FOSSIL BIVALVES OF YUNNAN

Guo Fuxiang

Yunnan Institute of Geological Sciences

Kunming, Yunnan, CHINA

(**Summary**)

The book contains two parts.

PART 1. KNOWN BIVALVES OF EACH GEOLOGICAL TIME OF YUNNAN

The part reviews the previous study results, some in which are revised in the paper according to the current materials. It introduces briefly bivalve strata of Yunnan, discusses bivalve stratigraphic problems of the Yunnan Triassic and Cretaceous and deals with the bivalve zonation of Yunnan.

I. BIVALVE ZONATION OF YUNNAN

On account of known data, 30 zones and 6 subzones can be distinguished in the paper in descending order below.

A. Cretaceous Bivalve Zonation of Yunnan

3 non-marine bivalve zones of the Yunnan Cretaceous have been known (Table 1) :

Zone Cr3 *Hoffetrigonia* (*Hoffetrigonia*) *laotiae* (Hoffet) - *Hoffetrigonia* (*Hoffetrigonia*) *trigona* (Hoffet) zone represented by the upper Matoushan Formation, might be thought to be Cenomanian-Turonian age.

Zone Cr2 *Trigonioides sinensis* Gu et Ma - *Nippononaia* (*Nippononaia*) *yunnanensis* Gu et Ma zone, can be seen in the lower Matoushan Formation,

Table 1. Cretaceous classification of central and west Yunnan

					West Yunnan	Central Yunnan
Cretaceous	Upper				Mankuanhe Formation	Jiangdihe Formation
	Middle	3			Bashahe Formation	Matoushan Formation
		2			Mangang Formation	Shimenshao Formation
	Lower	1	1b	Jingxing Formation	Upper member	Puchanghe Formation
			1a		Lower member	Gaofengsi Formation

the Shimenshao Formation and the middle Mangang Formation, etc., and probably belongs to Aptian–Albian age.

Zone Cr1 *Koreanaia antiqua* (Gu et Ma)–*Peregrinoconcha nuanliensis* Guo–*Sinonaia chuxiongensis* (Gu et Ma) zone can be thought to be Neocomian age, and may be divided into 2 subzones:

Subzone Cr1b *Peregrinoconcha nuanliensis* Guo–*Sinonaia chuxiongensis*

(Gu et Ma) – *Nippononaia* (*Eonippononaia*) *diana* Guo subzone, represented by the upper member of the Jingxing Formation and the Puchanghe Formation.

Subzone Cr1a *Koreanaia antiqua* (Gu et Ma) subzone, represented by the Gaofengsi Formation.

B. Jurassic Bivalve Zonation of Yunnan

At present, Jurassic bivalves of Yunnan can only be divided into 2 zones and 2 subzones (Table 2) :

Zone J2 *Undulatula* (*Undulatula*) *sichuanensis* Gu – *Dianina yunnanensis* gen. et sp. nov. – *Myopholas yunnanensis* J. Chen et Lin zone occurs in the Longhai

Table 2. Jurassic classification of central and west Yunnan

		zone	subzone	West Yunnan	Central Yunnan
Jurassic	Upper			Bazhulu Formation	Tuodian Formation / Shedian Formation
	Middle	2	2b	Longhai Formation	Zhanghe Formation
			2a	Liuwan Formation / Hepingxiang Formation / Huakaizou Formation	Shanglufeng Formation
	Lower	1		Mengga Formation / Zhangkezhai Formation / Yangjiang Formation	Fengjiahe Formation / Xialufeng Formation

Formation, the Liuwan Formation, the Hepingxiang Formation and the Huakaizou Formation intercalated with marine beds, and the non-marine Zhanghe Formation, etc.

Zone J2 can be distinguished into 2 marine subzones in Baoshan-Lùxi region:

Subzone J2b *Lùxitrigonia menggaensis* gen. et sp. nov. subzone lies in the Longhai Formation.

Subzone J2a *Myopholas yunnanensis* J. Chen et Lin subzone occurs in the Liuwan Formation.

Zone J1 *Cuneopsis* (*Eocuneopsis*) *yipinglangensis* (Ma)-*Cuneopsis* (*Eocuneopsis*) *lufengensis* (Ma) zone occurs in non-marine beds, represented by the Xialufeng Formation, the Fengjiahe Formation and the Zhangkezhai Formation, etc.

C. Triassic Bivalve Zonation of Yunnan

9 zones, 2 subzones and 3 parallel zones of bivalves have been recognized in the Triassic (Table 3):

Zone T9 *Burmesia lirata* Healey-*Yunnanophorus boulei* (Patte)-*Indosinion dianense* Guo (MS.) can be found in the Huobachong Formation, the Xiangyun Group, the Yipinglang Group and the Maichuqing Formation, etc.

Zone T9 can be difficultly distinguished also into 2 subzones in partial region:

Subzone T9b *Yunnanophorus boulei* (Patte)-*Indosinion dianense* Guo (MS.) subzone of the Baitutian Formation;

Subzone T9a *Burmesia lirata* Healey-*Costatoria napengensis* (Healey) subzone of the Luojiadashan Formation.

Zone T8 *Halobia pluriradiata* Reed-*Halobia spectabilis* sp. nov. zone of the Niaoge Formation.

Zone T7 *Halobia rugosoides* Hsü-*Halobia rugosa* Guembel zone of the Caizitang Formation.

Zone T6 *Daonella lommeli* (Wissmann)-*Daonella indica* Bittner zone occurs in the Falang Formation, the Dounan Formation, the Choushui Formation.

Zone T5 *Costatoria goldfussi mansuyi* Hsü-*Leptochondria paradoxica* (Chen) zone appears in the Gejiu Formation and the Shanglan Formation.

Table 3. Triassic classification of Yunnan

		zone	West Yunnan		Central – East Yunnan				S. E. Yunnan
Triassic	Upper	Nor.–Rhaet.	9	Daping-zhang F. / Taozishu Formation	Maichuqing-Formation	Xiangyun Group	Baitutian Formation / Luojiada-shan F.	Yipinglang Group	Huobachong Formation
			8	Weiyuanjiang Formation	Shanhedong Formation	Yunnanyi Formation	Niaoge Formation		
		Car.	7		Waigucun Formation		Caizitang Formation		
	Middle	Lad.	6		Choushui Formation		Falang Formation / Dounan Formation		Hekou Formation
		Anis.	5		Shanglan Formation		Gejiu Formation		Baipeng Formation
	Lower	Olenek.	4				Yongningzhen Formation		Luolou Formation
		Ind.	3				Feixianguan Formation		
			2				Ximatang Formation		
			1						

Zone T4 *Pteria murchisoni leshanensis* subsp. nov. zone of the Yongningzhen Formation.

Zone T3 *Eumorphotis multiformis* (Bittner) – *Claraia aurita* (Hauer) zone.

Zone T2 *Towapteria scythica* (Wirth) – *Pseudoclaraia wangi* (Patte) zone.

Zone T1 *Pteria ussurica variabilis* Chen zone.

Zone T1–3 can be collected in the Feixianguan and the Ximatang Formations.

There are still 3 parallel zones in the Yunnan Triassic:

Parallel Zone T3 *Otapiria yunnanica* sp. nov. – *Otapiria rotunda* sp. nov. zone of the Taozishu Formation is parallel with zone T9.

Parallel Zone T2 *Trigonodus costatus* Woehrmann – *Costatoria inaequicostata* (Klipstein) zone of the Weiyuanjiang Formation parallels to zone T7 and 8.

Parallel Zone T1 *Daonella producta* Hsü – *Pterohalobia productalata* gen. et sp. nov. zone of the Baipeng Formation runs parallel to zone T5.

D. Permian Bivalve Zonation of Yunnan

Because the Permian bivalve data is seldom known, no condition of zonation is mature. It is necessary that several species of the Upper Permian are emphasized for correlation of relative strata.

Tambanella yunnanensis sp. nov. – *Tambanella alta* sp. nov. zone has been found in the Xuanwei Formation of east Yunnan.

Claraia diana sp. nov. zone has been discovered in the Uppermost Permian, the top of the Changxing Formation from Ninglang County.

E. Devonian Bivalve Zonation of East and Southeast Yunnan

Currently, 7 zones can be tentatively presented below (Table 4):

Zone D7 *Palaeolucina? luliangensis* sp. nov. zone lies in the Yidade Formation.

Zone D6 *Tanaodon yunnanensis* sp. nov. – *Xinshaophorus* (*Dalophonychia*) *lophoides* subgen. et sp. nov. – *Limoptera yunnanensis* sp. nov. zone occurs in the Qujing Formation.

Zone D5 *Paraphtonia semilevis* sp. nov. zone is known in the Haikou Formation.

Zone D4 *Pholadella* (*Qiaojiaia*) *usitata* subgen. et sp. nov. – *Ptychopteria*

Table 4. Devonian bivalve zonation of east and southeast Yunnan

Devonian	Upper			Zaijieshan Formation	
		zone 7		Yidade Formation	*Palaeolucina? luliangensis* zone
	Middle	6		Qujing Formation	*Tanaodon yunnanensis – Xinshaophorus (Dalophonychia) lophoides – Limoptera yunnanensis* zone
		5		Haikou Formation	*Paraphtonia semilevis* zone
	Lower			Gumu Formation	*Pholadella (Qiaojiaia) usitata – Ptychopteria (Actinopteria) raricostalis* zone
		4	Daigu Group	Bianqinggou F. / Dongliji F.	
		3		Pojiao Formation	*Antactinodion biradiatum – Antactinodion cuneatum* zone
		2		Xujiachong Formation	*Dianolimnia lacustris* zone
				Guijiatun F.	
		1	Cuifengshan Group	Xitun Formation	*Dysodonta deprati – Dysodonta levis – Modiolopsis yunnanensis* zone
				Xiaxishancun Formation	

(*Actinopteria*) *raricostalis* sp. nov. zone has been collected in the Bianqinggou Formation and the Dongliji Formation.

Zone D3 *Antactinodion biradiatum* Guo–*Antactinodion cuneatum* Guo zone appears in the Daigu Group and the Pojiao Formation.

Zone D2 *Dianolimnia lacustris* Guo zone has been found in the non-marine Xujiachong Formation.

Zone D1 *Dysodonta deprati* Mansuy–*Dysodonta levis* Guo–*Modiolopsis yunnanensis* sp. nov. is widespread in Xitun Formation and the Xiaxishancun Formation.

F. Late Silurian Bivalve Zonation of East Yunnan

3 zones have been known in the Upper Silurian of east Yunnan (Table 5):

Zone S3 *Glossites* (*Pharciglossites*) *rugatus* subgen. et sp. nov.–*Lunulacardium qujingensis* sp. nov. zone appears in the Yulongsi Formation.

Table 5. Upper Silurian bivalve zonation of east Yunnan

Upper Silurian	zone 3	Yulongsi Formation	*Glossites* (*Pharciglossites*) *rugatus*–*Lunulacardium qujingense* zone
	2	Miaogao Formation	*Mytilarca qujingensis*–*Mytilarca xiaoxiangensis* zone
	1	Guandi Formation	*Sinocaris asiatica*–"*Sanguinolites*" *chunaiensis* zone

Zone S2 *Mytilarca qujingensis* sp. nov. – *Mytilarca xiaoxiangensis* sp. nov. zone occurs in the Miaogao Formation.

Zone S1 *Sinocaris asiatica* Mansuy – "*Sanguinolites*" *chunaiensis* sp. nov. zone is represented in the Guandi Formation.

G. A Bivalve Zone of the Early Ordovician

Cypricardinia prisca Mansuy – *Cypricardinia parallela* (Hsü) zone is probably of Arenigian – Llanvirnian age and corresponds to the Fenxiang Formation, the Hongshiai Formation, the Honghuayuan Formation and the Meitan Formation.

Ⅱ. BIVALVE STRATIGRAPHIC PROBLEMS OF THE YUNNAN TRIASSIC AND CRETACEOUS

Bivalve stratigraphic problems of the Yunnan Triassic and Cretaceous are discussed, and the conclusion is reached below.

A. On the "Falang Formation" of East Yunnan and Southwest Guizhou

The "Falang Formation" extensively is distributed in Zhenfeng – Xingren of southwest Guizhou and Luoping – Lúxi – Kaiyuan – Gejiu of east Yunnan, and has been considered as Ladinian age since Hsü (1940) collected *Daonella indica* Bittner in it. New materials indicate that the horizon contains 2 bivalve zones, the *Halobia rugosoides* Hsü zone in the upper part and the *Daonella lommeli* (Wissmann) in the lower part. The upper one is equivalent to the *Halobia rugosa* Guembel zone of European Carnian. On the other hand, the genus *Halobia* appeared in Anisian and is less in Iabinian, but most abuntant in Carnian and more in Norian in number of species and individuals. There are a lot of *Halobia* in the upper part of the "Falang Formation". Therefore it is better that the upper part, which is named as the Caizitang Formation in the paper, belongs to Carnian age. The rest is referred to Ladinian age as before.

B. Correlation of Coal—containing Formations of Late Triassic

1. Correlation of the Huobaching Formation with the Yipinglang Group

Previously, the Yipinglang Group dominated by non-marine beds was regarded as overlying strata of the Huobachong Formation mainly constituted with marine beds. Afterwards, important marine bivalve fossils of zone T9, *Yunnanophorus boulei* (Patte), *Indosinion emeiense* (Chen et Zhang), *Costatoria* cf. *napengensis* (Healey), etc., were collected in the Yipinglang Group, which shows that the two fundamentally are contemporaneous but of different facies (Table 6).

2. On the Horizon of the Daqiaodi Formation

Which horizon does the Daqiaodi Formation correspond to? There are 3 facts to be able to enlighten us as follows:

a. The Daqiaodi Formation disconformably underlies the overlying strata Daqing Formation like the relations between the Pujiacun Formation and the Ganhaizi Formation.

b. The flora and the bivalve fauna of the Ganhaizi Formation generally are consistent with those of the Daqing Formation.

c. Bivalves of the Pujiacun Formation are the same as those of the lower part of the Huobachong Formation.

Such as above, the Daqiaodi Formation is equivalent to the Pujiacun Formation or the lower part of the Huobachong Formation (Table 6).

Table 6. Correlation of Late Triassic coal-bearing formations

	West Yunnan	Central Yunnan					East Yunnan
Upper Upper Triassic	Maichuqing Formation	Xiangyun Group	Baitutian Formation	Yipinglang Group	Shezi Formation	Nalaqing Group	Daqing Formation	Huobachong Formation
			Luojiadashan Formation		Ganhaizi Formation		
					Pujiacun Formation		Daqiaodi Formation

C. On Ages of Late Triassic Formations of Yunnan

The formations of Yunnan Late Triassic can naturally be divided into 2 parts (Table 3). The upper ones, which contain the Huobachong Formation, the Nalaqing Group, the Yipinglang Group, the Xiangyun Group and the Maichuqing Formation, etc., yield an endemic bivalve fauna, including *Burmesia*, *Prolaria*, *Indopecten*, *Pergarmidia*, *Yunnanophorus*, *Indosinion* (MS.), *Eosion* (MS.) and so on, without or with a few *Halobia*; the lower those composed of the Caizitang Formation, the Niaoge Formation, the Yunnanyi Formation, the Waigucun Formation and the Shanhedong Formation, etc., are dominated by *Halobia* in number of species and individuals. The Norian stage still possesses relatively many *Halobia* in number of species and individuals. The fact indicates that the top boundary of the the lower formations of the Yunnan Upper Triassic is higher than that between the Carnian and the Norian stages. Because the Lower Jurassic red beds conformably overlie the Upper Triassic of Yunnan, there must be the Rhaetian geological body, which is difficultly distinguished at present owing to the endemic characteristics. As above mentioned, it is probably appropriate that the Upper Triassic of Yunnan and adjacent areas is divided into the 2 parts to display the bipartite character instead of the tripartite as in the case of Europe.

D. Bivalve Character and Nomenclatorial Revision of the Jingxing Formation from West Yunnan

Chen and Lan (see Gu et al., 1976) considered that the bivalves of the Jingxing Formation is a marine Late Jurassic fauna. Gu, Chen and Lan (see Ma et al., 1976) expounded further the idea which correlated the fauna with that of the Oxfordian and Kimmeridgian stages in Europe, Africa and India. Gu (1980, 1982) expressed their previous opinion once more. Wen (1979) reported *Peregrinoconcha* of the upper part of the Yanshiping Group and thought *Peregrinoconcha* is of the Middle Jurassic age.

Guo (1981) displayed the new materials revealing the hinge struture of several important genera, such as, *Peregrinoconcha*, *Sinonaia* and *Nakamuranaia*, and so on. The hinge of *Peregrinoconcha* is the same as that of *Wakinoa*. And the perfect specimens show that *Sinonaia* and *Eonipponaia* were misidentified with *Goniomya* and that *Nakamuranaia* was erroneously consider-

ed as *Quenstedtia* of the marine Upper Jurassic bivalves by Gu, Chen, Lan and others. Guo (1981) dealed with the phylogeny of the superfamily Trigonioidacea, and explained that the fauna is early products of the trigonioidacean phylogeny and that it is part of the endemic characteristic trigonioidacean fauna of the Asian non-marine Cretaceous. The non-marine bivalves are entirely different from the marine. The previous nomenclatorial list of the Jingxing Formation bivalves has to be revised (please see Table 57 in Chinese).

E. On the Bivalve Character and Sedimentary Facies of the Mangang Formation from Nuguishan, Puer County

The book named by "Mesozoic Red Beds of Yunnan" (1975, p. 39) considered that the Mangang Formation mentioned contains marine bivalves. The writer recollected specimens in the same locality and restudied the bivalve fauna, which indicates that it is also the non-marine bivalves. A revised list is shown in Table 58 in Chinese.

F. *Peregrinoconcha* of the Puchanghe Formation of Central Yunnan

Gu (1962) established *Trigonioides yunnanensis* Gu et Ma yielding in the Puchanghe Formation at Zhuxichong, Chuxiong, central Yunnan. The writer recollected specimens at the same fossil point. Some of the treated specimens display the generally same hinge as that of *Peregrinoconcha* of the Jingxing Formation of west Yunnan. *Trigonioides yunnanensis* Gu et Ma, 1962, has to be transferred to *Peregrinoconcha yunnanensis* (Gu et Ma), which is homonymous with *Peregrinoconcha yunnanensis* Chen et Lan, 1976. The latter has to be rejected because it is a junior homonym. A subspecies of *Peregrinoconcha yunnanensis* Chen et Lan, *Peregrinoconcha yunnanensis nuanliensis* Guo, 1981, is elevated to the species *Peregrinoconcha nuanliensis* Guo instead of the new name method to remove the homonym.

G. Bivalve Nomenclatorial Revision of the Matoushan Formation of Yejiachong, Yaoan County

The book of "Mesozoic Red Beds of Yunnan" (1975, p. 117-118) recorded the Yejiachong section of the Matoushan Formation. In the same fossil

point of the section there is a bivalve list including the following species:

Trigonioides (*Trigonioides*) *laotiae* Hoffet,

Trigonioides (*Trigonioides*) *sinensis* Gu et Ma,

Trigonioides (*Trigonioides*) *yongkangensis* Gu et Ma.

Ma (in Ma et al., 1976) described the three species, of which *Trigonioides* (*Trigonioides*) *laotiae* Hoffet, namely, *Hoffetrigonia* (*Hoffetrigonia*) *laotiae* (Hoffet), occurs in the Senonian strata of Laos to be able to be correlated with the Goshonoura Group or the Mifune Group of Japan belonging to Cenomanian－Turonian age. The other 2 species, being important representatives of zone Cr2 lie in the Guantou Formation of Zhejiang, which is equivalent to the Wakino Subgroup of Japan or the Nagdong Subgroup of Korea to be thought to be of Aptian－Albian age. Obviously, the list has to be revised, please see Table 53 in Chinese.

PART 2. DESCRIPTIONS OF NEW GENERA AND SPECIES OF YUNNAN BIVALVES

The purpose of this part is to record 167 genera and subgenera and 281 species and subspecies, including 7 new genera, 12 new subgenera, 258 new species and 18 new subspecies. Here the diagnoses of the only new genera and subgenera are summarily recorded below.

Class BIVALVIA Linné, 1758 (Buonanni, 1681)

Order PRAECARDIOIDA Newell, 1965

Superfamily PRAECARDIACEA Hoernes, 1884

Family ANTIPLEURIDAE Neumayr, 1891

Genus *Antipleura* Barrande, 1881

subgenus *Daiguia* Guo, subgen. nov.

Type-species: *Antipleura* (*Daiguia*) *mengziensis* Guo, sp. nov.

Shell subrounded, subequilateral, inequivalve, with moderate convexity. Umbo slightly anterior to median, weakly prosogyrous at the beak. Left valve obviously more convex with prominently overhanging umbo; right valve flat and slightly concave with obscure low and small umbo. Surface ornamented broad radial folds, which are broader and lower in right valve.

The new subgenus is discriminated from *Antipleura* and *Dualina* by the flat and slightly concave right valve and the broad radial folds on the shell surface.

Lower Devonian Daigu Group from Daigu, Mengzi County, east Yunnan.

Order PTERIOIDA Newell, 1965

Superfamily AMBONYCHIACEA S. A. Miller, 1877

Family AMBONYCHIIDAE S. A. Miller, 1877

Genus *Xinshaophorus* Ding, 1982

Subgenus *Dalophonychia* Guo, subgen. nov.

Type-species: *Xinshaophorus* (*Dalophonychia*) *lophoides* Guo et Liu*, sp. nov.

Shell subrectangular, equivalve, moderately inflated. Hinge margin nearly rectilineal; anterior margin uprightly truncated; semi-circular from ventral to

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posterior margin. Posterior dorsal part flat with a broad wing. Umbo claw-shaped, interiorly bent and slightly prosogyrous at the beak, near the front end. Anterior umbonal carina coarse, ruonded, with a narrow and rather steep anterior slope and a broad and somewhat flat posterior slope. Byssal sinus obvious. Shell surface covered with coarse, pinnate plicae radiating toward the ventral and posterior margins from the umbo.

Dalophonychia subgen. nov. is characterised by the subrectangule in outline and the rounded anterior venter but *Xinshaophorus* s. s. has the subtriangular outline and the angular anterior venter. *Dalophonychia* is similar to *Follmannia* in the plica-ornamentation, but different from the latter by the subrectangular outline and the broad flat posterior wing.

Middle Devonian Qujing Formation at Liukongqiao, Luquan County, east Yunnan.

Superfamily PTERIACEA Gray, 1847 (1820)

Family BAKEVELLIIDAE King, 1850

Genus *Hoernesia* Laube, 1866

Subgenus *Strophopteria* Guo, subgen. nov.

Type-species: *Hoernesia* (*Strophopteria*) *spiralis* Guo, sp. nov.

Shell knife-shaped, elongated, strongly twisted toward the right at the front and the left at the rear, inequivalve. Umbo near the anterior end. Hinge nearly straight. Anterior wing roundedly triangular without an obvious boundary from the shell body; posterior wing board, obtuse and relatively flat. Left valve strongly convex, with relatively broad, overhanging umbonal region; right valve flat, with obscure, low umbo. Posterior muscle scar rather large, situated at posterior dorsal part; right one larger and deeper than the left. Minute pedal scar small, subcicular, deep, located before posterior adductor scar, from which departed a relalively long distance.

The subgenus is distinguished from *Hoernesia* s. s. in the strongly twisted and elongated shell body.

Lower Triassic Lamei Formation at Peiyuan, Yongsheng County, central Yunnan.

Superfamily PECTINACEA Rafinesque, 1815

Family AVICULOPECTINIDAE Meek et Hayden, 1864

Genus *Claraia* Bittner, 1901

Subgenus *Pteroclaraia* Guo, subgen. nov.

Type – species: *Claraia* (*Pteroclaraia*) *protinalata* Guo, sp. nov.

Shell subcircular, weakly inflated. Hinge margin long, nearly straight. Right anterior ear small, subrectangular. Posterior wing relatively broad and large, prominently extended backward and outstripped posterior margin, set off from body by obvious groove. Umbo low, near the anterior margin. Left umbo slightly overtaken hinge margin; right one not so. Shell surface ornamented with fairly regular concentric folds, which weaker in the right than those in the left.

Pteroclaraia subgen. nov. is distinguishable from *Claraia* s. s., *Pseudoclaraia* and *Guichiella* in the well developed posterior wing set off from the shell body by the obvious groove.

Lower Triassic Ximatang Formation at Maanshan, Balang, Guangnan County, southeast Yunnan.

Family POSIDONIIDAE Frech, 1909

Genus *Pterohalobia* Guo, gen. nov.

Type – species: *Pterohalobia productalata* Guo, sp. nov.

Shell elongated, ensiform, equivalve, highly inequilateral, weakly inflated, with stright 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, a little extended above the hinge margin, situated very anteriorly. Shell surface covered by concentric wrinkles and growth lines. Ligament groove long and slender. Edentulous.

The new genus is somewhat similar to *Longidaonella* in the shell outline, but lacks the radial ribs.

Lower Middle Triassic Baipeng Formation at Kana, Pingzhai, Qiubei County, southeast Yunnan.

Family ENTOLIIDAE Korobkov, 1960

Genus *Bupecten* Guo (MS.)

Type – species: *Bupecten cornutus* Guo, sp. nov.

Shell subcircular, subovate, equilateral, nearly equally convex in the 2 valves, symmetrical in the 2 sides of the front and rear, with straight and short hinge margin, having 2 ox horn – shaped auricles protruding high above the hinge axis and defined by sulci from the rest of shell. Auricles on the left valve wider and higher than those on the right. Umbo nearly situated

at median, extended a little above the hinge margin. Surface covered with concentric growth lines. Ligament area narrow; resillifer subtrigonal.

Bupecten differs from *Entolium* in the 2 accuminated and high shooting auricles, which are at least 2 limes as high as those of Pernopecten.

Middle and Upper Triassic of southeast Yunnan.

Subgenus *Bupecten* (*Linobupecten*) Guo, subgen. nov.

Type-species: *Bupecten* (*Linobupecten*) *reticularis* Guo, sp. nov.

Shell subcircular, equileteral, symmetrical in the 2 sides of the front and rear. Umbo nearly located at median; beak extended a little above the hinge margin. 2 ears protruded high above the hinge axis like 2 ox horns. Surface covered with concentric costae and radial ribs to form netting ornamentation.

The new subgenus is different from *Bupecten* s. s. in the netting ornamentation and the relatively low auricles.

Upper Upper Triassic Taozishu Formation at Huangtian, Dehua, Puer County, west Yunnan.

Order UNIONOIDA Stoliczka, 1871

Superfamily UNIONACEA Fleming, 1828

Family UNIONIDAE Fleming, 1828

Genus *Undulatula* Gu, 1976

Subgenus *Ancyrunio* Guo, subgen. nov.

Type-species: *Undulatula* (*Ancyrunio*) *omegoides* Guo, sp. nov.

Shell cuneate, elliptical, elongatedly elliptical, elongatedly rectangular, subrhomboidal, moderatedly inflated, with moderate thickness of shell wall, sometimes with broad and shallow lateral sulcus and obscure ventral sinus. Umbo near the 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, provided with anterior teeth 2 in each valve and posterior teeth 2 in the left valve and 1 in the right. They can fall into the following dental formula:

$$\frac{a5 \quad a3 \qquad\qquad p3}{a4 \quad a2 \quad p2 \quad p4}.$$

a5 weak, shortly lamellar or absent; a3 subtriangular; a4 narrow and short; a2 coarse. p2, p3 and p4 elongated lamellar, parallel with the adjacent hinge margin.

The new subgenus is characterized by the anchor-shaped ribs but lacks the rugous ribs in *Undulatula* s. s. and the concentric ribs of *Qiyangia* in which there are w-shaped ribs only in the umbonal region.

Middle Jurassic of Yunnan.

Family PACHYCARDIIDAE Cox, 1961

Genus ***Weixiella*** Guo et J. Chen*, gen. nov.

Type-species: *Weixiella diana* Guo et J. Chen, sp. nov.

Shell elongatedly ovate, equivalve, inequilateral, with moderate convexity. Umbo broadly rounded, slightly protruded above the hinge margin, with incurved and prosogyrous beak, near the anterior end. Surface covered with growth lines. Anterior teeth situated under the umbo, 2 in the right valve, slightly jointed at the upper end of them; anterior one shortly lamellar, opisthocline; posterior that subtriangular, coarse. And 2 in the left, anterior one obliquely triangular, opisthocline, relatively strong, somewhat elongated; posterior that low, weak, obscure, obliquely triangular. Posterior teeth rather elongatedly lamellar, 2 in the left valve and 1 in the right, parallel with the adjacent margin. Anterior adductor muscl scar somewhat deep, posterior one obscure.

The new genus is similar to *Cardinioides* in the anterior teeth, but possesses the well developed posterior lamellar teeth.

Upper Upper Triassic Maichuqing Formation at north suburbs, weixi County, west Yunnan.

Order TRIGONIOIDA Dall, 1889

Superfamily TRIGONIACEA Lamarck, 1819

Family MYOPHORIIDAE Bronn, 1849

Genus *Rhenania* Waagen, 1907

Subgenus *Dianorhenania* Guo, subgen. nov.

Type-species: *Rhenania* (*Dianorhenania*) *yunnanensis* Guo, sp. nov.

Shell small, obliquely subtriangular, inflated, arcuate from the anterior to the ventral margin, arched at the posterior dorsal part, with acuminate postero-ventral angle twisted upward. Umbo situated near the anterior end; posterior umbonal carina well developed, reached the postero-ventral angle, just like a diagonal line. Area covered with radial ribs diverging from the postero-

* Chen Jinhua.

dorsal part to the posterior umbonal carina, and with obscure radial threads from the umbo. Flank ornamented by coarse strong and regular concentric costae. Interior unknown.

The area of *Dianorhenania* is covered with the radial ribs from the postero-dorsal part, while the one of *Rhenania* s. s. is ornamented by the curved oblique ridges from the posterior umbonal carina.

Upper Silurian Guandi Formation at Chunai, Xundian County, east Yunnan.

Genus *Acanomyophoria* Guo, gen. nov.

Type-species: *Acanomyophoria tuberosa* Guo, sp. nov.

Shell subtriangular, equivalve, subequilateral, inflated, semi-circular at the anterior margin, arcuated at the ventral margin, prosoclinely truncated at the posterior margin. Umbo rounded, somewhat protruded, slightly anterior to median; posterior umbonal carina well developed, reached postero-ventral angle, with tubercula on the tops, with antecarinal depression and correspondent postero-ventral sinus. Flank covered by concentric costae with thorn-shaped tubercula on the tops; bases of the tubercula elongated along the concentric costae. Area slightly depressed, transversely ridged with relatively regular and slender costae. Hinge similar to that in *Costatoria*.

The new genus is distinguished from *Elegantinia* or *Gruenewaldia* in the concentric costae with thorn-shaped tubercula.

Lower Upper Triassic Weiyuanjiang Formation at Nabang, Guanfang, puer County, west Yunnan.

Family TRIGONIIDAE Lamarck, 1819

Genus *Trigonia* Bruguière, 1789

Subgenus *Protrigonia* Guo, subgen. nov.

Type-species: *Trigonia* (*Protrigonia*) *yunnanensis* Guo, sp. nov.

Shell small or medium in size for genus, subtriangular, equivalve, subequilateral, inflated, semi-circular from the anterior to ventral margins, truncated or slightly curved forward at the posterior margin. Umbo prominent, incurved and prosogyrous at the 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 the umbo, with

slender transverse crenulations. In the left valve, median tooth strong, coarse, bifid; anterior one shortly lamellar, opisthocline; posterior that slender and weak. In the right, anterior one opisthocline, posterior that prosocline; the two joined at the upper end of them. Anterior adductor scar rather deep, strongly impressed, bordered by buttress; posterior one faint.

The new subgenus is distinguished from *Trigonia* s. s. by the small and the nearly smooth shell and the relatively weak teeth. Perhaps, *Trigonia* s.s. has evolved from *Protrigonia* subgen. nov.

Except the type-species, the new subgenus includs 2 following species:
Trigonia gaytani Klipstein,
Trigonia zlambachiensis O. Haas.

Upper Upper Triassic Maichuqing Formation at north suburbs, weixi County, west Yunnan.

Genus *Lùxitrigonia* Guo, gen. nov.

Type-species: *Lùxitrigonia menggaensis* Guo, sp. nov.

Shell subrectangular. Umbo prominent, incurved and opisthogyrate at the beak, slightly anterior to median; posterior umbonal carina well developed, edged, crenulated. Flank covered by coarse and strong concentric costae, with tubercula radiating from the umbo; each tuberculum elongated at the lower end to form tail in shaped; area transversely ridged without tubercula.

The new genus is different from *Ibotrigonia* and *Myophorella* by the tail-shaped tubercula and the area with coarse and strong transverse costae.

Except the type-species, *Myophorella andoensis* Wen belongs to the new genus.

Middle Jurassic Longhai Formation at mengga, Lùxi County, west Yunnan.

Order VENEROIDA H. Adams et A. Adams, 1856

Superfamily ARCTICACEA Newton, 1891

Family NEOMIODONTIDAE Casey, 1955

Genus *Dianina* Guo, gen. nov.

Type-species: *Dianina yunnanensis* Guo, sp. nov.

Shell subcircular, subelliptic, subovate, equivalve, subequilateral to inequilateral, moderately inflated. Umbo near the median point of the shell length or the anterior end, with incurved and slightly prosogyrous beak; posterior umbonal carina weakly developed. Surface covered with growth lines. Hinge plate moderate or slender in breadth, provided with cardinal teeth 2 in each

valve and smooth lateral teeth without cross striations on the sides, right 2 and left 1 respectively in the front and the rear of the umbo, coming into the following hinge formula:

$$\frac{\text{AIII}\quad\text{AI}\quad 3a\quad 3b\quad\text{PI}\quad\text{PIII}}{\text{AII}\quad 2\quad 4b\quad\text{PII}}.$$

The new genus is consistent with *Neomiodon* in the number and arrangement of hinge teeth, but characterised by the short and smooth lateral teeth instead of the obviously elongated those with cross striations in *Neomiodon*.

Jurassic of southwest China and southeast Asia.

Order PHOLADOMYOIDA Newell, 1965

Superfamily PHOLADOMYACEA Gray, 1847

Family GRAMMYSIIDAE S. A. Miller, 1877

Genus *Glossites* Hall, 1885

Subgenus *Pharciglossites* Guo, subgen. nov.

Type-species: *Glossites* (*Pharciglossites*) *rugatus* Guo, sp. nov.

Shell lingual, elongatedly elliptic,equivalve, inequilateral, with moderate convexity, semi-circular at the anterior and posterior margins, arcuated at the 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 now subgenus is distinguished from *Glossites* s. s. by the rugate concentric costae crossed with the radial shallow grooves.

Upper Silurian Yulongsi Formation, Qujing, east Yunnan.

Genus *Pholadella* Hall, 1869

Subgenus *Qiaojiaia* Guo, subgen. nov.

Type-species: *Pholadella* (*Qiaojiaia*) *usitata* Guo et Hu, sp. nov.

Shell elongated, elliptic, equivalve, inequilateral, moderate inflated, semi-circular at the anterior margin, arcuate at the ventral margin, subrounded at the posterior end, without lateral sulcus and ventral sinus, but with broad shallow obscure groove on the postero-dorsal part. Umbo obtuse and relatively large, subrounded, protruded above the hinge margin, situated anteriorly; posterior umbonal carina weakly developed. Surface marked by radial costae but without concentric costae or undulations.

Qiaojiaia subgen. nov. is different from *Pholadella* s. s. in the lack of

the concentric undulations and the lateral sulcus as well as the ventral sinus.

Except the type-species, *Pholadella radiata* Zhang, 1977, non *Pholadella radiata* Hall, 1885, is included in the new subgenus.

Lower Devonian of east Yunnan and Guangxi.

Family PHOLADOMYIDAE Gray, 1847

Genus *Dianomya* Guo, gen. nov.

Type-species: *Dianomya lirulata* Guo, sp. nov.

Shell elongatedly rectangular or elliptic, equivale, inequilateral, moderately inflated, with narrow posterior gape and faint and narrower anterior gape, obliquely truncated at the anterior and posterior margins, arcuated at the ventral margin, with straight and long hinge margins. Umbo broad, low and obtuse, near the anterior end, with incurved and prosogyrous beak; anterior umbonal carina more well developed than posterior one. Surface of the posterior part marked by opisthocline oblique costae which subparallel each other in arrangement; rest of surface smooth.

Dianomya gen. nov. clearly differs from *Goniomya* in the presence of the anterior umbonal carina and the lack of the of oblique costae on the anterior and median part like in *Goniomya*.

Lower Middle Triassic Baipeng Formation at Naze, Mubian, Funing County, southeast Yunnan.

Genus *Osteomya* Moesch, 1874

Subgenus *Yunnanomya* Guo, subgen. nov.

Type-species: *Osteomya* (*Yunnanomya*) *ninglangensis* Guo, sp. nov.

Shell rectangular, trapezoid, equivalve, inequilateral, relatively flated. Anterior margin semi-circular; ventral margin arcuate; posterior margin obliquely truncated. Umbo broad and large, rounded, slightly opisthogyrate at the beak, located at about one-third from the anterior margin; posterior umbonal carina more or less developed; sometimes anterior umbonal carina also developed. Posterior dorsal part spread, relatively flat, sometimes risen upward. Posterior gape obvious, with a elongatedly elliptic outlet. Lateral sulcus more or less developed to form correspondent sinus at the ventral margin. Area slightly depressed, sometimes with a few radial costae. Surface covered by growth lines and wrinkles.

Yunnanomya subgen. nov. is distinguishable from *Osteomya* s. s. in the presence of the lateral sulcus and the ventral sinus.

Lower Middle Triassic Beiya Formation and Leikoupo Formation of central Yunnan.

Superfamily PANDORACEA Rafinesque, 1815

Family LATERNULIDAE Hedley, 1918

Genus *Orthomya* Guo, gen. nov.

Type-species: *Orthomya puerensis* Guo, sp. nov.

Shell flatly tubed, elongatedly rectangular on lateral view, with straight and long hinge margin and narrow faint gape at the posterior end, semi-circular at the anterior margin, nearly straight at the ventral margin. Umbo low and broad, placed very anteriorly. Internal umbonal plate developed, extended toward the anterior ventral part. 3 carinae radial from the umbo to the posterior margin respectively. Surface marked by concentric costae and growth lines.

Cercomya, *Capillimya* differ from *Orthomya* gen. nov. in the tapering and upcurved posterior end. The umbo of *Plectomya* is placed near the mid-length of the shell, whereas the one of *Orthomya* is situated very anteriorly. *Orthomya* is easily distinguished from *Platymyoidea* in the radial costae on the posterodorsal part.

Lower Upper Triassic Weiyuanjiang Formation at Ganlanba, Puer County, west Yunnan.

Superfamily POROMYACEA Dall, 1886

Family CUSPIDARIDAE Dall, 1886

Genus *Cuspidaria* Nardo, 1840

Subgenus *Dianocuspidaria* Guo, subgen. nov.

Type-species: *Cuspidaria* (*Dianocuspidaria*) *lúxiensis* Guo, sp. nov.

Shell small, spoon-shaped, subequivalve, with straight and long hinge margin. Main part of the shell body subcircular; posterior part elongated, tapered, strongly rostrate. Umbo obtuse, large and broad, a little anterior to median. Surface ornamented by coarse rounded concentric costae relatively regularly and slender radial costae.

The new subgenus is similar to *Tergulina*, *Pseudocuspidaria* in the coarse and rounded concentric costae, but different from the latter two in the possession of the slender radial costae.

Lower Upper Triassic Niaoge Formation at Wayao, Lúxi County, southeast Yunnan.