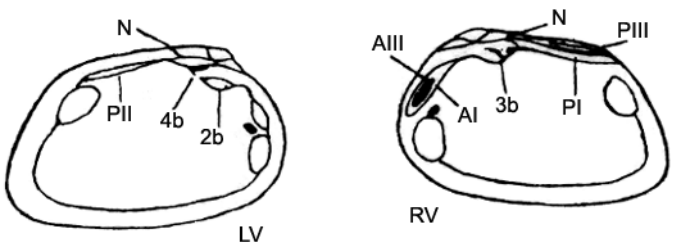

Figure 44. Diagrammatic drawing of *Gansuella xinminpuensis* Ma, showing hinge, no scale (adapted from Ma, 1986, p. 188, text-fig. 3).

Anterior and posterior adductor scars shallow and smooth, pallial line simple [*sic*].

Type species.—*Neomiodonoides subrotundus* Ma, 1986, p. 190, pl. 3,*1–4,5* (holotype), *6–32*; text-fig. 7; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Ma, 1986, p. 190): Shell 10–19.4 mm long, 9–16.9 mm high, with height to length ratio about 0.84–0.90; subcircular in outline. Anterior margin rounded, ventral margin convex, dorsal margin arched, posterodorsal margin broadly arcuate; Umbo rather pointed, slightly incurved, situated slightly anterior of center of hinge margin; posterior umbonal carina obtusely rounded; shell inflated evenly; shell thick, 5.2–11.9 mm, about 0.63 times shell length. Surface covered by regular concentric lines and rugae, becoming finer and closer toward ventral and coarser and sparser toward dorsal. Hinge teeth as in genus diagnosis, rather variable, cardinal tooth generally short, papilla-like, nearly perpendicular to dorsal margin (pl. 3,*7–10,18*), but sometimes 3b short-lamellar, forming obtuse angle with anterodorsal margin (pl. 3,*16,19*), or 3b sometimes with groove (pl. 3,*10–11,17*); both 3a and 3b with grooves in specimen of figure 13, pl. 3, while smooth in most specimens; 2b mostly triangular (pl. 3,*27,25,21*), but sometimes like a reversed V (pl. 3,*22*) or bifid with a smaller half near 4b (pl. 3,*32*); 2b often connected more or less with AII, but sometimes 2b independent of AII (pl. 3,*22–23*); AII usually inflated in middle part, evidently attenuated toward both ends. Anterior adductor scar not deep.

Type locality.—Chijinpu, Yumen, Gansu, northwestern China.

Type occurrence.—Xiagou Formation, Lower Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 75903 (holotype); 75899–75902, 75904–75930.

Distribution of genus.—Upper Jurassic; northwestern, northern, and eastern China (Ma, 1986, p. 190) [*Neomiodonoides* may range from the Uppermost Jurassic to Lower Cretaceous].

Taxonomic position.—Neomiodontidae (by original designation).

Genus EOSION Guo, 1988, p. 131

[in Chinese]

Figure 45.9–45.11

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1988, p. 131): shell small, inflated; subtriangular, suboval, or subtrapeziform in outline; equivalve, subequilateral; anterior margin rounded, posterior margin truncated, ventral margin arcuate; posterodorsal angle distinct and obtuse, posteroventral angle rounded and obtuse. Umbo broad, rounded, prominent, beak incurved, slightly prosogyrate, situated just anterior of center on hinge margin; posterior umbonal carina distinct, extending from umbo to posteroventral angle; corselet lanceolate, with distinct ridge extending from umbo to posterior margin. Surface with rather regular concentric ridges. Lunule small, short, slightly sunken; escutcheon narrow and long, lanceolate, bordered by escutcheon ridge; two cardinal teeth under umbo in each valve, upper ends of 3a and 3b weakly joined together in right valve, 3a weak, joining up with AIII; 3b strong, subtriangular, inclined forward; 2 of left valve bulky, subtriangular, joined up with AII; 4b weak, inclined forward; anterior and posterior laterals long and lamellar, subparallel to hinge margin, left valve with one anterior and one posterior lateral tooth, right valve with two laterals on each side. Adductor scars obscure.

Type species.—*Eosion jinlongense* Guo, 1988, p. 131, pl. 5,*1* (holotype), *2–8*; by original designation.

Original description of type species.—(Translation from Chinese text, Guo, 1988, p. 131): Shell inflated; subtriangular in outline, slightly longer than high; equivalve, subequilateral; anterior margin rounded, posterior truncated, ventral margin arcuate; posterodorsal angle distinct and obtuse, posteroventral angle broad, rounded, and obtuse. Umbo broad, rounded, prominent, beak incurved, slightly prosogyrate, situated just anterior of center on hinge margin; posterior umbonal carina distinct, extending from umbo to posteroventral angle; corselet bordered by carina, with escutcheon ridge extending from umbo to posterior margin. Surface with rather regular concentric ridges, narrow and fine, with wide and flat interspaces. Lunule small, cordate, sunken; escutcheon narrow, lanceolate, bordered by escutcheon ridge. Two cardinal teeth under umbo in each valve, subtriangular; upper ends of 3a and 3b weakly joined together in right valve, 3a weak, inclined backward, weakly joined up with AIII; 3b strong, inclined forward; 2 of left valve weakly joined up with AII; 4b weak, slightly elongate, inclined forward. Left valve with one anterior and one posterior lateral tooth, right valve with two laterals on each side. Adductor scars obscure.

Type locality.—Jinlong, Lanping, Yunnan, southwestern China.

Type occurrence.—Maichuqing Formation, upper Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0684 (holotype); IVy0685–0691.

Distribution of genus.—upper Upper Triassic; southwestern China and Southeast Asia (Guo, 1988, p. 131).

Taxonomic position.—Neomiodontidae (by original designation).

Note.—The cardinal 3a is probably inclined forward rather than inclined backward.

Genus SPHAERIOIDES Yu & K. Zhang in Yu, 1982, p. 48

[in Chinese]

Figure 45.12–45.19

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Yu & K. Zhang in Yu et al., 1984, p. 57): shell not large, suborbicular, trigonally suboval, suboval to elliptical; equivalve, slightly or quite inequilateral; inflated to quite inflated; usually with posterior umbonal carina, without lunule and escutcheon. Umbo projected, subcentral or slightly anterior in position. Surface covered with fine and dense concentric lines and regular concentric rings. Ligament with smooth nymph; pallial line entire. Hinge teeth variable: right valve with a usually bifurcated and backward-inclined cardinal tooth, or sometimes with two slightly curved cardinal teeth, parallel to each other; either cardinal tooth split from top into halves, one long and slender, another

short and thick, or cardinal tooth split from middle rather than from top. Left valve with two discrete cardinal teeth, 2a triangular conelike, sometimes lower part bifurcated; 2b lamellar, inclined backward. Laterals strong and thick, with some distance to cardinal teeth; usually right valve with two laterals each in front and back, sometimes AI and PI very weak; left valve with one lateral each in front and back, anterior one short, posterior one long. Most lived in freshwater.

Type species.—*Tetoria*? *yixianensis* Gu in Gu et al., 1976, p. 376, pl. 101,*1–13* (=*Sphaerioides luanpingensis* Yu & K. Zhang in Yu, 1982, p. 48 (no figures) (=*S. luanpingensis* Yu & K. Zhang in Yu et al., 1984, p. 57, pl. 12,*6*,*9* (holotype), *10–16*,*20;* pl. 13,*4*,*6*,*9*,*13*; pl. 14,*2*) (subsequent designated by Gu, Li, & Yu, 1997, p. 200).

Original diagnosis of type species.—(Translation from Chinese text, Yu & K. Zhang in Yu et al., 1984, p. 57): Shell not large, largest length 17 mm; suborbicular, with length to height ratio ~1.15; moderately inflated, greatest convexity at middle-upper part of shell; posterior umbonal carina obvious, broadly rounded; umbo wide, protruding above hinge margin, situated slightly anterior of center of hinge margin; surface ornamented with alternating coarse and fine concentric lines. Right valve with two cardinal teeth, lamellar, slightly curved, nearly vertical to hinge margin; left valve with two discrete cardinal teeth; right valve with two laterals each in front and back, left with one each in front and back, sometimes 3a and 3b weak.

Type locality.—Liying, Luanping, Hebei, North China.

Type occurrence.—Yixian Formation, Lower Cretaceous.

Repository of type material.—Tianjin Institute of Geology, Chinese Academy of Geological Sciences, Tianjin, North China; accession number: 80LpX73 (holotype); L009, L0080, L0087, L0088, Li99, PL-9, PX0051, 80LpX073.

Distribution of genus.—Lower Cretaceous; North China and Japan.

Taxonomic position.—Pisidiidae (by original designation).

Revision suggestion.—Gu, Li, and Yu (1997, p. 200) and Gu (1998, p. 270) provisionally assigned this genus to Neomiodontidae based on its anterior pedal retractor scar situated on the upper, inner side of the anterior adductor scar. It seems that *Megasphaerioides* Komatsu, Chen, & Wang, 2003 could be relegated to a subgenus of the present genus, because it is very difficult to find any distinction of even minor importance in their dentition.

See also.—Yu and K. Zhang (in Yu et al., 1984, p. 57) described *Sphaerioides* as a new genus once again after they erected the genus in 1982.

Superfamily GLOSSOIDEA Gray, 1847
Family GLOSSIDAE Gray, 1847

[=Isocardiidae Gray, 1840]

Genus ISOCARDIOIDES Fan, 1963, p. 523

[in Chinese with English description, p. 540]

Figure 41.7–41.11

Discussion and diagnosis.—Original diagnosis (Fan, 1963, p. 540): shell fairly large, orbicular to ovate, equivalve, inequilateral, thick, strongly inflated. Surface covered with fine concentric lines of growth. Hinge structure: right valve with a triangular cardinal tooth (3b) and undeveloped or very small cardinal tooth (3a), left valve with two cardinal teeth (2 and 4b); lateral teeth entirely absent from both valves. Judging from hinge structure, genus resembles *Coelastarte* Boehm, but differs in having different outline and more strongly inflated shell. Strongly resembles *Isocardia* Lamarck in general outline and curved umbo, but differs in hinge structure. *Isocardia* has two cardinal teeth in both valves and ridgelike posterior-lateral tooth. New genus is closely related to *Isocardia. Cardinia* Agassiz and *Cardinoides* Kobayashi and Ichikawa differ chiefly in hinge structure. *Cardinia* possesses an undeveloped cardinal tooth (sometimes absent) and anterior and posterior lateral tooth. *Cardinoides* possesses a triangular pseudocardinal tooth on left valve, two toothlike projections on both sides of pseudocardinal socket, and a ridgelike posterior lateral tooth on right valve [*sic*].

Type species.—*Isocardioides yini* Fan, 1963, p. 541, pl. 2,*19–21* (holotype); pl. 3,*2–6*; pl. 4,*7–9*; by original designation.

Original diagnosis of type species.—(Fan, 1963, p. 541): Shell large, orbicular to ovate, equivalve, inequilateral, very inflated. Test very thick. Umbo wide, strongly incurved, and turned forward. Greatest convexity of shell situated near center of valve and defined by two ridgelike carina, gradually becoming weakened toward ventral margin and finally disappearing. Post-umbonal cardinal margin oblique toward posterior, forming obtuse angle with subvertical posterior margin. Anterior margin rounded, passing gradually toward gently arcuated ventral margin. Surface covered with fine concentric lines of growth. Hinge structure: large triangular cardinal tooth situated just below umbo on interior of right valve, left valve with two cardinal teeth (2 and 4b) [*sic*].

Type locality.—Xiaoshui, Lechang, Guangdong, China.

Type occurrence.—Xiaoping Formation, Upper Triassic (originally mistaken as Lower Jurassic, see also Chen, 1982).

Repository of type material.—Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing; accession number: 00849 (holotype); 00850–00856.

Distribution of genus.—Upper Triassic; Guangdong and southern Hunan, South China.

Taxonomic position.—Isocardiidae (by original designation, = Glossidae).

Revision suggestion.—Probably a junior synonym of *Schafhaeutlia* Cossmann, according to Gu et al., 1976, p. 101.

Superfamily TELLINOIDEA Blainville, 1814
Family PSAMMOBIIDAE Fleming, 1828
Genus SINOPSAMMOBIA
Li, Yu, Yao, & Gu in Li & Yu, 1982, p. 135

[in Chinese]

Figure 45.3–45.8

Discussion and diagnosis.—Original diagnosis (Li, Yu, Yao, & Gu in Gu, Chen, & Sha, 1984, p. 198): medium size, equivalve, ovate to elongate elliptical; without marked lunule and escutcheon, posterior ridge weak and not marked. Left valve with three radially arranged cardinals, right valve with two cardinals, laterals undeveloped and at most [at the utmost] expressed as thickening of hinge plate margin. Hinge formula: 3a, 3b/(4a), 2, 4b; 2 and 3b stout, 2 almost vertical to dorsal margin, 4a small and unstable.

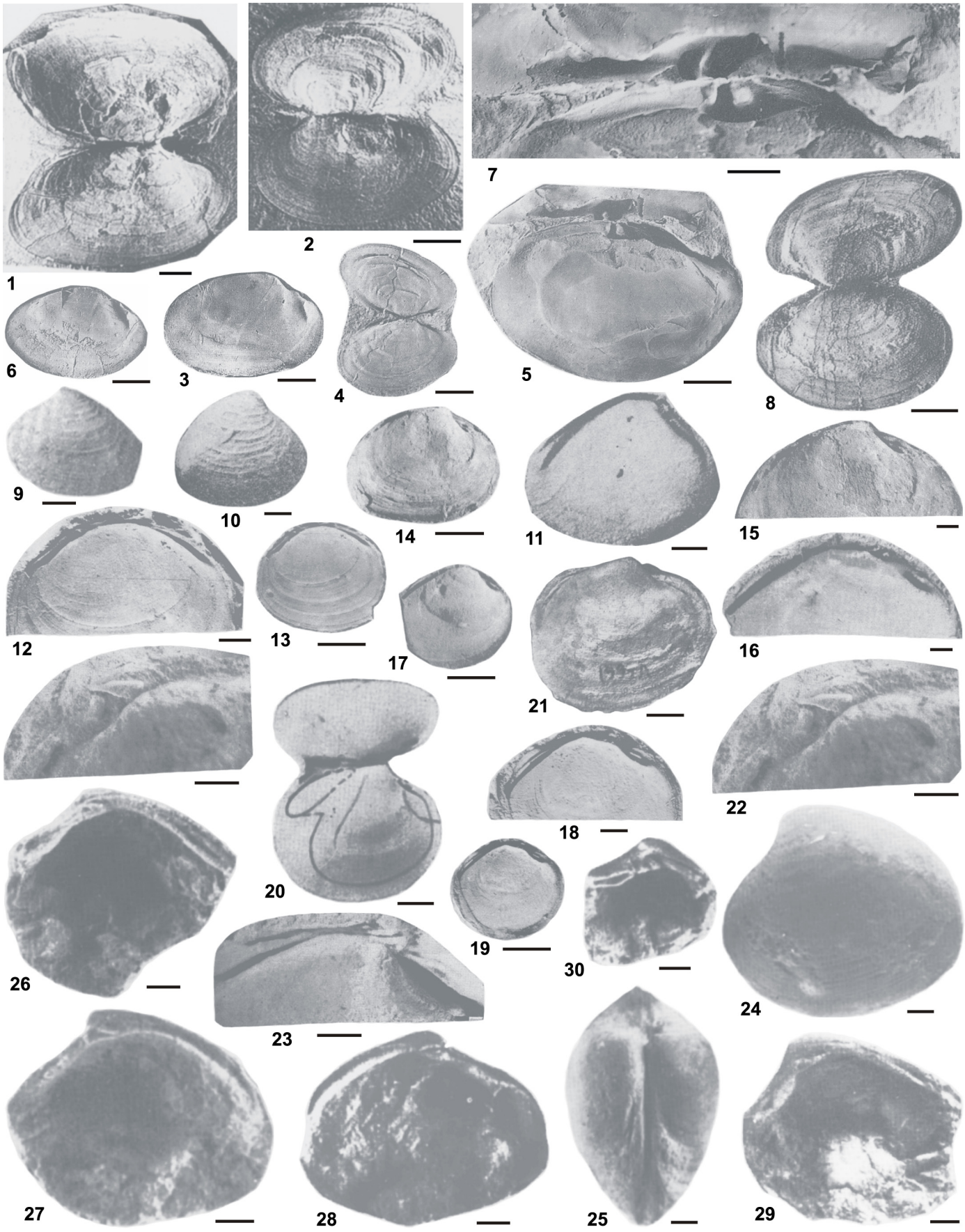

Figure 45. *For explanation, see facing page.*

Strong pedal muscle scar above and behind semicircular posterior adductor scar and small scars (possibly muscles for gill suspensories) inside umbonal cavity. Pallial sinus deep, rounded, and merely confluent, ventral and posterior margin forming acute angle with ventral and posterior pallial line. Surface with concentric ornament. Distinguished from *Gari* and *G. (Psammobia)* by position of pedal muscle scar and lack of developed external posterior ridge [*sic*].

Type species.—*Sinopsammobia ovalis* Li, Yu, Yao, & Gu in Li & Yu, 1982, p. 136, pl. 17,*5–7,8* (lectotype, subsequent designated by Gu, Li, & Yu, 1997, p. 183), *9–10*; by original designation.

Original diagnosis of type species.—(Li, Yu, Yao, & Gu in Gu, Li, & Yu, 1997, p. 183): Small to medium, greatest length measuring 35 mm. Equivalve and inequilateral. Moderately inflated, largest ratio of inflation of length of two valves to length being 0.43. Shell outline ovate to very slightly elongate. Both ends rather narrowly rounded, posterior one being slightly broader; ventral and dorsal margins with subequal curvatures and smoothly merged into two ends. Post-umbonal fold undeveloped, without marked ventro-posterior angle. Umbo low and obtuse, located at about anterior one-third shell length. No marked lunule and escutcheon. Shell surface ornamented with fine concentric lines and irregularly or not so regularly spaced concentric folds. Internal characters same as for genus [*sic*].

Type locality.—Longzhaogou, Hulin, Heilongjiang, northeastern China.

Type occurrence.—Upper Yunshan Formation, Lower Cretaceous.

Repository of type material.—Shenyang Institute of Geology and Mineral Resources, Chinese Academy of Geological Sciences, Shenyang, Liaoning, northeastern China; accession number: BH0475 (holotype); BH0464, 0474, 0503, 0507, 0604.

Distribution of genus.—Lower Cretaceous; Heilongjiang, northeastern China (by Li, Yu, Yao, & Gu in Gu, Li, & Yu, 1997, p. 183).

Taxonomic position.—Psammobiidae (by original designation).

Note.—Li, Yu, Yao, and Gu (in Gu, Chen, & Sha, 1984, p. 158) described *Sinopsammobia* Li et al. as a new genus once again, but supplemented with English description on p. 198 after they erected the genus in 1982. See also Gu, Li, and Yu (1997).

Superfamily CORBICULOIDEA Gray, 1847
Family CORBICULIDAE Gray, 1847
Genus BAIDUNOCONCHA
Gu in Gu & Yu, 1999, p. 71

[in Chinese with English description, p. 102]

Figure 45.1–45.2

Discussion and diagnosis.—Original diagnosis (Gu in Gu & Yu, 1999, p. 102): moderate size. Elliptic with posteroventral angle slightly or not projected. Without perceptible post-umbonal arching. Concentrically ornamented, without any trace of radial ornament. Lateral teeth two and one on both sides internally respectively in right and left valves, distal ends of lateral teeth being near posterodorsal angle. Cardinal teeth and pallial line unknown. Shell test porcelaneous [*sic*].

Type species.—*Baidunoconcha fuyuensis* Gu in Gu & Yu, 1999, p. 71, pl. 19,*9* (holotype), *10–14;* by original designation; by monotypy.

Original diagnosis of type species.—(Gu in Gu & Yu, 1999, p. 103): Holotype length 34. 55 mm, largest length among five specimens of new species. Slightly inflated. Very fine crenulated striae on inner or lateral sides of lateral teeth, perceptible only by lens with high magnification. Other characters same as in diagnosis of genus and shown by illustrated figures of type species [*sic*].

Type locality.—Drill hole Fu-24 (depth 46. 37–50. 14 m), Songyuan, Jilin, northeastern China.

Type occurrence.—Nenjiang Formation, Upper Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 126921 (holotype); 126912, 126915, 126923, 126924.

Distribution of genus.—Upper Cretaceous; western Jilin, northeastern China (Gu in Gu & Yu, 1999, p. 71).

Taxonomic position.—Corbiculidae (by original designation).

Figure 45. *1–2. Baidunoconcha fuyuensis* Gu, scale bar 5 mm; *1,* holotype, conjoined valves; *2,* paratype, conjoined valves (adapted from Gu in Gu & Yu, 1999, pl. 19,*9–10*).——*3–8. Sinopsammobia ovalis* Li et al.; *3,* lectotype, right internal mold, scale bar 5 mm; *4,* paralectotype, conjoined valves, scale bar 5 mm; *5,* paralectotype, subdorsal view of conjoined valves, scale bar 5 mm; *6,* paralectotype, right internal mold, scale bar 10 mm (adapted from Gu, Li, & Yu, 1997, pl. 24,*1,11,4–5;* =Li & Yu, 1982, pl. 17,*8,5–7*); *7,* enlargement of hinge of Fig. 45.5, scale bar 10 mm; *8,* plesiotype, conjoined valves, scale bar 5 mm (adapted from Li et al. in Gu, Li, & Yu, 1997, pl. 24,*3,14*).——*9–11. Eosion jinlongense* Guo; *9,* holotype, left valve, scale bar 2 mm; *10,* paratype, right valve, scale bar 2 mm; *11,* paratype, right internal mold, scale bar 1 mm (adapted from Guo, 1988, pl. 5,*1,6–7*).——*12–19. Sphaerioides luanpingensis* Yu & K. Zhang; *12–13,* holotype, left internal mold; *13*, left lateral view, scale bar 5 mm; and *12*, enlarged hinge, scale bar 1 mm; *14–15,* paratype, right internal mold; *14*, right lateral view, scale bar 5 mm; and *15*, enlarged hinge, scale bar 1 mm; *16–17,* paratype, right internal mold; 16, enlarged hinge, scale bar 2 mm, and *17*, right lateral view, scale bar 5 mm; *18–19,* paratype, right internal mold; *18*, enlarged hinge, scale bar 2 mm, and *19*, right lateral view, scale bar 5 mm (adapted from Yu & K. Zhang in Yu et al., 1984, pl. 12,*6,9,11–16*).——*20–23. Fulpioides orientalis* Gu & Yu; *20,* holotype, conjoined valves, scale bar 5 mm; *21,* paratype, right internal mold, scale bar 5 mm; *22,* paratype, left internal mold, scale bar 2 mm; *23,* paratype, right internal mold, scale bar 2 mm (adapted from Gu & Yu in Gu et al., 1976, pl. 119,*1,7,11–12*).——*24–30. Neomiodonoides subrotundus* Ma, scale bar 2 mm; *24–25,* holotype, articulated shell; *24,* left lateral view; *25,* dorsal view; *26–27,* paratype, right interior views; *28,* paratype, left interior view; *29,* paratype, right interior view; *30,* paratype, left interior view (adapted from Ma, 1986, pl. 3,*5a–b,7,19,32,12,17*).

Genus FULPIOIDES
Gu & Yu in Gu et al., 1976, p. 376

[in Chinese]

Figure 45.20–45.23

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Gu & Yu in Gu et al., 1976, p. 376): shell medium to large. Suborbicular to rounded triangular in outline. Rather inflated. Lunule and escutcheon indistinct or absent. Surface with concentric ornament and some fine radial lines on inner surface or under periostracum. Corbiculoid dentition, three cardinals in each valve, 3b stronger and bifurcate, anterior cardinal tooth connected with anterior lateral tooth; laterals slightly arched, with very fine transverse microcrenulations, posterior lateral slightly longer than anterior. Pallial sinus triangular with pointed apex. Adductor scars pear shaped to semilunar, posterior one larger.

Type species.—*Fulpioides orientalis* Gu & Yu in Gu et al., 1976, p. 376, pl. 119,*1* (holotype), *2–12*; by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Gu & Yu in Gu et al., 1976, p. 376): Shell suborbicular, with height to length ratio about 0.75–0.85. Anterior end convex.

Type locality.—Huaide, Jilin, northeastern China.

Type occurrence.—Nenjiang Formation, lower Upper Cretaceous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 25617 (holotype); 25618–25625.

Distribution of genus.—lower Upper Cretaceous; northeastern Asia (Gu & Yu in Gu et al., 1976, p. 376).

Taxonomic position.—Corbiculidae (by original designation).

Order ANOMALODESMATA Dall, 1889
Superfamily MODIOMORPHOIDEA Miller, 1877
Family MODIOMORPHIDAE Miller, 1877
Genus GONIOPHORIOPSIS Zhang in Zhang, Wang, & Zhou, 1977, p. 483

[in Chinese]

Figure 46.5–46.8

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 483): shell large, subtrapezoidal, transversely elongate, umbo anterior, hinge margin long and straight; anterior end narrow, becoming broader posteriorly, posterior end obliquely truncated; posterior umbonal carina rounded, becoming obscure toward posteroventral end, bordered anteriorly by shallow median sulcus; shell ornamentation unknown. Right valve with triangular cardinal tooth under umbo and peudocardinal tooth extending from umbo on each side of center tooth, posterior one long, subparallel to dorsal margin; triangular socket under umbo of left valve, two posterior and one anterior pseudocardinal teeth, all very weak; posterior adductor scar large, oval; anterior unknown, without pallial sinus.

Type species.—*Goniophoriopsis guangxiensis* Zhang in Zhang, Wang, & Zhou, 1977, p. 484, pl. 191,*13* (holotype), *14;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Zhang in Zhang, Wang, & Zhou, 1977, p. 484): Shell somewhat large, inequilateral, trapezoidal in outline, umbo situated about one-fifth shell length back from anterior end, projected above hinge margin; anterior end short and rounded, becoming broader posteriorly, dorsal margin nearly straight, posterior margin truncated, forming obtuse angle of 150º with posterior margin and forming rounded right angle with ventral margin; ventral margin arcuate, slightly concave at middle; posterior umbonal carina evident toward umbo, rounded or slightly angular, becoming obscure toward ventral, bordered anteriorly by shallow median sulcus, with corresponding ventral sinus at ventral margin. Internal structure same as for genus.

Type locality.—Zhuozhou, Daxin, Guangxi, China.

Type occurrence.—Yujiang Formation, Emsian, Lower Devonian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China; accession number: (IV)55176 (holotype); (IV)55177.

Distribution of genus.—Devonian; China and Viet Nam (Zhang in Zhang, Wang, & Zhou, 1977, p. 484).

Taxonomic position.—Modiomorphidae (by original designation).

Note.—Type species is represented by only two specimens, and preservation is rather poor.

Genus GANXIELLA
Liu & Gu in Liu, 1988 (June), p. 264

[in Chinese with English description, p. 401]

Figure 46.1–46.4

Discussion and diagnosis.—Original diagnosis (Liu & Gu in Liu, 1988 [June], p. 401): shell medium to large, elongate-sabered [sword-shaped], thick walled, equivalved, extremely inequilateral; narrowing and slightly gaping anteriorly; widening and truncated posteriorly; moderately inflated; provided with conspicuously postero-umbonal keel and obliquely lateral sulcus extending from umbos to corresponding sinus of anteroventral margin; siphonal area wide, compressed or concave. Umbos wide, prosogyrous, slightly or not rising above hinge line, located at extreme anterior end. Surface with growth lines and irregularly developed concentric rings as well as radial ridges. No lunule; escutcheon undeveloped. External ligament, opisthodetic; ligament area with longitudinal grooves parallel to each other; nymph long. Right valve with strong, long, wedge-shaped, oblique cardinal tooth and two posterior lamellar teeth; left valve with one or two anterior cardinal teeth, one near dorsal margin; if present, weak, thin, and one near ventral margin, strong, long and wedge-shaped, and posterior lamellar tooth. Umbonal cavity shallow. Inner surface, except for area under cardinal teeth and in front of anterior adductor scar, covered with coarse, concentric rings, smooth; pallial line simple, without sinus. Anterior adductor scar orbicular, deep, ornamented with transverse and concentric sculptures; small pedal scar isolated, located above posterior upper side; posterior adductor one large, shallow, ellipsoid [*sic*].

Type species.—Ganxiella longa Liu, 1988, p. 265, pl. 84,*4,5* (holotype), *6–7*; by original designation.

Original diagnosis of type species.—(Gu & Liu, 1988 [December], p. 362): Shell elongate, rectangular; dorsal margin straight, parallel to ventral margin. Highest point of shell outline occurring about one-fourth shell length from posterior end. Anterior part with concentric growth lines; posterior slope mainly with indistinct radial ribs. Between lines and ribs, strong carina forms boundary of posterodorsal and anteroventral areas. Midventral margin slightly concave. Beak slightly prosogyrate, nearly terminal to anterior end. Internal structure as for genus [*sic*].

Type locality.—Ganxi, Beichuan, Sichuan southwestern China.

Type occurrence.—Ganxi Formation, Emsian, Lower Devonian.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: LBV-851345 (holotype); LBV-851344, 851346, 851347c.

Distribution of genus.—Lower Devonian; South China (Liu, 1988, p. 264).

Taxonomic position.—Mecynodontidae (by original designation).

Revision suggestion.—Ganxiella is junior synonym of *Pseudosanguinolites* Patte and included in Modiomorphidae (Fang & Morris, 1997).

Note.—Gu and Liu (1988, p. 361, published in December, whereas Liu & Gu in Liu, 1988, published in June) again proposed *Ganxiella* as a new genus.

Genus ZAIDIOMYSIA
Guo, 1988, p. 132

[in Chinese]

Figure 46.15–46.17

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1988, p. 132): shell medium to rather large, subtriangular in outline, inequivalve, inequilateral, moderately inflated, with thick shell wall. Umbo anterior, prominent, beak incurved and slightly prosogyrate. Posterior umbonal carina well developed, broadly rounded and thick. Right valve larger and more convex than left, with salient umbo rising above subdued umbo of left valve. Surface covered by growth lines. Left valve with strong cardinal tooth under umbo. Adductor scars well developed, deep, and distinct, posterior one of right valve larger than that of left valve, anterior pedal scar of left valve larger than that of right valve, cone-shaped and deep scar above posterior adductor scar.

Type species.—Zaidiomysia inaequvalivata Guo, 1988, p. 132, pl. 2,*4a–b* (holotype), *5–6;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1988, p. 132): Shell subtriangular in outline, inequivalve, inequilateral, inflated. Anterior margin rounded, ventral margin arcuate, posterior margin obliquely truncated. Posteroventral angle evident and rounded. Umbo thick and large, prominent, beak incurved and slightly prosogyrate, situated in anterior third of shell. Surface covered by growth lines. Right valve larger and more convex than left one, with salient umbo rising above subdued umbo of left valve. Left valve with strong cardinal tooth under umbo. Anterior adductor scar of left valve deep and distinct, elliptical, with slightly thickened lower margin, small pedal scar in posterodorsal direction, about one-third anterior scar or more; posterior adductor scar large and rounded; cone-shaped scar just above, inclined forward. Pedal scar of right valve smaller and deeper than that of left valve; posterior adductor scar rather large, subelliptical, about two times as large in area as posterior one of left valve. Differences between musculature in two valves: (1) posterior adductor scar of left valve smaller, about half that in area of right valve, cone-shaped deep scar in anterodorsal direction; (2) anterior pedal scar of left valve larger and shallower than that of right valve. Cone-shaped scar near posterior hinge margin in left valve is possibly a special pedal muscle scar.

Type locality.—Lengshui, Longlin, Guangxi, China.

Type occurrence.—Pojiao Formation, upper Lower Devonian.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0659 (holotype); IVy0660, 0661.

Distribution of genus.—upper Lower Devonian; Yunnan and Guangxi, China (Guo, 1988, p. 132).

Taxonomic position.—Grammysiidae (by original designation).

Revision suggestion.—Zaidiomysia is herein placed in synonymy with *Beichuania* Liu & Gu in Liu, 1988 based on Fang's personal observation (November 2005) of Guo's type material deposited in The Geological Museum of China, Beijing.

See also.—Liu (1988) and Gu and Liu (1988) for descriptions of *Beichuania* Liu & Gu in Liu, 1988, and Fang (1998) for revised diagnosis of *Beichuania*.

Genus BEICHUANIA
Liu & Gu in Liu, 1988 (June), p. 259

[in Chinese with English description, p. 399]

Figure 46.18–46.21

Discussion and diagnosis.—Original diagnosis (Liu & Gu in Liu, 1988 [June], p. 399): Medium to very large, oval, tetragonus, triangular, wedge shaped in outline; extremely inequivalve, inequilateral. Test thick. Right valve by far larger and more convex than left, sharp, edgy postero-umbonal ridge and very wide siphonal area. Umbonal region angular, umbos slightly opisthogyrous, well incurved, greatly hanging over hinge line and left-valve umbo, located at anterodorsal end; left valve ranging from slightly concave to faintly convex, with wide, shallow posterodorsal sulcus and very weak or nearly degenerated umbo. Surface ornamented with irregular growth lines and rings. Lunule absent; escutcheon distinct. External ligament opisthodetic. Left valve with large, triangular-coned pseudocardinal tooth and one posterior lamellar tooth connecting with it; right valve with one short anterior lamellar tooth and one posterior lamellar tooth. Cavities deep in right valve and very shallow in left valve. Pallial line integripalliate. Anterior adductor scar small, oval, deep, with radial striae and concentric line, small pedal scar inserted above posterior upper side; posterior adductor scar shallow, large, suborbicular, placed near posterodorsal angle site [*sic*].

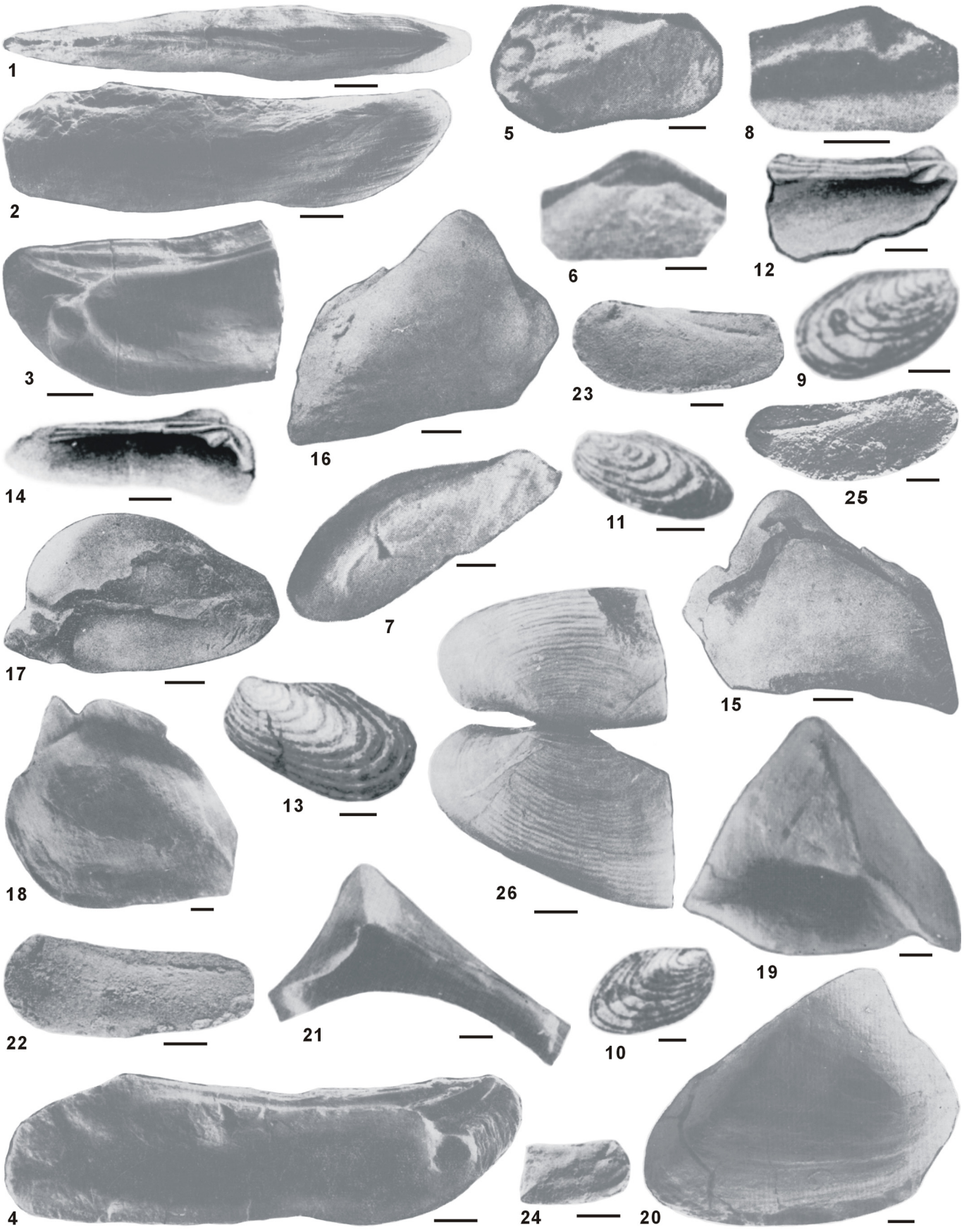

Figure 46. *For explanation, see facing page.*

Revised diagnosis.—(Fang, 1998, p. 185): Shell large and thick; strongly inequivalved; right valve strongly inflated; left valve slightly convex; umbonal ridge of right valve strong; corresponding sulcus in left valve with submarginal ridge; surface with commarginal growth lines; ligament in opisthodetic groove with well-marked nymph; hinge plate striated with growth lines; hinge plate supported below by anterior and posterior internal ridges, posterior one septumlike, anterior one flangelike, and fused with thickened myophoric buttress; single cardinal tooth 2 in left valve, with corresponding socket in right valve; no laterals; anterior adductor and pedal scars on a thickened buttress; posterior adductor scar larger and shallower; pallial line entire [*sic*].

Type species.—*Beichuania ganxiensis* Liu & Gu in Liu, 1988, p. 260, pl. 78,*1a–b* (holotype), *2*,*5–6*,*11*; pl. 81,*3–4*; by original designation.

Original diagnosis of type species.—(Gu & Liu, 1988 [December], p. 360): Shell large, obliquely triangular. Ventral margin gently convex, anterior and posterior margins strongly convex. Beak slightly opisthogyrate, located near anterior end of shell. Ornament of commarginal growth lines not well preserved. Escutcheon developing. Ligament external, opisthodetic. Dentition, pallial line, and muscle scars as in genus [*sic*].

Revised description of type species.—(Fang, 1998, p. 186): Shell large and thick, obliquely triangular to subrectangular; strongly inequivalve, left valve slightly convex or nearly flat; right valve strongly inflated, with gibbose and salient umbo rising above hinge margin; right valve slightly larger than left, margins of right valve slightly overlapping left, leaving no gap between valves; beak incurved, slightly opisthogyrate; lunule deep and small, escutcheon elongate; anterior margin rounded, continuing gradually into gently convex ventral margin, without byssal gape or byssal sinus; posterior margin slightly arcuate or somewhat obliquely truncate; umbonal ridge of right valve strong, angular, weakening toward posteroventral angle; left valve with corresponding shallow umbonal sulcus, bordered dorsally by submarginal ridge; sculpture rugose, concentric. Ligament parvincular with well-marked nymph; hinge plate wide and strong, striated with growth lines, supported below by anterior and posterior internal ridges; posterior one strong, septumlike, dividing umbonal cavity into two unequal chambers; anterior one flangelike, fused with thickened myophoric buttress; hinge with single cardinal tooth 2 in left valve, robust and elevated; corresponding deep socket in right valve; no laterals; anterior adductor and pedal scars occurring on thickened buttress, fused with anterior reinforcement ridge under hinge plate; posterior adductor scar slightly larger and shallower than anterior one; pallial line entire [*sic*].

Type locality.—Ganxi, Beichuan, Sichuan, southwestern China.

Type occurrence.—Ganxi Formation, Emsian, Lower Devonian.

Repository of type material.—Chengdu Institute of Geology and Mineral Resources, Chengdu, Sichuan, China; accession number: LBV-851304 (holotype); LBV-851305–851308, 851327–851328.

Distribution of genus.—Lower Devonian; South China (Liu, 1988, p. 260).

Taxonomic position.—Beichuanioidea, Beichuaniidae (by original designation).

Revision suggestion.—Modiomorphidae (Fang, 1998).

Note.—Gu and Liu (1988, p. 360, published in December, whereas Liu & Gu in Liu, 1988 published in June) again proposed *Beichuania* as a new genus.

Superfamily BEICHUANIOIDEA Liu & Gu in Liu, 1988 (June), p. 259

Family BEICHUANIIDAE Liu & Gu in Liu, 1988 (June), p. 259

[in Chinese with English description, p. 401]

Discussion and diagnosis.—Original diagnosis of superfamily and family (Liu & Gu in Liu, 1988 [June], p. 401): shell medium to very large, varied in outline, trigonal to cuneate generally; extremely inequivalve, inequilateral; right valve strongly inflated, large, sharp postero-umbonal ridge, with opisthogyrous, well-incurved umbo elevated high above hinge line and left valve umbo; left valve slightly concave to faintly convex, with weak or almost degenerated umbo and wide, shallow, posterodorsal longitudinal sulcus. Surface with growth lines and developed concentric rings. No lunule; escutcheon clear. External ligament, opisthodetic. Anterior lamellar tooth and posterior lamellar tooth in right valve; one pseudocardinal tooth and posterior lamellar tooth in left valve. Large, deep, ellipsoid pit above posterior end of posterior lamellar tooth in left. Anterior adductor scar deep, with isolated pedal scar above posterior upper

Figure 46. *1–4. Ganxiella longa* Liu, scale bar 10 mm; *1–2,* holotype, articulated shell; *1,* dorsal view; *2,* right lateral view; *3,* paratype, right interior view, showing hinge; *4,* paratype, left interior view (adapted from Liu, 1988, pl. 84,*5a–b,4,6*).——*5–8. Goniophoriopsis guangxiensis* Zhang, scale bar 5 mm; *5,* holotype, right internal mold; *6,* enlargement of Fig. 46.7, showing hinge; *7,* paratype, right internal mold; *8,* enlargement of dentition of Fig. 46.5 (adapted from Zhang in Zhang, Wang, & Zhou, 1977, pl. 191,*13a–b,14a–b*).——*9–14. Neocypricardinia sinensis* (Chao); syntype; *9,* right valve, scale bar 2 mm; *10,* right valve, scale bar 2 mm; *11,* left valve, scale bar 5 mm; *12,* interior of left valve, scale bar 5 mm; *13,* left valve, scale bar 5 mm; *14,* interior of Fig. 46.13, scale bar 5 mm (adapted from Chao, 1927, pl. 1,*21–24,25a–b*).——*15–17.* Holotype of *Zaidiomysia inaequvalivata* Guo, scale bar 10 mm; *15,* left lateral view; *16,* right lateral view; *17,* dorsal view (adapted from Guo, 1988, pl. 2,*4a–c*).——*18–21. Beichuania ganxiensis* Liu & Gu; *18–19,* holotype, articulated shell, scale bar 5 mm; *18,* left lateral view; *19,* dorsal view; *20,* paratype, right valve, scale bar 10 mm; *21,* paratype, right interior view, showing hinge, scale bar 5 mm (adapted from Liu & Gu in Liu, 1988, pl. 78,*1a–b,6,11*).——*22–25. Tulongella xizangensis* Chen & J. Chen, scale bar 2 mm; *22,* holotype, left internal mold; *23,* paratype, left internal mold; *24,* paratype, right internal mold; *25,* paratype, right internal mold (adapted from Chen & J. Chen in Wen et al., 1976, pl. 15,*2,4b,6–7*).——*26. Glossites (Pharciglossites) rugatus* Guo, scale bar 2 mm; holotype, lateral view of conjoined valves (adapted from Guo, 1985a, pl. 3,*1*).

Figure 47. Diagrammatic drawing of *Neocypricardinia sinensis* (Chao), showing hinge, no scale (adapted from Chen in Wen et al., 1976, p. 13, text-fig. 2b).

side; posterior adductor scar large, shallow. Pallial line simple, entire, without sinus [*sic*].

Diagnosis of superfamily and family.—(Gu & Liu, 1988 [December], p. 359): Right valves strongly inflated; left valves slightly convex or flat. Umbos erect; beaks curved, slightly opisthogyrate. Surface smooth or concentrically ribbed, with strong carina on right valves. Ligament external or sunken, opisthodetic. With lunule or escutcheon. Teeth tending to radiate from beaks; two pseudocardinal or pseudolateral teeth on each valve. Anterior adductor scars deep, oval shaped, and pedal scars very small, unconnected with them; posterior adductor scars large but shallow. Pallial line entire [*sic*].

Type occurrence.—Lower Devonian.

Taxonomic position.—Trigonioida (by original designation).

Revision suggestion.—Family and superfamily names are herein rejected because of misinterpretation of hinge characters in the type genus *Beichuania* (Fang, 1998, p. 185).

Note.—Gu and Liu (1988; published in December, whereas Liu and Gu in Liu, 1988, published in June of 1988) again proposed Beichuanioidea and Beichuaniidae as new taxa.

Genus MODIOPHORUS
Fang & Morris, 1997, p. 61
[in English]

Discussion and diagnosis.—Original diagnosis (Fang & Morris, 1997, p. 61): shell medium, modioli- to mytiliform, equivalve; inequilateral, with low beaks near anterior end; sculpture concentric; hinge margin long, gently arcuate; ligament opisthodetic, with two or three flanking insertional grooves. Dentition: 0 (1) -n (0) 1 0/1 - -n (1) 0 1. Cardinal tooth of right valve strong, cuneiform, just beneath is smaller and weaker cardinal tooth of left valve; posterior left valve lateral evident, additional inner posterior lateral in right valve; anterior adductor scar small, subcircular, strongly impressed, myophoric buttress weak; in addition to small anterior pedal scar above anterior adductor are three umbonal muscle scars, two of them small and round, other one narrow elliptical along anterior umbonal slope; second shell thickening extending medioventrally from below ligament area [*sic*].

Type species.—Modiomorpha bilsteinensis Beushausen, 1895, p. 19, pl. 1,*14–18*; by original designation, Fang and Morris (1997).

Distribution of genus.—Lower Devonian; Germany.

Taxonomic position.—Mordiomorphidae (by original designation).

Note.—See Beushausen (1895) for figures and original diagnosis of the type species.

Family CYPRICARDINIIDAE Ulrich, 1897
Genus NEOCYPRICARDINIA
Liu in Gu et al., 1976, p. 94
[in Chinese]

[*emend*. Chen in Wen et al., 1976, p. 12 (in Chinese)]
Figure 46.9–46.14, 47

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Liu in Gu et al., 1976, p. 94): shell small to medium. Obliquely oval, extending obliquely in posteroventral direction. Slightly inequivalve. Left valve slightly inflated. Posterior umbonal carina rounded, slightly developed. Beak prosogyrate, situated near anterior end of dorsal margin. Surface ornamented with regular concentric growth lamellae and fine and less pronounced concentric lines. External ligament, opisthodetic. One cardinal tooth in left valve, two in right valve. Posterior lateral tooth long, one in each valve, posterior part of lateral tooth bifurcating or trifurcating into 2 or 3 lamellar teeth subparallel to dorsal margin. Shell interior smooth, lacking pallial sinus. Anterior adductor scar small, posterior one large.

Revised diagnosis.—(Translation from Chinese text, Chen in Wen et al., 1976, p. 12): Shell *Modiolus*-type, equivalve, umbo situated near anterior end. Surface covered by concentric growth lamellae and weak radial lines. Lunule and escutcheon lacking. External ligament, opisthodetic, right valve with two inclined small cardinal teeth, two or three in left valve; elongate and lamellar posterior laterals 2 (or 3) in each valve. Adductor scars shallow and small, anterior one without myophoric buttress.

Type species.—Cypricardinia sinensis Chao, 1927, p. 17, pl. 1,*21–25* (syntype); by original designation, Liu in Gu et al., 1976, p. 94.

Original diagnosis of type species.—(Chao, 1927, p. 17): Shell small, modiomorphoid, elongate, broadest at posterior extremity of hinge line and narrowing toward anterior end. More or less inequivalve and somewhat strongly inflated, left valve larger and more convex. Left valve somewhat strongly convex in umbonal region, marked behind by prominent rounded umbonal ridge becoming gradually less pronounced toward posterior end. Well-defined byssal sulcus extending obliquely from beak to slightly anterior to middle of ventral margin where it produces slight sinuation. Beak incurved, placed just behind anterior extremity. Anterior outline narrow and rounded, projecting but slightly beyond beak, not nasute. Ventral margin slightly impressed by byssal sulcus, rounding up toward both ends. Hinge line straight, equal to about one-half greatest length of shell, meeting somewhat obliquely truncated posterior slope in obtuse angle where shell is greatest breadth. Posterior margin strongly extended and rounded. Right valve similar in outline and configuration to left, but much less strongly gibbose. Surface of both valves marked by many smooth concentric bands, each band being added from beneath preceding one. In left valve, concentric bands inflated in middle and separated from one another by concentric depressions, in right valve essentially flat and sharply defined from one another by well-marked and narrow concentric grooves or growth interruptions. Bands broadest along crescentic line of shell, narrowing gradually toward both ends. As many as 15 bands each have been

discriminated on each valve, extremely narrow ones at very apical part being excluded. In some well-preserved specimens, concentric bands also marked by some concentric growth lines. Hinge of left valve represented by several individuals. Just beneath beak, strong oblique cardinal tooth bordered behind by deep socket and grooved in front so as to have trifid character. From beneath beak, long posterior ridge becoming gradually bifurcated or even trifurcating and extending to very end of hinge. Muscular impressions not observed [*sic*].

Type locality.—Lincheng coal field, Hebei, North China.

Type occurrence.—Houkou limestone, Taiyuan Formation, upper Carboniferous.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 30782 (holotype); 30783–30788.

Distribution of genus.—Carboniferous–Permian; Asia, Europe, North America, Oceania (Liu in Gu et al., 1976, p. 94).

Taxonomic position.—Permophoridae (by original designation).

Revision suggestion.—*Neocypricardinia* may be better placed within family Cypricardiniidae.

Superfamily PHOLADOMYOIDEA Gray, 1847
Family PHOLADOMYIDAE King, 1844
Genus OSTEOMYA Moesch, 1874
Subgenus OSTEOMYA (YUNNANOMYA) Guo, 1985a, p. 230

[in Chinese with English description, p. 272]

Figure 48.8–48.10

Discussion and diagnosis.—Original diagnosis of subgenus (Guo, 1985a, p. 272): shell rectangular, trapezoid, equivalve, inequilateral, relatively inflated. Anterior margin semicircular; ventral margin arcuate; posterior margin obliquely truncated. Umbo broad and large, rounded, slightly opisthogyrate at beak, located at about one-third from anterior margin; posterior umbonal carina more or less developed; sometimes anterior umbonal carina also developed. Posterior dorsal part spread, relatively flat, sometimes rising upward. Posterior gape obvious, with an elongate-elliptical outlet. Lateral sulcus more or less developed to form correspondent sinus at ventral margin. Area slightly depressed, sometimes with few radial costae. Surface covered by growth lines and wrinkles. *Yunnanomya subgen. nov.* is distinguishable from *Osteomya s.s.* in presence of lateral sulcus and ventral sinus [*sic*].

Type species.—*Osteomya (Yunnanomya) ninglangensis* Guo, 1985a, p. 230, pl. 17,*8* (holotype); by original designation.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1985a, p. 230): Shell subtrapezoidal. Height slightly smaller than two-thirds length. Rather flat, not very inflated. Anterior margin semiorbicular; ventral margin arcuate; posterior margin obliquely truncated. Posteroventral angle subrounded, nearly at right angle; posterodorsal angle widely obtuse, about 120°. Posterodorsal part slightly expanded, rather flat, with warped-upward posterodorsal margin. Gaping at posterior end, expanding like a loudspeaker, with elliptical outlet. Umbo wide, subrounded, slightly projected above hinge margin, beak slightly opisthogyrate, situated about one-third shell length back from anterior end. Anterior umbonal carina low and gentle, widely subrounded, extending from umbo to anteroventral angle. Posterior umbonal carina low and gentle, widely rounded, evident, extending from umbo to posteroventral angle, bordered posteriorly by a wide and gentle sulcus. Surface ornamented with concentric growth lines and undulations, not very regular, slightly curving toward umbo when crossing lateral sulcus, extending from umbo to ventral margin, with corresponding ventral sinus. Posterior area with three to four radial costae near posterior hinge margin, not very distinct.

Type locality.—Laidashi, Ninglang, Yunnan, southwestern China.

Type occurrence.—Beiya Formation, Anisian, Middle Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0212 (holotype).

Distribution of subgenus.—lower Middle Triassic; Yunnan, southwestern China (Guo, 1985a, p. 230).

Taxonomic position.—Pholadomyidae (by original designation).

Revision suggestion.—The type material is too poor to merit subgeneric recognition. Presently regarded as a junior synonym of *Homomya* Agassiz.

Family SANGUINOLITIDAE Miller, 1877
Genus DIANOLIMNIA Guo, 1985b, p. 105

[in Chinese]

Figure 48.1–48.3

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1985b, p. 105): shell subtrapezoidal, cuneiform. Equivalve, inequilateral. Moderately inflated. Anterior part short and small, posterior part elongate and large. Hinge margin nearly straight, anterior margin rounded, posterior margin obliquely truncated, ventral margin arcuate or nearly straight. Umbo wide and large, situated anteriorly. Posterior umbonal carina well developed, keel-like, like a diagonal line. Surface ornamented with irregular concentric ridges, evident in anterior part, becoming weaker and disappearing posteriorly. Interior unknown.

Type species.—*Dianolimnia lacustris* Guo, 1985b, p. 105, pl. 24,*1* (holotype), *2a–b* by original designation; =*Cimitaria guangxiensis* Zhang in Zhang, Wang, & Zhou, 1977, p. 530, pl. 201,*11–12*; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1985b, p. 105): Shell subtrapezoidal, cuneiform. Length about 2 times height. Hinge margin nearly straight, about two-thirds shell length. Anterior part short and narrow, anterior margin rounded; posterior part elongate and becoming wider posteriorly, posterior margin obliquely truncated. Posterodorsal angle obtusely rounded, about 130°; posteroventral angle evident, slightly less than 90°. Umbo wide and obtuse. Beak incurved, slightly prosogyrate, slightly projected above hinge margin, situated about one-quarter shell length back from anterior end. Posterior umbonal carina well developed, keel-like, extending from umbo to posteroventral angle, like a diagonal line, separating conelike flank from subtriangular posterior area. Surface ornamented with irregular concentric ridges, slight bunching evident in anterior part, becoming weaker and disappearing posteriorly.

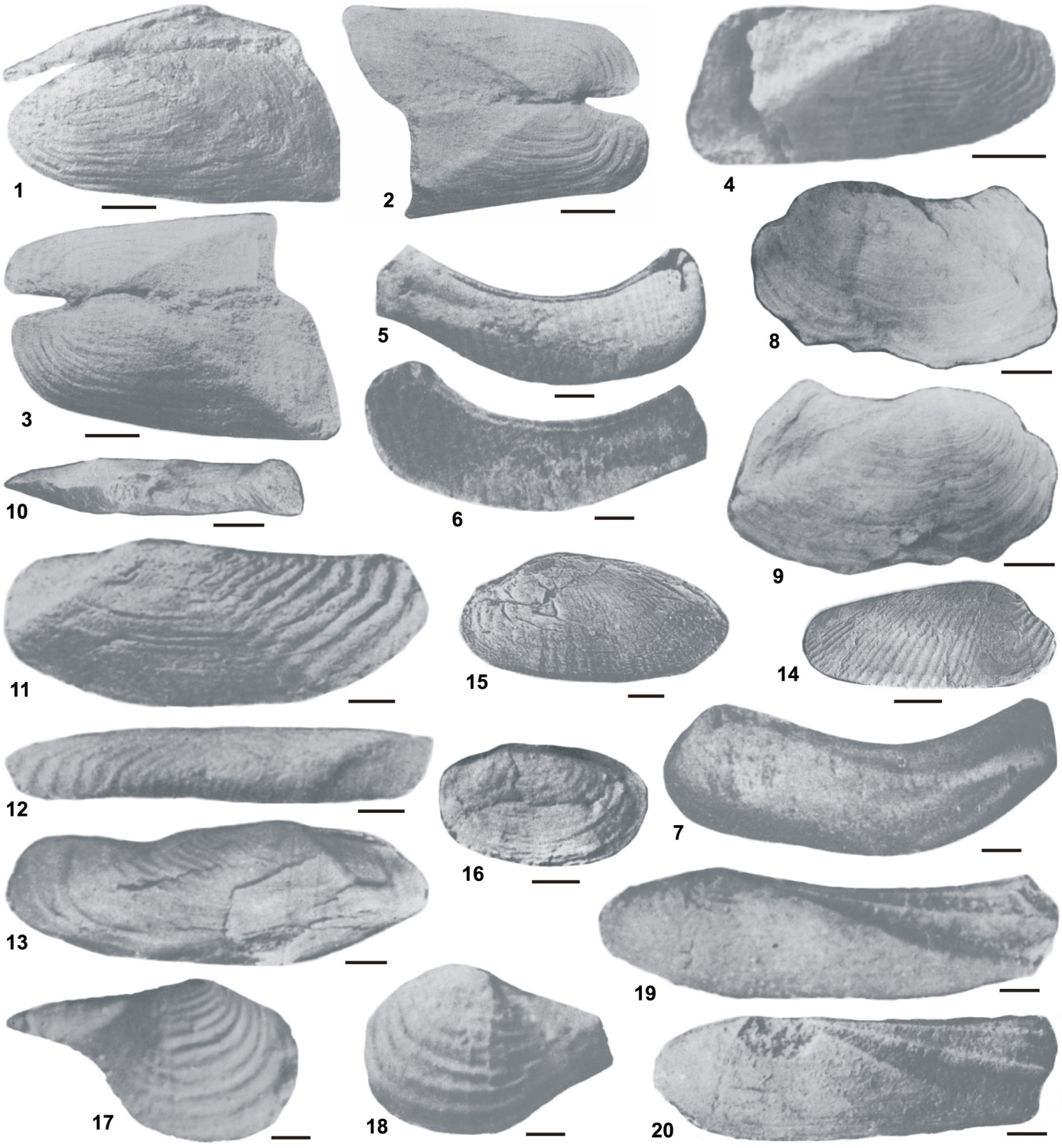

Figure 48. *For explanation, see facing page.*

Type locality.—Xujiachong, Qujing, Yunnan, southwestern China.

Type occurrence.—Xujiachong Member, Cuifengshan Formation, Emsian, Lower Devonian.

Repository of type material.—Yunnan Institute of Geological Sciences, Kunming, Yunnan; accession number: 820634 (holotype); 820635.

Distribution of genus.—Lower Devonian; eastern Yunnan, southwestern China (Guo, 1985b, p. 105).

Taxonomic position.—Archanodontidae (by original designation).

Revision suggestion.—This genus name was proposed by Guo (1985b) based on the assumption that *Dianolimnia* was limnetic. Besides plant fragments, however, fossils associated with *Dianolimnia lacustris* Guo include many marine or estuarine elements, such as *Lingula, Dysodonta,* and *Antactinodion* (Fang in Cai, Fang et al., 1994, p. 636). Therefore, this is a marine or estuarine rather than limnetic genus. *Sanguinolites qiaojiaensis* Guo (1985a, p. 227, pl. 5,*9*; see also fig. 48.4) from the marine Lower Devonian of Xiaohejie, Qiaojia County of eastern Yunnan, is very similar to *Dianolimnia lacustris* Guo. In fact, it is impossible to make any distinction of even minor importance between them (compare fig. 48.1–48.3 with fig. 48.4). In addition, *Sanguinolites qiaojiaensis* Guo should be a junior synonym of *Cimitaria guangxiensis* Zhang (in Zhang, Wang, & Zhou, 1977, p. 530, pl. 201,*11–12*). Thus, the genus name *Dianolimnia* is rejected herein, because the type species *Dianolimnia lacustris* Guo is a junior synonym of *Cimitaria guangxiensis* Zhang (Fang in Cai, Fang, et al., 1994, p. 636).

Family GRAMMYSIDAE Miller, 1877
Genus GLOSSITES Hall, 1885
Subgenus GLOSSITES (PHARCIGLOSSITES) Guo, 1985a, p. 225

[in Chinese with English description, p. 271]

Figure 46.26, 48.16

Discussion and diagnosis.—Original diagnosis of subgenus (Guo, 1985a, p. 271): shell linguiform, elongate-elliptical, equivalve, inequilateral, with moderate convexity, semicircular at anterior and posterior margins, arcuate at dorsal and ventral margins. Umbo broad, obtuse, and rounded, situated anteriorly. Surface ornamented with rugate concentric costae crossed by radial shallow grooves. Interior unknown. The new subgenus is distinguished from *Glossites s.s.* by rugate concentric costae crossed with radial shallow grooves [*sic*].

Type species.—Glossites (Pharciglossites) rugatus Guo, 1985a, p. 225, pl. 3,*1* (holotype), *2–4;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1985a, p. 225): Shell linguiform or elongate-elliptical in outline. Height slightly larger than half of length. Anterior part short, somewhat narrow, anterior margin semiorbicular; posterior part long, slightly expanded, posterior margin semiorbicular. Dorsal and ventral margins arcuate. Umbo wide, slightly projected above hinge margin, beak small, slightly incurved, situated about one-third shell length back from anterior end. Posterior umbonal carina not developed. Narrow, shallow, and fine furrow extending downward from anterior of umbo to about middle of height. Surface ornamented with rugose concentric ridges, sometimes one dividing into two, or two combining into one, ridges not well developed in anterior and posterior parts; radial shallow grooves not very evident, fine and dense anteriorly, fine and sparse posteriorly, wide and sparse in middle part of shell, grooves intersecting concentric ridges and making them rugose, bifurcating, or combining.

Type locality.—Hongmiao, Qujing.

Type occurrence.—Yulongsi Formation, upper Silurian.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0035 (holotype); IVy0036–0038.

Distribution of subgenus.—upper Silurian; eastern Yunnan, southwestern China (Guo, 1985a, p. 225).

Taxonomic position.—Grammysiidae (by original designation).

Note.—Preservation of the type species usually poor, and internal details are unknown. In addition, a narrow furrow extending downward from the anterior of the umbo of the holotype is not recognizable in the paratypes.

Figure 48. *1–4. Dianolimnia lacustris* Guo, scale bar 5 mm; *1,* holotype, left lateral view of conjoined valves; *2–3,* paratype, conjoined valves; *2,* right lateral view; *3,* left lateral view (adapted from Guo, 1985b, pl. 24,1,*2a–2b*); *4, Cimitaria guangxiensis* Zhang (=*Sanguinolites qiaojiaensis* Guo), plesiotype, left lateral view, from marine Lower Devonian of Xiaohejie, Qiaojia County of eastern Yunnan, China (adapted from Guo, 1985a, pl. 5,*9*).——*5–7. Enosolen ensatus* Guo, scale bar 1 mm; *5,* holotype, right internal mold; *6,* latex cast of Fig. 48.5; *7,* paratype, left internal mold (adapted from Guo, 1988, pl. 4,*1a-b,2*).——*8–10.* Holotype of *Osteomya (Yunnanomya) ninglangensis* Guo, scale bar 10 mm; *8,* left lateral view; *9,* right lateral view; *10,* dorsal view (adapted from Guo, 1985a, pl. 17,*8a–c*).——*11–13. Dianomya lirulata* Guo, scale bar 2 mm; *11–12,* holotype, left valve; *11,* left lateral view; *12,* dorsal view; *13,* paratype, right valve (adapted from Guo, 1985a, pl. 17,*12a–b,13*).——*14–15. Pseudoburmesia maantaoensis* Gou, scale bar 10 mm; *14,* holotype, right valve; *15,* paratype, left valve (adapted from Gou, 1993, pl. 3,*33,31*).——*16. Glossites (Pharciglossites) rugatus* Guo, scale bar 2 mm; paratype, left lateral view (adapted from Guo, 1985a, pl. 3,*3*).——*17–18. Cuspidaria (Dianocuspidaria) luxiensis* Guo, scale bar 2 mm; *17,* holotype, right valve; *18,* paratype, left valve (adapted from Guo, 1985a, pl. 34,*2–3*).——*19–20. Orthomya puerensis* Guo, scale bar 1 mm; *19,* holotype, left valve; *20,* paratype, left valve (adapted from Guo, 1985a, pl. 34,*4–5*).

Family BURMESIIDAE Healey, 1908
Genus PSEUDOBURMESIA Gou, 1993, p. 20

[in Chinese with English description, p. 26]

Figure 48.14–48.15

Discussion and diagnosis.—Original diagnosis (Gou, 1993, p. 26): shell transversely oval, inequilateral, slightly inflated, with gape in posterior part. Umbo small, marked. Beak incurved, located in anterior part. Hinge line straight, shorter than shell. Shell surface ornamented with intermittently fine radial lines and covered with many radial ridges in midposterior part and V-shaped costa or concentric ridges in anterior part of shell. Lunule indistinct. Escutcheon narrow and long. Similar to transversely oval, *Burmesia* Healey, but latter has radial lines in middle part and only concentric lines at anterior and posterior ends of shell. Both easily distinguished from each other. Resembles *Anomalopleuroides* Cox in shell shape and sculpture, but in latter, oblique ridges in anterior part of shell do not form V-shape, instead forming acute angle with radial line in middle part of shell [*sic*].

Type species.—*Pseudoburmesia maantaoensis* Gou, 1993, p. 21, pl. 3,*30–32*,*33* (holotype), *34;* by original designation; by monotypy.

Original diagnosis of type species.—(Gou, 1993, p. 27): Shell transversely oval, small to medium, 21–54 mm in length and 15–23 mm in height, inequilateral, with umbo broad and rounded. Hinge line straight, shorter than shell. Beak incurved, located at about one-fourth to one-fifth length from front. Anterior margin prominently rounded; posterior margin narrowly rounded. Three-fourths of shell surface covered with 20–25 radial ridges in posterior part of valve. Groove between both radial ridges covered with broken and very fine radial lines. One-fourth of shell surface possessing V-shaped costal sculpture in anterior part of shell. Lunule small; escutcheon large. Both valves with slight gape in posterior part [*sic*].

Type locality.—Maantang, Jiangyou, Sichuan, southwestern China.

Type occurrence.—Lower Member, Hanwang Formation, Upper Triassic.

Repository of type material.—Chengdu Institute of Technology, Chengdu, Sichuan, China; accession number: 21 (holotype); 18–20, 22.

Distribution of genus.—Upper Triassic; China (Gou, 1993, p. 21).

Taxonomic position.—Burmesiidae (by original designation).

Revision suggestion.—It may be better to regard this genus as a synonym of *Anomalopleuroides* Cox.

Superfamily THRACIOIDEA Stoliczka, 1870
Family LATERNULIDAE Hedley, 1918
Genus DIANOMYA Guo, 1985a, p. 229

[in Chinese with English description, p. 272]

Figure 48.11–48.13

Discussion and diagnosis.—Original diagnosis (Guo, 1985a, p. 272): shell elongate-rectangular or elliptical, equivalve, inequilateral, moderately inflated, narrow posterior gape and faint and narrower anterior gape, obliquely truncate at anterior and posterior margins, arcuate at ventral margin, with straight and long hinge margin. Umbo broad, low, and obtuse, near anterior end, with incurved and prosogyrous beak; anterior umbonal carina more well developed than posterior one. Surface of posterior part marked by opisthoclinely oblique costae that subparallel each other in arrangement; rest of surface smooth. *Dianomya gen. nov.* clearly differs from *Goniomya* in presence of anterior umbonal carina, and lack of oblique costae on anterior and median parts as in *Goniomya* [*sic*].

Type species.—*Dianomya lirulata* Guo, 1985a, p. 229, pl. 17,*12* (holotype), *13;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1985a, p. 229): Shell elongate-rectangular or elliptical. Length about 2.5 times height. Moderately inflated. Anterior gape weak, posterior gape evident. Hinge margin nearly straight, long, slightly shorter than shell length. Anterior margin truncate, ventral margin arcuate, posterior margin obliquely truncate. Anterodorsal and anteroventral angles subrounded, posterodorsal and posteroventral angles subequal, about 110°. Umbo wide, low, and obtuse, slightly projected above hinge margin, beak incurved, slightly prosogyrate, situated about one-third shell length back from anterior end. Anterior umbonal carina developed, evident, thick, rounded, extending from umbo to anteroventral angle; posterior carina not well developed, gentle and obscure. Surface of anterior and middle part covered only by growth lines and undulations, posterior part ornamented with oblique costae, thick and rounded, inclined backward, more than 20 in number. Anterior end of oblique costae slightly curved downward, posterior end slightly curved forward, crossing posterior hinge margin nearly at right angles.

Type locality.—Mubian, Funing, Yunnan, southwestern China.

Type occurrence.—Baifeng Formation, lower Middle Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0216 (holotype); IVy0217.

Distribution of genus.—lower Middle Triassic; southeastern Yunnan, southwestern China (Guo, 1985a, p. 229).

Taxonomic position.—Pholadomyidae (by original designation).

Revision suggestion.—This genus may be better placed in Laternulidae.

Genus TULONGELLA
Chen & J. Chen in Wen et al., 1976, p. 68

[in Chinese]

Figure 46.22–46.25

Discussion and diagnosis.—Original diagnosis (translation from Chinese text, Chen & J. Chen in Wen et al., 1976, p. 68): shell small, transverse-elongate and narrow. Anterior end rounded, posterior part elongate and tapered. Moderately inflated. Umbo low and wide, situated near anterior end. Anterior hinge margin short and obliquely truncated, posterior long and nearly straight. Posterior umbonal carina extending from umbo to posteroventral

angle, broadly rounded, flank rather inflated, siphonal area concave. Escutcheon narrow, long, and low. Surface covered only by concentric ornament. Umbonal cavity with short internal septum, preserved as slit on internal molds or external shell surfaces. Siphonal area with groove corresponding to internal ridge extending from umbo to posteroventral angle on interior surface. Hinge teeth not seen. Anterior adductor scar small, oval, posterior weak. Pallial line without sinus.

Type species.—Tulongella xizangensis Chen & J. Chen in Wen et al., 1976, p. 69, pl. 15,*2* (holotype), *3–8;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Chen & J. Chen in Wen et al., 1976, p. 69): As for genus.

Type locality.—Tulong, Nielamu, Xizang (Tibet), China.

Type occurrence.—Qulonggongba Formation, Norian, Upper Triassic.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 30782 (holotype); 30783–30788.

Distribution of genus.—Upper Triassic; China and Burma (Chen & J. Chen in Wen et al., 1976, p. 69).

Taxonomic position.—Laternulidae (by original designation).

Note.—Enosolen Guo, 1988, is a junior synonym of this genus, as mentioned below.

Genus ENOSOLEN
Guo, 1988, p. 128

[in Chinese]

Figure 48.5–48.7, 49

Discussion and diagnosis.—Original diagnosis of genus (translation from Chinese text, Guo, 1988, p. 128): shell small and thin, crescent or ensiform, equivalve; anterior end rounded, dorsal and ventral margins subparallel to each other, arcuate; umbo obtuse, salient slightly above hinge margin, situated near anterior end; posterior umbonal carina narrow, steep, and prominent, extending from umbo to posteroventral extremity; posterior area marked by one radial ridge, radiating from umbo to posterior margin similar to posterior umbonal carina; surface ornamented with growth lines. Cardinal teeth well developed, with 2 in each valve; small septum under umbo, dividing umbonal cavity; narrow and thin ridge along dorsal margin in right valve.

Type species.—Enosolen ensatus Guo, 1988, p. 129, pl. 4,*1* (holotype), *2–4*; text-fig. 8; by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1988, p. 129): Shell length 6–11 mm, more than 3–4 times height; anterior and posterior ends curved upward, resulting in crescent or ensiform shell; anterior margin rounded, dorsal margin subparallel to ventral margin, both arcuate; umbo obtuse, situated near anterior end; posterior umbonal carina well developed, angular, prominent, extending from umbo to posteroventral extremity, like a diagonal line; posterior area marked by one radial ridge, angular and prominent, radiating from umbo to posterior margin; wide and shallow sulcus between two ridges; surface ornamented only with growth lines. Two cardinal teeth in each valve, teeth of right valve anterior to those of left valve in their given order; small septum under umbo, dividing umbonal cavity; slender ridge along posterodorsal margin in right valve.

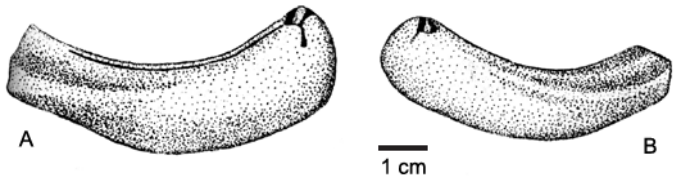

Figure 49. Diagrammatic drawing of *Enosolen ensatus* Guo; *1,* holotype, right valve (Ivy 0670); *2,* paratype, left valve (Ivy 0671) (adapted from Guo, 1988, p. 129, text-fig. 8).

Type locality.—Shizhongshan, Jianchuan, Yunnan, southwestern China.

Type occurrence.—Shanglan Formation, Anisian, lower Middle Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0670 (holotype); IVy0671–0674.

Distribution of genus.—lower Middle Triassic; western Yunnan; southwestern China (Guo, 1988, p. 129).

Taxonomic position.—Cultellidae (by original designation).

Revision suggestion.—Enosolen Guo, 1988 is junior synonym of *Tulongella* Chen & J. Chen in Wen et al., 1976 and is included in Laternulidae. See *Tulongella* Chen & J. Chen (above).

Genus ORTHOMYA Guo, 1985a, p. 234

[in Chinese with English description, p. 273]

Figure 48.19–48.20

Discussion and diagnosis.—Original diagnosis (Guo, 1985a, p. 273): shell flatly tubed [flattened cylindrical], elongate-rectangular in lateral view, straight and long hinge margin and narrow faint gape at posterior end, semicircular at anterior margin, nearly straight at ventral margin. Umbo low and broad, placed very anteriorly. Internal umbonal plate developed, extending toward anterior ventral part. 3 carinae radiating from umbo to posterior margin respectively. Surface marked by concentric costae and growth lines. *Cercomya* and *Capillimya* differ from *Orthomya gen. nov.* in tapering and upcurved posterior end. Umbo of *Plecomya* placed near midlength of shell, whereas that of *Orthomya* situated very anteriorly. *Orthomya* easily distinguished from *Platymyoidea* in radial costae on posterodorsal part [*sic*].

Type species.—Orthomya puerensis Guo, 1985a, p. 234, pl. 34,*4* (holotype), *5;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1985a, p. 234): Shell rather small, flat tubelike, elongate rectangular. Length about three times height. Gaping at posterior end. Hinge margin nearly straight, long, slightly smaller than shell length. Anterior margin semiorbicular, ventral margin nearly straight. Posterior margin truncated twice, upper part inclined forward, lower part inclined backward. Umbo wide, low, and obtuse, slightly projected above hinge margin, beak small, incurved, situated about one-quarter shell length back from anterior end. Narrow slit extending from umbo downward to one-third height. Corselet

with three radial ribs extending from umbo to posterior margin or posteroventral angle, ventral one (namely, posterior umbonal rib) thick and acute; middle one strongest, wide and thick, with flat crest; dorsal one narrow and fine; two shallow grooves between them, wide and flat, extending from umbo to posterior margin, and becoming wider. Flank ornamented with concentric ridges, regular and distinct near umbo and on anterior part, but obscure on remainder. Corselet with two times as many concentric ridges as flank, strength about same as those on flank.

Type locality.—Ganlanba, Pu'er, Yunnan, southwestern China.

Type occurrence.—Weiyuanjiang Formation, lower Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0392 (holotype); IVy0393.

Distribution of genus.—lower Upper Triassic; western Yunnan, southwestern China (Guo, 1985a, p. 234).

Taxonomic position.—Laternulidae (by original designation).

Note.—*Healeya* Hautmann (2001, p. 108) also has three radial costae on posterior area, but lacks intenal septum.

Order SEPTIBRANCHIA Pelseneer, 1889
Superfamily CUSPIDARIOIDEA Dall, 1886
Family CUSPIDARIIDAE Dall, 1886
Genus CUSPIDARIA Nardo, 1840
Subgenus CUSPIDARIA (DIANOCUSPIDARIA) Guo, 1985a, p. 235

[in Chinese with English description, p. 273]

Figure 48.17–48.18

Discussion and diagnosis.—Original diagnosis of subgenus (Guo, 1985a, p. 273): Shell small, spoon shaped, subequivalve, with straight and long hinge margin. Main part of shell body subcircular; posterior part elongate, tapered, strongly rostrate. Umbo obtuse, large, and broad, slightly anterior to median. Surface ornamented by coarse, rounded, concentric costae and relatively regular and slender radial costae. Similar to *Tergulina* and *Pseudocuspidaria* in coarse and rounded concentric costae, but differs in possession of slender radial costae [*sic*].

Type species.—*Cuspidaria (Dianocuspidaria) luxiensis* Guo, 1985a, p. 235, pl. 34,*2* (holotype), *3;* by original designation; by monotypy.

Original diagnosis of type species.—(Translation from Chinese text, Guo, 1985a, p. 235): Shell small, somewhat spoon shaped. Flank of shell subcircular in outline; posterior part of shell elongate, tapered, and rostrate. Length nearly two times height. Hinge margin nearly straight, long, slightly smaller than shell length. Anterior and posterior margins semiorbicular. Umbo large, obtuse, and broad, slightly projected above hinge margin, situated about two-fifths shell length back from anterior end. Posterior umbonal carina well developed near umbo, becoming obscure toward posteroventral margin. Rostrate posterior end inflated, not raised, somewhat cone shaped, separated from flank by wide sulcus, radiating from umbo, becoming wider and shallower toward ventral end. Surface ornamented with thick and rounded concentric ridges, regular, about same width as interspaces, not beyond sulcus. Few radial costae occurring in umbo and middle posterior part of flank, narrow, slender, and thin, about 10 in number.

Type locality.—Wayao, Luxi, Yunnan, southwestern China.

Type occurrence.—Wuge Formation, lower Upper Triassic.

Repository of type material.—The Geological Museum of China, Beijing; accession number: IVy0390 (holotype); IVy0391.

Distribution of subgenus.—lower Upper Triassic; eastern Yunnan, southwestern China (Guo, 1985a, p. 235).

Taxonomic position.—Cuspidaridae (by original designation).

Note.—Type species represented by only two specimens; internal details are quite unknown.

NONBIVALVE TAXA THAT HAVE BEEN CONSIDERED TO BE CAMBRIAN BIVALVES

Genus CYCLOCONCHOIDES Zhang Ren-jie, 1980, p. 12

[in Chinese]

Type species.—*Cycloconchoides venustus* Zhang Ren-jie, 1980, p. 13, pl. 3,*6* (holotype), *4–13*; by original designation.

Type locality.—Zhongbao, Xianfeng, Hubei, South China.

Type occurrence.—Tianheban Formation, lower Cambrian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China.

Taxonomic position.—Cycloconchoididae (by original designation).

Revision suggestion.—*Cycloconchoides* is a conchostracan branchiopod rather than a bivalve, as suggested by Pojeta (2000, p. 161).

See also.—Fang (2004a) for discussion of Cambrian bivalves in China.

Family CYCLOCONCHOIDIDAE Zhang Ren-jie, 1980, p. 12

[in Chinese]

Distribution of family.—lower Cambrian, Hubei, South China.

Taxonomic position.—Praelamellodontoidea Zhang Ren-jie, 1980 (by original designation).

Revision suggestion.—Because the type genus is not a bivalve, the family name is presently rejected for the purposes of bivalve taxonomy.

Genus HUBEINELLA
Zhang Ren-jie, 1980, p. 14
[in Chinese]

Type species.—*Hubeinella formosa* Zhang Ren-jie, 1980, p. 14, pl. 3,*1* (holotype), *2–5*; by original designation.

Type locality.—Zhongbao, Xianfeng, Hubei, South China.

Type occurrence.—Tianheban Formation, lower Cambrian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China.

Taxonomic position.—Undecided in original text.

Revision suggestion.—*Hubeinella* may be a obolellid brachiopod rather than a bivalve (Pojeta, 2000, p. 161).

See also.—Fang (2004a) for discussion of Cambrian bivalves in China.

Genus PRAELAMELLODONTA
Zhang Ren-jie, 1980, p. 7
[in Chinese]

Type species.—*Praelamellodonta elegansa* Zhang Ren-jie, 1980, p. 8, pl. 1,*1* (holotype), *2–14*; by original designation.

Type locality.—Zhongbao, Xianfeng, Hubei, South China.

Type occurrence.—Tianheban Formation, lower Cambrian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China.

Taxonomic position.—Praelamellodontidae (by original designation).

Revision suggestion.—As suggested by Pojeta (2000, p. 161), *Praelamellodonta* is an obolellid brachiopod rather than a bivalve.

See also.—Fang (2004a) for discussion of Cambrian bivalves in China.

Superfamily PRAELAMELLODONTOIIDEA
Zhang Ren-jie, 1980, p. 6
Family PRAELAMELLODONTIDAE
Zhang Ren-jie, 1980, p. 7
[in Chinese]

Distribution of superfamily and family.—lower Cambrian, Hubei, South China.

Taxonomic position.—Modiomorphoida (by original designation).

Revision suggestion.—Because the type genus is not a bivalve, the family and superfamily names are presently rejected for purposes of bivalve taxonomy.

Genus XIANFENGOCONCHA
Zhang Ren-jie, 1980, p. 9
[in Chinese]

Type species.—*Xianfengoconcha elliptica* Zhang Ren-jie, 1980, p. 10, pl. 2,*1* (holotype), *2–6*; by original designation.

Type locality.—Zhongbao, Xianfeng, Hubei, South China.

Type occurrence.—Tianheban Formation, lower Cambrian.

Repository of type material.—Yichang Institute of Geology and Mineral Resources, Ministry of Land and Resources, Yichang, Hubei, China.

Taxonomic position.—Praelamellodontidae (by original designation).

Revision suggestion.—*Xianfengoconcha* probably is an inarticulate brachiopod rather than a bivalve (Pojeta, 2000, p. 161).

See also.—Fang (2004a) for discussion of Cambrian bivalves in China.

Genus YANGTZEDONTA Yu, 1985, p. 402
[in Chinese with English description, p. 406]

Type species.—*Yangtzedonta primitiva* Yu, 1985, p. 407, pl. 1,*1–5* (monotype); text-fig. 1; by original designation.

Type locality.—Baize, Xundian, Yunnan, southwestern China.

Type occurrence.—Zhongyicun Member, Tongying Formation, lower Cambrian.

Repository of type material.—Nanjing Institute of Geology and Palaeontology; accession number: 84430 (holotype).

Taxonomic position.—?Pterineidae (by original designation).

Revision suggestion.—*Yangtzedonta* is rejected as a bivalve because the holotype (accession number: 84430) of *Yangtzedonta primitiva* Yu, 1985, shows no diagnostic bivalve features (Fang, 2004a, 2007b). Because the holotype has preserved internal and external shell surfaces, it is a body fossil rather than an internal mold. Yu Wen (1985, 2005) mistook the holotype for an internal mold. Therefore, all muscle scars described by Yu (1985, 2005) are fictitious because they cannot be preserved on an external shell surface. Unfortunately the interior of the holotype is covered by sediment so that internal features are not visible. Electron probe analysis of the holotype (Fang, 2007b) proved Qian's view of point that a so-called lamellar tooth (Yu, 1985, p. 407) or lamellar ridge (Yu, 2005, p. 770) is a secondary phosphatic feature formed during diagnosis rather than an original hinge structure. Qian (2001) suggested that *Yangtzedonta primitiva* Yu is only an incomplete specimen of *Xianfengella* He and Yang, a problematic small shelly fossil.

ACKNOWLEDGMENTS

This work was supported by the Special Basic Research Program of the Ministry of Science and Technology, China (2006FY120400), State Key Laboratory of Palaeobiology and Stratigraphy, NIGPAS (No. 073102), the Knowledge Innovation Program of Nanjing Institute of Geology and Palaeontology (KIP2007), the Chinese Academy of Sciences (KZCX3-SW-149), and the Major Basic Research Project of the Ministry of Science and Technology, China (2006CB806400). We would like to thank Dr. Joseph G. Carter for reading our initial submission with commendable care and offering many helpful comments. Jill M. Hardesty improved significantly the final language of the manuscript. Thanks also go to Dr. Philippe Bouchet (Museum National d'Histoire Naturelle, Paris, France) for discussion of nomenclatural problems with *Yunnanophorus*, *Guangdongella*, and *Lilingella.*

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