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Triassic Gastropods of the Southern Qinling Mountains, China

Jinnan Tong and Douglas H. Erwin

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ABSTRACT

Tong, Jinnan, and Douglas H. Erwin. Triassic Gastropods of the Southern Qinling Mountains, China. *Smithsonian Contributions to Paleobiology,* number 92, 47 pages, 11 figures, 6 plates, 5 tables, 2001. Forty-eight species in 27 genera of gastropods, including 14 new species and one new genus, are described from early- to middle-Triassic (Scythian- to Ladinian-aged) rocks from the southern Qinling Mountains of Gansu and Sichuan provinces, China. This report expands the knowledge of the biogeographic distribution of gastropods during the recovery from the end-Permian mass extinction. The new taxa include *Tongweispira sichuanensis,* new genus and new species, and the following new species: *Ananias guojiashanensis, Worthenia extendia, Gosseletina? dangchangensis, Zygites laevigatus, Trochotoma* (*Discotoma*) *gansuensis, Cheilotomona acutocarinata, Naticopsis* (*Dicosmos*) *compressus, Naticopsis* (*Dicosmos*) *sichuanensis, Naticopsis? ribletella, Neritopsis planoplicatus, Platychilina sinensis, Platychilina obliqua,* and *Omphaloptycha gansuensis.*

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Contents

Triassic Gastropods of the Southern Qinling Mountains, China

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Introduction

This is the first report of marine Triassic gastropods from the Qinling Mountains, Gansu and Sichuan provinces, northwestern China. Forty-eight species in 27 genera are described, of which 14 species and one genus are new. This assemblage is the most abundant marine Triassic gastropod fauna yet described from the northwestern China region and one of the most diverse Triassic gastropod faunas known worldwide.

Triassic gastropods were first described from Middle and Upper Triassic rocks of the European Alps and neighboring areas during the mid-1800s (see the excellent catalogs of Diener, 1926, and Kutassy, 1937a, 1937b). Although many Late Triassic specimens have been discovered in North and South America (e.g., Haas, 1953; Erwin in Stanley et al., 1994), gastropods are relatively rare in Lower and Middle Triassic deposits (Batten and Stokes, 1986).

In China, the earliest descriptions of Triassic gastropods were provided by Lóczy (1899) from northern Yunnan Province (five species in four genera) and by Koken (1900) from Sizishan, Guizhou Province (eight species in six genera). Studies of Triassic gastropods have been more common in the past 20 years, when Pan (1977, 1980, 1982a, 1982b) and Yin and Yochelson (1983a, 1983b, 1983c) described several abundant marine Triassic gastropod faunas in southwestern China. The relatively continuous Permian and Triassic depositional sequence includes diverse assemblages of gastropods from the Upper Paleozoic to the Upper Triassic. The histories of these assemblages were summarized by Pan (1980), Pan and Erwin (1994), and Erwin and Pan (1995). The Triassic gastropod assemblage from northwestern China differs markedly from the southwestern region of the country and has greater similarity to Tethyan regions than do the assemblages from southern China.

MATERIAL.—All specimens described herein have been deposited in the National Museum of Natural History (NMNH), Smithsonian Institution, and have been assigned USNM (collections of the former United States National Museum, now housed in the NMNH) catalog numbers. For many species, the total number of available specimens, including partial or incomplete specimens, is noted under "Material Examined" in the species account; only type specimens and specimens figured or measured were given catalog numbers. All specimen measurements are given in millimeters (mm) unless indicated otherwise; in tables, a dash indicates a measurement was not taken.

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General Geology and Stratigraphy

The fossils described herein were collected from two marine Triassic sections in northwestern China: Guojiashan, Qinyu Xiang (Town), Dangchang Xian (County), Gansu Province, and Saierlangshan, Hongxing Xiang, Zoigê Xian, Sichuan Province (Figure 1). These two sections lie about 120 km apart in the southern Qinling Mountains. Both belong to the South Qinling tectonostratigraphic province (Yin et al., 1992)—Guojiashan is part of the northern zone whereas Saierlangshan lies in the southern zone (Figure 2). Their sedimentary sequences and faunas are similar. The South Qinling tectonostratigraphic province was a part of the Yangtze Platform during the Early to Middle Triassic and records a transition from carbonate to clastic rocks intercalated with bioclastic limestones. At the Guojiashan section, gastropods are both abundant and diverse in the Guojiashan Formation (Anisian age). At the Saierlangshan section, gastropods have been recovered at horizons ranging from Induan through Ladinian. The following overview of the stratigraphy and depositional environments is primarily based on the Saierlangshan section (Figure 3). The gastropods found in each section are listed in Table 1.

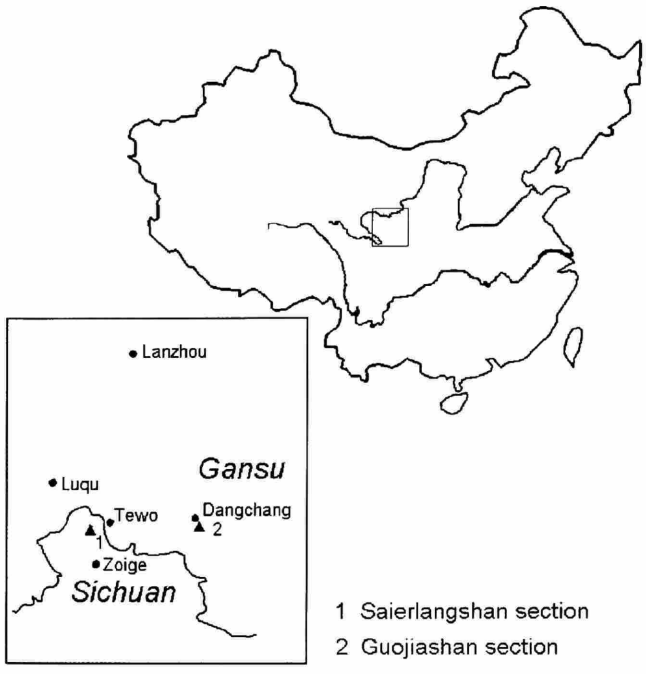

FIGURE 1.—Location in China of the marine Triassic sections discussed in this paper.

ZALISHAN FORMATION (previously the Bobanshan Formation).—The formation is composed of a gray and dark gray, thin- to medium-bedded and thick-bedded micrite, intercalated with purplish red thin-bedded argillaceous limestone and gray, medium- to thin-bedded bioclastic-bearing limestone; it is 693.5 m thick and conformable with the underlying Permian. Bivalves, gastropods, trace fossils, and elements of the bivalve *Claraia hubeiensis* assemblage, the *Claraia stachei–C. aurita* assemblage, and the *Eumorphotis multiformis–E. inaequicostata* assemblage are found at many horizons. At the type locality in Zalishan, Yiwagou, Tewo Xian, Gansu Province, the formation includes the *Hindeodus parvus, Neospathodus dieneri, N. pakistanensis,* and *Pachycladina–Parachirognathodus* conodont zones, documenting a range from early Induan to early Olenekian (for details of the assemblages and biostratigraphic correlations, see Yang and Li, 1992). Gastropods have been recovered mostly from near the base of the section, but some were near the top as well.

MARESONGDUO FORMATION.—This formation is composed of a yellowish gray and light gray, thin- to medium-bedded dolomite intercalated with a few beds of light gray, medium- to thin-bedded dolomitic limestone and occasionally with a possible evaporite solution breccia; the total thickness is 126.5 m. This formation contains only scattered bivalves and gastropods, including *Chlamys* (*Praechlamys*) *weiyuanensis* (Hsu). At the type locality in Yiwagou, Tewo Xian, the *Neospathodus triangularis* and *N. hungaricus–N. homeri* conodont zones indicate a late Olenekian age.

GUOJIASHAN FORMATION.—The lower part of this formation is composed of gray, medium-bedded bioclastic dolomitic limestone; the middle part is a gray, medium-bedded algal clastic micrite intercalated with stromatolitic limestone; and the upper part is a gray, medium- to thin-bedded micrite with intercalated gray, medium- to thick-bedded calcirudite; the total thickness is 1424.5 m. Numerous fossil bivalves and gastropods and several brachiopods have been collected at many horizons in this formation; most of them are from beds in the lower and middle parts of the unit. The bivalves include the *Plagiostoma beyrichii–Chlamys ruoergaiensis* assemblage. At the type locality at Guojiashan, Dangchang Xian, many bivalves, gastropods, brachiopods, ammonoids, and conodonts have been recovered. The conodonts are of the *Neospathodus constricta* zone and the ammonoids include *Procladiscites,* indicating an Anisian age.

GUANGGAISHAN FORMATION.—Only the lower unit is exposed in the Zoigê Xian area (Lagecaimo) where it is composed of alternating beds of gray or grayish blue, fine quartzose sandstone and siltstone with thin-bedded, gray micrite intercalated with a gray, medium- to thin-bedded intraformational breccia; the total thickness is 454 m. Although this unit is poorly fossiliferous, the matrix of one brecciola bed in the middle to upper part of this unit contains the *Leptochondria seebachi–Entolioides subdemissus* bivalve assemblage and a few brachiopods and gastropods. The corresponding strata have been described as the Qinyu Formation in the Dangchang area, where the conodonts *Neogondolella mombergensis* Tatge, *N. navicula* Huckriede, and *N. excelsa* Mosher have been discovered, indicating an early Ladinian age.

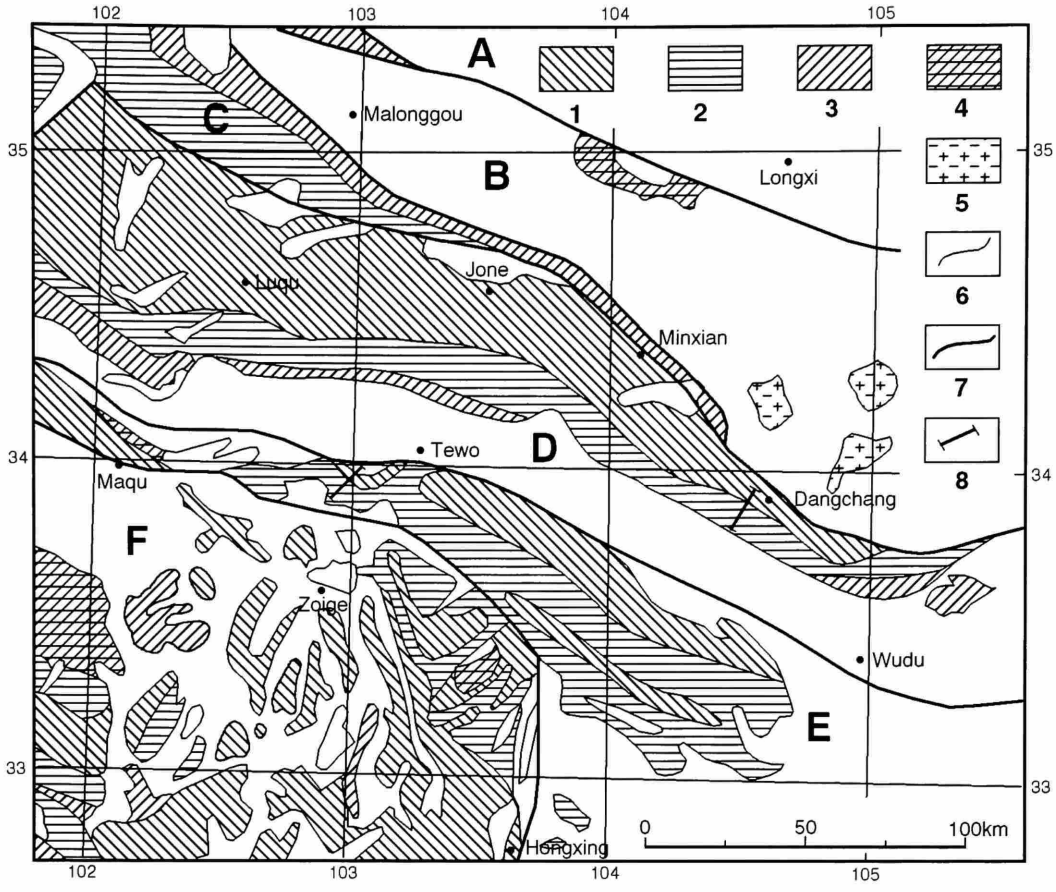

FIGURE 2.—Distribution of Triassic rocks and tectonostratigraphic divisions of South Qinling. 1 = Upper Triassic, 2 = Middle Triassic, 3 = Lower Triassic, 4 = Lower–Middle Triassic, 5 = Indosinian intermediate-acid rocks, 6 = geological boundary, 7 = faulted zone, 8 = sections yielding gastropods; A = southern margin of North China Platform, B = northern zone of South Qinling tectonostratigraphic province, C = southern zone of Central Qinling province, D = northern zone of South Qinling province, E = southern zone of South Qinling province, and F = Bayan Har province.

Gastropod Assemblages

Previous studies of Triassic gastropods from China emphasized the southwestern part of the country, and the reports on the Triassic gastropods of northwestern China are rare. In the southwest, Yin and Yochelson (1983a, 1983b, 1983c) listed 14 genera and 11 species from South Qingyan, Guizhou Province, and Wang and Qi (1986) studied 13 genera and 19 species from various areas of Qinghai Province. These reports are from scattered horizons deposited from the Early to the Late Triassic.

LOWER TRIASSIC GASTROPODS

The Saierlangshan section contains two beds containing gastropods of the Zalishan Formation but only four specimens from the Maresongduo Formation. Interestingly, many of these specimens are larger than those found in corresponding strata in the other areas on the world. No bellerophontids have been collected here.

ZALISHAN FORMATION.—The *Toxoconcha* gastropod bed is located close to the base of the Zalishan Formation and is composed primarily of *Toxoconcha uniformis*; other forms are rare, high-spired, and medium- to large-sized. The shells in this bed are of smaller size, which is quite different from shells in equivalent rocks from other areas. Although the assemblage is dominated by *T. uniformis,* which occurs in the Ladinian of the southern Alps, and by other species that also occur in younger rocks in Europe, the presence of the *Claraia stachei–C. aurita* bivalve assemblage demonstrates an Early Triassic age. No evidence of redeposition was observed. As discussed elsewhere, the stratigraphic evidence suggests these gastropod lineages occur earlier in northern China than in the Alps.

MARESONGDUO FORMATION.—This formation was deposited under restricted conditions and contains very few fossils. There are only a few poorly preserved specimens of the

TABLE 1.—List of the Triassic gastropods found in southern Qinling, China. An asterisk (*) indicates holotype specimen; GS = Guojiashan section, Gansu Province; SC = Saierlangshan section, Sichuan Province; MF = Maresongduo Formation of Saierlangshan, Sichuan Province, but the exact bed no. is not known because the specimen was collected from a nearby section.

Genus and species	USNM catalog no.	Section	Bed no.
Amberleya? sp. indet.	485537	SC	16-1
Ananias guojiashanensis, n. sp.	485500	GS	20
Ananias guojiashanensis, n. sp.	485502*	GS	19-3
Ananias guojiashanensis, n. sp.	485503	GS	19-3
Ananias guojiashanensis, n. sp.	485509	GS	19-3
Ananias johannisaustriae (Klipstein)	485510	GS	19-3
Ananias johannisaustriae (Klipstein)	485511	GS	19-3
Ananias johannisaustriae (Klipstein)	485512	SC	59
Ananias johannisaustriae (Klipstein)	485513	SC	59
Ananias johannisaustriae (Klipstein)	485515	GS	18-1
Cheilotomona acutocarinata, n. sp.,	485621	SC	58-3
Cheilotomona acutocarinata, n. sp.,	485622	SC	58-3
Cheilotomona acutocarinata, n. sp.,	485623	SC	60-1
Cheilotomona acutocarinata, n. sp.	485624	SC	58-3
Cheilotomona acutocarinata, n. sp.	485625	SC	58-3
Cheilotomona acutocarinata, n. sp.	485626*	SC	58-3
Cheilotomona acutocarinata, n. sp.	485627	SC	58-3
Codinella? sp. indet.	485527	GS	19-3
Codinella? sp. indet.	485528	GS	20
Coelostylina ahlburgi (Assmann)	485637	SC	74-1
Coelostylina ahlburgi (Assmann)	485638	SC	74-1
Coelostylina ahlburgi (Assmann)	485639	SC	77-1
Coelostylina cf. *waageni* Kittl	485640	GS	19-3
Coelostylina cf. *waageni* Kittl	485641	SC	16-1
Coelostylina? sp. indet.	485644	SC	16-1
?*Eunemopsis dolomitica* Kittl	485620	GS	19-3
Euryalox sp. indet.	485526	GS	20
Genus and sp. indet.	485654	GS	18-1
Gosseletina? *dangchangensis*, n. sp.	485520*	GS	20
Gosseletina? *dangchangensis*, n. sp.	485521	GS	19-3
Gosseletina? sp. indet.	485519	SC	55-1
Gradiella sp. indet.	485652	SC	16-1
Gradiella sp. indet.	485653	SC	16-1
Marmolatella (*Marmolatella*) *complanata* (Stoppani)	485539	GS	20
Marmolatella (*Marmolatella*) *complanata* (Stoppani)	485540	GS	20
Marmolatella (*Marmolatella*) *complanata* (Stoppani)	485541	GS	20
Marmolatella (*Marmolatella*) *complanata* (Stoppani)	485542	GS	20
Marmolatella (*Marmolatella*) cf. *complanata* (Stoppani)	485543	GS	20
Marmolatella (*Marmolatella*) *obtusangula* (Koken)	485551	GS	19-3
Marmolatella (*Marmolatella*) *obtusangula* (Koken)	485552	GS	19-3
Naticopsis (*Dicosmos*) *applanatus* Kutassy	485544	GS	19-3
Naticopsis (*Dicosmos*) *applanatus* Kutassy	485545	GS	19-3
Naticopsis (*Dicosmos*) *applanatus* Kutassy	485546	GS	19-3
Naticopsis (*Dicosmos*) *compressus*, n. sp.	485573	GS	20
Naticopsis (*Dicosmos*) *compressus*, n. sp.	485574	GS	20
Naticopsis (*Dicosmos*) *compressus*, n. sp.	485575	GS	20
Naticopsis (*Dicosmos*) *compressus*, n. sp.	485576	GS	19-3
Naticopsis (*Dicosmos*) *compressus*, n. sp.	485577	GS	19-3
Naticopsis (*Dicosmos*) *compressus*, n. sp.	485578	GS	19-3
Naticopsis (*Dicosmos*) *compressus*, n. sp.	485579	GS	20
Naticopsis (*Dicosmos*) *compressus*, n. sp.	485580	GS	20
Naticopsis (*Dicosmos*) *compressus*, n. sp.	485581*	GS	20
Naticopsis (*Dicosmos*) *declivis* (Kittl)	485547	GS	20
Naticopsis (*Dicosmos*) *declivis* (Kittl)	485548	GS	20
Naticopsis (*Dicosmos*) *declivis* (Kittl)	485549	GS	20
Naticopsis (*Dicosmos*) *declivis* (Kittl)	485550	GS	20
Naticopsis (*Dicosmos*) *eyerichi* (Noetling)	485557	SC	55-1
Naticopsis (*Dicosmos*) *eyerichi* (Noetling)	485558	SC	55-1
Naticopsis (*Dicosmos*) *eyerichi* (Noetling)	485559	SC	55-1
Naticopsis (*Dicosmos*) *eyerichi* (Noetling)	485560	SC	55-1
Naticopsis (*Dicosmos*) *eyerichi* (Noetling)	485561	SC	55-1
Naticopsis (*Dicosmos*) *impressa* (Münster)	485553	SC	62-1
Naticopsis (*Dicosmos*) *impressa* (Münster)	485554	SC	62-1
Naticopsis (*Dicosmos*) *impressa* (Münster)	485555	SC	62-1
Naticopsis (*Dicosmos*) *impressa* (Münster)	485556	SC	62-1
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	485562*	SC	62-1
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	485563	SC	62-1
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	485564	SC	62-1
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	485565	SC	62-1
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	485566	SC	62-1
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	485567	SC	62-1
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	485568	SC	62-1
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	485569	SC	62-1
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	485570	SC	95-1
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	485571	SC	95-1
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	485572	SC	77-1
Naticopsis? *ribletella*, n. sp.	485586*	GS	20
Naticopsis? *ribletella*, n. sp.	485587	GS	20
Naticopsis (*Vernelia*) *sublimneiformis* Kittl	485582	GS	19-3
Naticopsis (*Vernelia*) *sublimneiformis* Kittl	485583	GS	20
Naticopsis (*Vernelia*) *sublimneiformis* Kittl	485584	GS	19-3
Naticopsis (*Vernelia*) *sublimneiformis* Kittl	485585	SC	95-1
Natiria? sp. indet.	485538	MF	–
Neodonaldina cf. *elongata* (Zardini)	485645	GS	20
Neritaria cf. *calcitica* (Kittl)	485589	GS	19-3
Neritaria cf. *calcitica* (Kittl)	485590	GS	19-3
Neritaria cf. *calcitica* (Kittl)	485591	GS	19-3
Neritaria cf. *calcitica* (Kittl)	485592	GS	19-3
Neritaria candida (Kittl)	485593	GS	19-3
Neritaria candida (Kittl)	485594	GS	19-3
Neritaria candida (Kittl)	485595	GS	19-3
Neritaria candida (Kittl)	485596	GS	19-3
Neritaria candida (Kittl)	485597	GS	20
Neritaria candida (Kittl)	485598	GS	20
Neritaria ingrandita (Kittl)	485606	SC	58-3
Neritaria ingrandita (Kittl)	485607	GS	20
Neritaria plicatilis (Klipstein)	485608	SC	95-1
Neritaria sphaeroidica Picard	485599	GS	20
Neritaria sphaeroidica Picard	485600	GS	20
Neritaria sphaeroidica Picard	485601	GS	20
Neritaria sphaeroidica Picard	485602	GS	18-1
Neritaria sphaeroidica Picard	485603	GS	18-1
Neritaria sphaeroidica Picard	485604	GS	18-1
Neritaria sphaeroidica Picard	485605	GS	19-3
Neritopsis planoplicatus, n. sp.	485588*	GS	19-3
Omphaloptycha gansuensis, n. sp.	485642	GS	20
Omphaloptycha gansuensis, n. sp.	485643*	GS	20
Platychilina obliqua, n. sp.	485615	SC	72-1
Platychilina obliqua, n. sp.	485616	GS	19-3

TABLE 1.—Continued.

Genus and species	USNM catalog no.	Section	Bed no.	Genus and species	USNM catalog no.	Section	Bed no.
Platychilina obliqua, n. sp.	485617*	GS	20	*Toxoconcha uniformis* (Stoppani)	485634	SC	16-1
Platychilina obliqua, n. sp.	485618	GS	20	*Triassocirrus*? sp. indet.	485499	GS	20
Platychilina obliqua, n. sp.	485619	GS	20	*Trochotoma* (*Discotoma*) *gansuensis*, n. sp.	485529	GS	20
Platychilina sinensis, n. sp.	485609	GS	20	*Trochotoma* (*Discotoma*) *gansuensis*, n. sp.	485530*	GS	20
Platychilina sinensis, n. sp.	485610	GS	20	*Trochotoma* (*Discotoma*) *gansuensis*, n. sp.	485531	GS	20
Platychilina sinensis, n. sp.	485611*	GS	20	*Trypanostylus konincki* (Münster)	485647	GS	19-3
Platychilina sinensis, n. sp.	485612	GS	20	*Trypanostylus konincki* (Münster)	485648	GS	19-3
Platychilina sinensis, n. sp.	485613	GS	20	*Trypanostylus konincki* (Münster)	485649	GS	19-3
Platychilina sinensis, n. sp.	485614	GS	20	*Trypanostylus konincki* (Münster)	485650	GS	19-3
Ramina ptychitica (Kittl)	485656	SC	77-1	*Trypanostylus* cf. *pseudoscalatus* Assmann	485651	SC	35-1
Spirostylus cf. *linctus* (Böhm)	485629	SC	60	*Tylotrochus elongatus* Bandel	485532	SC	77-1
Spirostylus sp. indet.	485628	SC	16-1	*Worthenia extendia*, n. sp.	485501	GS	19-3
Tongweispira sichuanensis, n. gen., n. sp.	485491	SC	58-3	*Worthenia extendia*, n. sp.	485504	GS	20
Tongweispira sichuanensis, n. gen., n. sp.	485492	SC	58-3	*Worthenia extendia*, n. sp.	485505*	GS	20
Tongweispira sichuanensis, n. gen., n. sp.	485493	SC	58-3	*Worthenia*? sp. indet. A	485506	SC	60-1
Tongweispira sichuanensis, n. gen., n. sp.	485494*	SC	58-3	*Worthenia*? sp. indet. A	485507	SC	60-1
Tongweispira sichuanensis, n. gen., n. sp.	485495	SC	58-3	*Worthenia*? sp. indet. A	485508	SC	60-1
Tongweispira sichuanensis, n. gen., n. sp.	485496	SC	58-3	*Worthenia*? sp. indet. B	485514	GS	20
Tongweispira sichuanensis, n. gen., n. sp.	485497	SC	58-3	*Worthenia*? sp. indet. C	485516	GS	19-2
Tongweispira sichuanensis, n. gen., n. sp.	485498	SC	58-3	*Worthenia*? sp. indet. C	485517	GS	19-2
Toxoconcha brocchii brevis Kittl	485635	SC	16-1	*Worthenia*? sp. indet. C	485518	GS	19-2
Toxoconcha uniformis (Stoppani)	485630	SC	16-1	*Zygites laevigatus*, n. sp.	485522	GS	20
Toxoconcha uniformis (Stoppani)	485631	SC	16-1	*Zygites laevigatus*, n. sp.	485523*	GS	20
Toxoconcha uniformis (Stoppani)	485632	SC	16-1	*Zygites laevigatus*, n. sp.	485524	GS	20
Toxoconcha uniformis (Stoppani)	485633	SC	16-1	*Zygites laevigatus*, n. sp.	485525	GS	20

gastropod *Gradiella* and two better preserved shells similar to some species of *Natiria*.

MIDDLE TRIASSIC GASTROPODS

Anisian Gastropods

Most of the fossils discussed in this paper are from the Anisian Guojiashan Formation of Saierlangshan, Sichuan Province, and of Guojiashan, Gansu Province.

SAIERLANGSHAN SECTION.—Although gastropods are found at many horizons in the Guojiashan Formation, they are most common in the lower and middle units. This diverse assemblage is dominated by three species: *Naticopsis* (*Dicosmos*) *eyerichi*, *N.* (*D.*) *sichuanensis*, new species, and *Tongweispira sichuanensis*, new genus, new species. *Ananias johannisaustriae*, *Worthenia*? spp., *Coelostylina ahlburgi*, and *Cheilotomona acutocarinata*, new species, are also common. *Naticopsis* (*Dicosmos*) *eyerichi* was previously described from the Muschelkalk and *Coelostylina ahlburgi* was described from the upper part of the Wellenkalk to the Muschelkalk of Europe. *Neritaria calcitica* and *Acilia* cf. *franciscae* Böhm are found from the late Early Triassic to the Middle Triassic in Europe; the former was also discovered in the Naochuangjiangou Formation (Middle Triassic) of Hongshuichuan, Dulan Xian, Qinghai Province (Wang and Qi, 1986). In the Guojiashan Formation, however, some species such as *Ramina ptychitica*, *Naticopsis* (*Dicosmos*) *impressa*, and *Ananias johannisaustriae* occur in the Ladinian. In Europe, the gastropods found in these beds range from the late Early Triassic to the Ladinian.

GUOJIASHAN SECTION.—Of the four gastropod beds in the middle and upper parts of the Guojiashan Formation, the two lower beds yield relatively few fossils whereas the two upper beds contain a much richer gastropod assemblage. The predominant members within these units are *Marmolatella* (*Marmolatella*) *complanata*, *Neritaria sphaeroidica*, *Platychilina sinensis*, new species, and *Naticopsis* (*Dicosmos*) *compressus*, new species. The less common species are *Neritaria candida*, *N.* cf. *calcitica*, *Platychilina obliqua*, new species, *Naticopsis* (*Dicosmos*) *declivis*, *N.* (*D.*) *applanatus*, *Trochotoma* (*Discotoma*) *gansuensis*, new species, and *Trypanostylus konincki*. Many of these species as well as rarer, coexisting forms such as *Ananias johannisaustriae*, *Eunemopsis dolomitica*, *Naticopsis* (*Vernelia*) *sublimneiformis*, and *Neodonaldina elongata* have been reported from the Ladinian or younger units in Europe. The associated bivalves, conodonts, and ammonoids in these beds suggest an Anisian age; thus, the unit may be somewhat younger than the fossil beds in the Saierlangshan section.

Ladinian Gastropods

Gastropods of Ladinian age were found only in the lower part of the Guanggaishan Formation at the Saierlangshan section. One bed of this section is dominated by *Naticopsis*

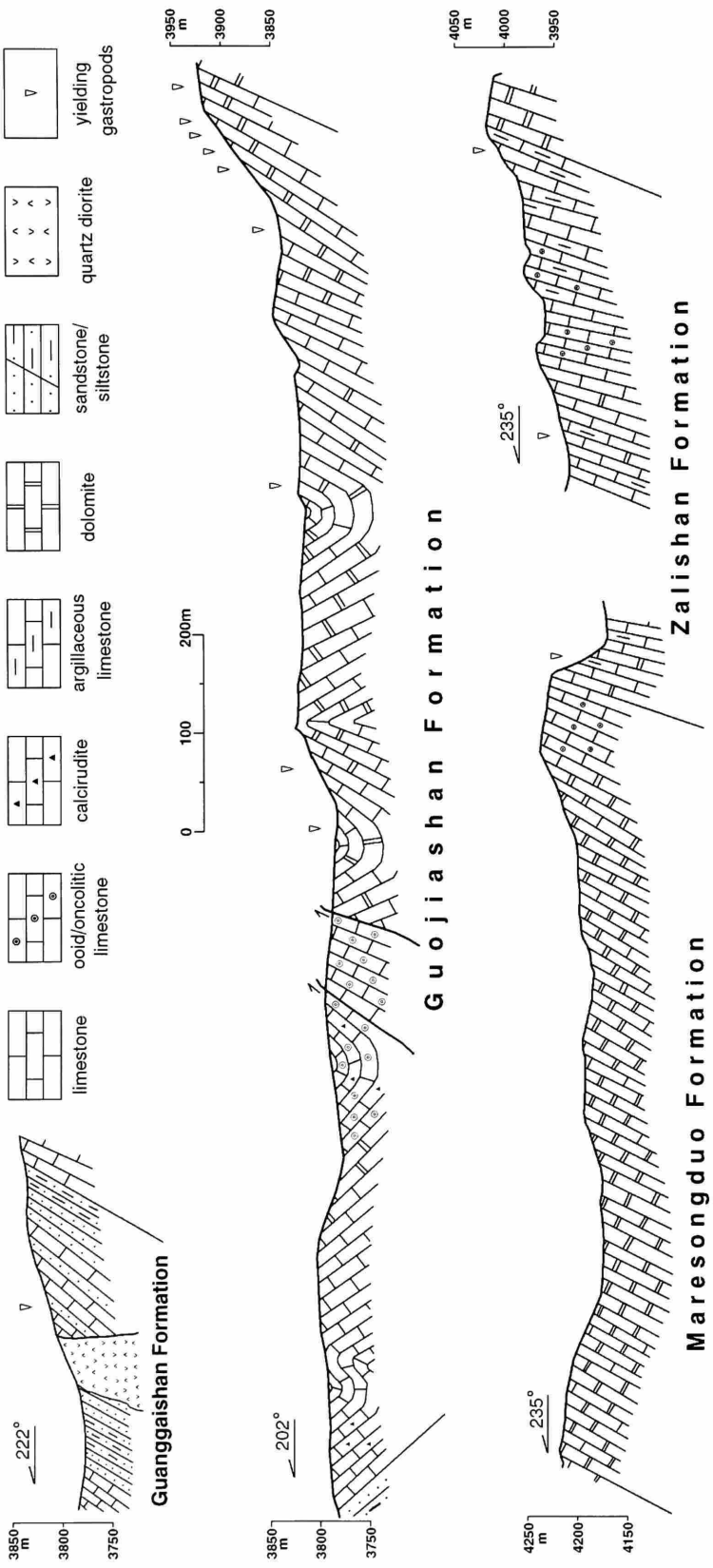

FIGURE 3.—Stratigraphic profile through Triassic rocks at Saierlangshan, Hongxing, Zoigê, Sichuan Province.

(*Dicosmos*) *sichuanensis,* new species, but the species is not common; other taxa are even rarer. *Naticopsis* (*Dicosmos*) *sichuanensis,* new species, is more abundant in the underlying Guojiashan Formation. The coexisting *Naticopsis* (*Vernelia*) *sublimneiformis* and *Neritaria plicatilis* have been reported from the Ladinian and the Carnian of the southern Alps.

More than one-half of the Triassic gastropod species from the South Qinling stratigraphic province were first described from the European Alps or Polish Upper Silesia. Although the northern and southern China gastropod assemblages share some similarities, the differences are pronounced. Neritimorphs predominate in this collection—perhaps for diagenetic reasons—and account for more than one-half of the total number of specimens, which is similar to the Triassic fauna described from the South Qilian Mountains of northwestern China (Yang et al., 1983).

Distribution

Geological Distribution

The conodonts and bivalves indicate an Anisian age for most of the gastropod assemblage, although the same gastropod species, or closely related species, are found in the Ladinian and Carnian of Europe (Tables 2, 3). The Qinling fauna includes 38 species of Anisian age, three from the Ladinian, and only seven species from the Early Triassic. The abundant gastropods reported by Yin and Yochelson (1983a, 1983b, 1983c) from Qingyan, southwestern China, are also primarily from Anisian strata. These Chinese gastropod assemblages have extended the stratigraphic ranges of many genera into the Anisian and even down into the Early Triassic (Table 4), closing some of the gaps between Permian and Triassic faunas (Pan and Erwin, 1994; Erwin, 1996).

A quarter of a century ago, most described Triassic gastropods were known from Ladinian, Carnian, or younger units in Europe, and only a few had been described from the Early Triassic and Anisian; the situation is much the same today. Consequently, Batten (1973) viewed the Early Triassic and Anisian as a continuation of the end-Permian crisis for gastropods and suggested that gastropod recovery did not begin until after the Anisian. The results presented herein, however, together with those of Yin and Yochelson (1983a, 1983b, 1983c) demonstrate that the postextinction recovery was well underway by the Anisian. Work by Batten and Stokes (1986) suggests that the recovery may have begun by the end of the Early Triassic, at least in the western United States. As indicated by Yin and Yochelson (1983a), the large numbers of archaeogastropods within these Anisian gastropod assemblages makes them more similar to those of the Paleozoic than to later Mesozoic gastropod assemblages. Thus, the extinction across the Paleozoic–Mesozoic boundary seems less significant for gastropods than it was for brachiopods, crinoids, or several other groups (Erwin, 1993, 1994; Pan and Erwin, 1994). The new information presented herein suggests that many of the Triassic genera originated during the Early Triassic and the early Anisian (Table 4).

TABLE 2.—Distribution of previously described gastropod species collected from Qinling, northwestern China, showing their age and the age of the species in European and other Chinese faunas (A = Anisian, C = Carnian, L = Ladinian, N = Norian, S = Scythian, T2 = Middle Triassic). A question mark (?) indicates species identification is uncertain at the location; ages in parentheses are for closely related species within the genus; a dash (–) indicates species was not collected from the region. European and other Chinese taxa are cited in the individual species accounts.

Species	Age by location			
	Qinling, China	Europe	NW China	SW China
Acilia franciscae	(A)	L	–	–
Ananias johannisaustriae	A	C	–	A
Coelostylina ahlburgi	A	A–L	–	A
Coelostylina waageni	(S–A)	(A)C	–	–
?*Eunemopsis dolomitica*	?A	C	–	–
Marmolatella (*Marmolatella*) *complanata*	A	L	–	–
Marmolatella (*Marmolatella*) *obtusangula*	A	C–N	–	–
Naticopsis (*Dicosmos*) *applanatus*	A	C	–	–
Naticopsis (*Discosmos*) *declivis*	A	L–N	–	–
Naticopsis (*Dicosmos*) *eyerichi*	A	A–L	–	–
Naticopsis (*Dicosmos*) *impressa*	A	C	–	
Naticopsis (*Vernelia*) *sublimneiformis*	A–L	L	–	–
Neodonaldina elongata	A	C	–	–
Neritaria calcitica	(A)	A–L	T2	–
Neritaria candida	A	L	–	A
Neritaria ingrandita	A	L	–	–
Neritaria plicatilis	L	C–N	–	–
Neritaria sphaeroidica	A	A	–	–
Proturba intermittens	A	C	–	–
Ramina ptychitica	A	L	–	
Spirostylus linctus	(A)	L	–	–
Toxoconcha brocchii	S	A–L	–	A
Trypanostylus konincki	A	A–C	–	–
Trypanostylus cf. *pseudoscalatus*	?S	A	–	–
Trypanostylus semiglaber	(A)	C	–	–

Paleobiogeographic Distribution

Unlike the Triassic gastropod faunas of southern China, those from Qinling share many species with European gastropod assemblages (Table 2). Many Chinese species, including new species, appear to be closely related to European forms (Table 3). In contrast, the relationships between the Chinese and European gastropods and the American taxa are weak; even at the generic level the similarity is very low (Table 4). These differences may be exacerbated by lack of recent systematic treatment. Many European gastropod species were last studied more than 100 years ago and are only now undergoing reexamination (e.g., Bandel, 1988, 1991, 1992, 1993, 1994, 1995, 1996; Schwardt, 1992; Nützel, 1997). Completion of this work will be necessary for more detailed consideration of the biogeographic relationships with Chinese taxa. Material in

TABLE 3.—Geographic distribution and age of species probably related to those newly collected from Qinling, China. Age abbreviations: A = Anisian, C = Carnian, L = Ladinian, N = Norian, S = Scythian; a dash (–) indicates species was not collected from the region. Data sources: Diener (1926), Kutassy (1937b), this paper, and Tong and Erwin, unpublished.

Species from Qinling, China	Age	Probable related species	Age by location		
			Europe	NW China	SW China
Ananias guojiashanensis, n. sp.	A	*Worthenia marmolatae* Kittl	L	–	–
Cheilotomona acutocarinata, n. sp.	A	*Cheilotomona avisii* Böhm, *C. blumii* (Wissmann)	L–C	–	–
Codinella? sp. indet.	A	*Codinella leda* (Kittl)	L	–	–
Coelostylina? sp. indet.	S	*Coelostylina irritata* Kittl	L–C	L	–
Euryalox sp. indet.	A	*Euryalox subcancellata* (d'Orbigny)	C	–	–
Gosseletina? *dangchangensis*, n. sp.	A	*Gosseletina fasciolata* (Münster)	L–R	–	–
Gosseletina? sp. indet.	A	*Gosseletina calypso* (Laube)	C	–	–
Gradiella sp. indet.	S	*Gradiella semigradata* (Kittl), *G. gradata* (Hörnes)	L	C	–
Naticopsis (*Dicosmos*) *compressus*, n. sp.	A	*Naticopsis* (*D.*) *declivis*	L–N	–	–
Naticopsis (*Dicosmos*) *sichuanensis*, n. sp.	A–L	*N.* (*D.*) *cassiana* (Wissmann), *N.* (*D.*) *impressa*	L–N	–	–
Omphaloptycha gansuensis, n. sp.	A	*Omphaloptycha jaworskii* Haas, *O. cochlea* (Münster)	L–C		–
Platychilina obliqua, n. sp.	A	*Platychilina tuberculata* Kittl	L	–	–
Platychilina sinensis, n. sp.	A	*Trachynerita nodifera* Kittl	L–C	–	–
Spirostylus sp. indet.	S	*Spirostylus subcolumnaris* (Münster)	A–C	–	A
Triassocirrus? sp. indet.	A	*Triassocirrus infracarinatum* (Kittl)	L	–	–
Trochotoma (*Discotoma*) *gansuensis*, n. sp.	A	*Discotoma planoconvexa* Pan	–	–	–
Worthenia extendia, n. sp.	A	*Worthenia conica* Assmann	A	–	A
Worthenia? sp. indet. B	A	*Worthenia esinensis* Kittl	L	–	–
Zygites laevigatus, n. sp.	A	*Zygites delphinula* (Laube)	C	–	–

TABLE 4.—Age of genera found in Qinling, China, and their distribution by age and occurrence in other geographic areas of the world. Ages are defined in Table 3. Symbols: + = occurrence of genus; * = specimens of indicated age found only in China to date; ? = forms found were of questionable identity; a dash (–) = no occurrence.

Genus	Age in Qinling	Occurrence by age							Occurrence by geographic area				
		Pre-Triassic	Scythian	Anisian	Ladinian	Carnian	Norian, Rhaetian	Post-Triassic	Europe	Western Asia	Other areas in China	Southeast Asia, Australia	North and South America
Acilia	A	–	–	*	+	+	+	–	+	–	–	–	–
Amberleya	S	–	*	–	+	+		+	+	–	–	–	–
Ananias	A	+	–	*	–	–		–	+	–	+	+	+
Cheilotomona	A	–	–	+	+	+	–	–	+	–	–	–	–
Codinella	?A	–	–	?*	+	*	–	–	–	–	+	–	–
Coelostylina	S, A	–	*	*	+	+	+	+	+	+	+	+	+
Eunemopsis	A	–	–	*	+	+	–	–	+	–	–		–
Euryalox	A	–	–	+	+	+	+	–	+	–	+	+	–
Gosseletina	?A	+	*	+	+	+	+	–	+	–	+	–	+
Gradiella	S	–	*	–	+	+	+	–	+	–	+	–	+
Marmolatella (*Marmolatella*)	A	+	–	+	+	+	–	–	+	–	+	–	+
Naticopsis (*Dicosmos*)	A–L	–	–	+	+	+	–	–	+	–	+	+	–
Naticopsis (*Vernelia*)	A–L	+	–	*	+	+	–	–	+	–	+	–	+
Natiria	?S–A	+	+	+	+	+	+	*	+	–	+	+	+
Neodonaldina	A	–	–	*	+	+	–	–	+	–	–	–	–
Neritaria	A–L	–	*	*	+	+	+	–	+	–	+	–	+
Neritopsis	A	–	–	*	+	+	+	+	+	+	–	–	+
Omphaloptycha	A	+	*	+	+	+	+	–	+	+	+	–	+
Platychilina	A	–	–	*	+	+	–	–	+	–	–	–	–
Proturba	A	–	–	*	–	+	–	–	+	–	–	–	–
Ramina	A	–	–	*	+	+	–	–	+	–	–	–	?+
Spirostylus	S–A	–	*	*	+	+	–	–	+	–	?+	–	+
Toxoconcha	A	–	*	+	+	+	+	–	+	–	+	–	+
Triassocirrus	?A	–	–	+	+	+	–	–	+	–	+	–	–
Trochotoma (*Discotoma*)	A	–		+	–	–	+	+	+	–	+	–	–
Trypanostylus	A	–		+	+	+	+	+	+	–	+	–	–
Tylotrochus	A	–	–	*	–	+	+	+	+	–	–	–	–
Zygites	A	–	–	*	+	–	–	–	+	–	+	–	–

Timor, Indonesia, also has been restudied (Tichy, 1979, 1980a, 1980b, 1980c).

Gastropods were diverse during the late Paleozoic, and abundant gastropods assemblages have been found worldwide. Many genera had a more extensive geographic distribution during the late Paleozoic than during the Triassic, suggesting the end-Paleozoic extinction had a major impact on gastropod biogeography. Although the paucity of Triassic gastropod assemblages limits the extent of any biogeographic analysis, southern China was perhaps the only region where a shallow sea existed continuously from the Permian into the Triassic, and diverse gastropod faunas are known throughout this interval (Pan and Erwin, 1994; Erwin and Pan, 1995). Early Triassic gastropods were very rare and limited. The earlier reappearance of diverse gastropod assemblages in China relative to the western Tethys Sea or western North American suggests that the eastern Tethys may have served as a refuge during the end-Permian mass extinction (see also Batten, 1985).

Both southern China and alpine Europe were located in the Tethys Sea during the Triassic. This tropical sea lay more or less parallel to the paleoequator, and no significant barriers to migration have been identified within it. In contrast, the paleo-Pacific was a natural barrier between the Tethys and America, and latitudinal temperature gradients restricted migration along the circum-Pacific margins. The earlier occurrence of many gastropod genera and species in China relative to Europe suggests a possible westward migration of the fauna through the Tethys during the Triassic. This suggestion is supported by the analysis by Yin and Yochelson (1983a, 1983b, 1983c) of the gastropods of Guizhou Province and by analyses of many other fossil groups including foraminifera and bivalves (e.g., Yin, 1994).

The distribution of these gastropods was rigidly controlled by sedimentary facies. Almost all known abundant and diverse gastropod fossil assemblages are connected with shallow-water carbonate platforms, especially platforms with carbonate build-ups or bioherms. Yin and Yochelson's (1983a, 1983b, 1983c) Anisian gastropods of Qingyan were deposited in front of a carbonate build-up. Similarly, the richest Ladinian gastropod faunas of this region were also in the setting of a shallow bank (Tong and Huang, 1992). Gastropods are also found on carbonate platforms, but they are generally not very diverse; they are extremely rare in the terrigenous clastics (Tong, 1997, 1998). The Qinling gastropods reported herein are mostly from carbonate platforms, with the richest assemblage found in the Anisian shallow bank of Guojiashan. In Saierlangshan, the richest gastropod assemblages are found on Early Triassic and Anisian, semi-closed to open, carbonate platforms. During the Ladinian, this area developed into a bathyal carbonate basin, in which gastropods became very rare, and then into a terrigenous clastic basin. In Europe the richest assemblages of gastropods were also located on carbonate platforms.

Systematic Paleontology

Class GASTROPODA Cuvier, 1797

Subclass EOGASTROPODA Ponder and Lindberg, 1995

Order EUOMPHALINA de Koninck, 1881

Superfamily EUOMPHALOIDEA de Koninck, 1881

Family EUOMPHALIDAE de Koninck, 1881

The euomphaloids were a major clade of Paleozoic gastropods (see Wagner, in press, for a phylogenetic analysis), but their phylogenetic relationships with Triassic forms remain poorly understood (e.g., Bandel, 1988). Most had well-developed whorl angulations—interpreted as exhalant channels—but the outer whorl surfaces were commonly smooth and without evident sculpture. Many Mesozoic euomphaloids differ from the Paleozoic forms in whorl features and ornament, raising the uncertainty regarding the connection between the two groups. Mesozoic euomphaloids had been divided into two groups. The first group was characterized by increased development of shell sculpture, including nodes, ribs, and even spines, and included *Woehrmannia, Discohelix, Triassocirrus,* and *Platybasis*. Bandel (1993), however, transferred *Woehrmannia* to the Trochomorpha, and Schröder (1995) transferred *Discohelix* to the new family Discohelicidae within the Trochoidea. The second group maintained a smooth shell, but the whorl angulation became round as in *Coelodiscus* and the new genus *Tongweispira*. Bandel (1988) argued that none of these Mesozoic forms belong to the Euomphaloidea; rather, the genera belong to a variety of other groups including the Allogastropoda, the Trochoidea, the neogastropods, and an uncertain group of Vetigastropoda. Bandel, however, has not discussed any of the forms described herein, or any close relatives. Although recognizing the considerable uncertainties about the phylogenetic relationships of the group, we have elected to place them within the Euomphalidae as they appear to be more closely related to demonstrable Permian euomphalids than to any of the genera discussed by Bandel. We note, however, that *Tongweispira* may not be a euomphalid at all and may have close affinities with some trochids. Determining the relationship among the two groups, and between them and the Paleozoic lineages, will require detailed phylogenetic study beyond the scope of this contribution.

Tongweispira, new genus

TYPE SPECIES.—*Tongweispira sichuanensis*, new genus, new species; by original designation.

DIAGNOSIS.—Subdiscoidal to hemispherical euomphalids with depressed spire. Base convex and mostly embraced. Outer whorl face with one rounded angulation on middle to upper part. Umbilicus round and deep; width about one-third diameter of shell; umbilical angulation narrowly rounded. No prominent ornament. Aperture long and narrow but curved; holostomous.

DISCUSSION.—This genus is characterized by a depressed spire and a convex and entirely embraced base, producing a narrow umbilicus. Mesozoic low-spired discoidal genera include the euomphalids *Coelodiscus* and *Woehrmannia,* but these all have protruding spires. Shells with a depressed spire occurred in some Paleozoic groups, such as the Permian genera *Planotectus* and *Euomphalus*; however, these Paleozoic genera have a marked outer-whorl angulation that might indicate a quite different ecological habit. This angulation is also similar to the Jurassic *Coelodiscus* and other younger shells and might suggest a link between some Paleozoic and Mesozoic forms. This new genus is also similar to ?*Condonella,* a poorly known genus from the Upper Cretaceous.

ETYMOLOGY.—The genus is named in honor of Jinnan Tong's daughter Tongwei, who was born when these fossils were discovered.

Tongweispira sichuanensis, new species

PLATE 1: FIGURES 1–9

DIAGNOSIS.—As for the genus.

DESCRIPTION.—Small- to medium-sized, subdiscoidal to hemispherical gastropod with widely depressed spire and markedly convex base. Sutures deeply impressed. Apex depressed. Shell of more than five whorls, not embraced on the adapical side but which almost entirely embrace earlier whorls at base; thus all whorls visible on spiral side and only final whorl and a round phaneromphalous umbilicus visible on basal side. Whorl profile crescentic; an obvious but rounded angulation at outer-upper edge; upper surface between angulation and suture flat to slightly concave; lateral face extending in ~50° angle with upper face; lateral to lower surface evenly arched and continuously curved to base. Umbilicus round and deep; its width less than one-third diameter of shell; umbilical angulation narrowly rounded; no obvious ornament except for very faint, obviously opisthocline collabral lines, visible only on uppermost outer-wall layer of final whorl. Aperture long, narrow, and trapezoidal, narrowing at base; holostomatous. Shell wall of two almost equally thick layers; layers considerably thickened close to aperture.

MATERIAL EXAMINED.—Fifteen mostly well-preserved specimens from the lower part of the Guojiashan Formation at Saierlangshan.

TYPE SPECIMENS.—*Holotype:* USNM 485494; *Paratypes:* USNM 485491–485493, 485495–485498.

MEASUREMENTS.—As follows:

USNM catalog no.	Shell height (mm)	Shell width (mm)
485491	3.6	6.3
485492	8.8	19.0
485493	3.5	5.7
485494	5.4	8.8
485495	8.7	13.6
485496	5.0	7.3
485497	4.2	7.2
485498	5.4	7.9

DISCUSSION.—The features distinguishing this species from other described genera are the widely depressed spire, strongly convex and embraced base, obtuse angulation of the middle to upper whorl, and lack of ornament.

ETYMOLOGY.—The species is named for the Chinese province where the specimens were discovered.

Subclass ORTHOGASTROPODA? Ponder and Lindberg, 1995

Order VETIGASTROPODA? Salvini-Plawen, 1980

Superfamily EOTOMARIOIDEA Ulrich and Scofield, 1897

The affinities of the Eotomarioidea within modern gastropod classification remain unclear. They could fall within the Vetigastropoda or may be paraphyletic relative to the Vetigastropoda.

Family EOTOMARIIDAE Wenz, 1938

Genus *Ananias* Knight, 1945

TYPE SPECIES.—*Phanerotrema*? *welleri* Newell, 1935; by original designation.

DISCUSSION.—This genus is characterized by a moderately high-spired and gradate shell, which distinguishes this taxon from *Glabrocingulum* Thomas, 1940 (see Schindel, 1982). The narrow, concave selenizone at or immediately below the whorl shoulder distinguishes this species from the convex peripheral selenizone of *Worthenia. Ananias* is common in many late Paleozoic assemblages and has been traced into the Triassic by Yin and Yochelson (1983a). The genus is closely related to *Raphistomella,* whose Paleozoic forms are generally placed in *Glabrocingulum.* Earlier species of *Ananias* were generally ornamented and exhibited well-developed funicles, but in Permian species the ornament and funicle became rare and weak. The Triassic *Ananias* were faintly ornamented and generally lacked funicles. We follow Batten (1989) in considering this a separate genus from *Glabrocingulum* in light of the evidence for a lengthy independent history. The relationships between *Worthenia, Platyworthenia,* and *Wortheniella* are discussed by Nützel and Senowbari-Daryan (1999).

Ananias johannisaustriae (Klipstein, 1843)

PLATE 1: FIGURES 10–12

Pleurotomaria johannisaustriae Klipstein, 1843:161, pl. 10: fig. 13.
[For intervening synonymy see Diener, 1926, and Kutassy, 1937b.]
Worthenia apunctata Kittl, 1894b.—Zardini, 1978:20, pl. 5: fig. 8.
Ananias joannis-austriae (Klipstein).—Yin and Yochelson, 1983a:167, fig. 4I–K [lapsus calami].
Wortheniella joannisaustriae (Klipstein).—Schwardt, 1992:41, pl. 5: fig. 1 [lapsus calami].

DESCRIPTION.—Small- to medium-sized, moderately spired pleurotomarioid. Pleural angle about 90°. Shell of four rapidly expanding whorls. Two strong, acute keels at upper and lower

margin of outer whorl face. Sutural grooves narrow and shallow. Sutural ramp obviously concave, about as wide as lateral face. Selenizone narrowly band-like and somewhat concave immediately below upper keel, observed in only two specimens. Lateral face nearly flat to slightly concave. Base low, convex, and rounded. Spiral threads regular, well and acutely protruded, covering whole shell surface including base; two prominent threads below sutures. Growth lines faint but generally visible. Aperture quadrangular to circular. Outer lip angular. Anomphalous and lacking funicle.

MATERIAL EXAMINED.—Eight specimens from the middle part of Guojiashan Formation of Guojiashan, Gansu Province, and two specimens from the lower part of Guojiashan Formation of Saierlangshan, Sichuan Province: USNM 485510–485513, 485515.

DISCUSSION.—Kittl (1894b) named *Worthenia apunctata* but did not give a useful description of the species and only figured a broken specimen. He distinguished the species from *W. subpunctata* (Klipstein) and from *W. marmolatae* Kittl but not from *Pleurotomaria johannisaustriae* Klipstein, although he noted the resemblance between them and suggested they might be united (Kittl, 1894b:113). The present specimens coincide with both Klipstein's and Kittl's shells in the distinguishing characters of spiral ornament and lateral keels, which indicate the two species should be synonymized.

Ananias guojiashanensis, new species

PLATE 1: FIGURES 13–16

DIAGNOSIS.—Acutely pyramidal pleurotomarioids of six gradually enlarging whorls with pleural angle of 60° Whorl profile showing two prominent keels with lower keel acute and slightly stronger than upper one. Lateral face concave and ramp steep.

DESCRIPTION.—Small- to medium-sized, acutely pyramidal shell with lateral face flattened. Sutural grooves shallow. Two prominent, acute keels on whorls; lower keel a little stronger and forming periphery. Selenizone concave and quite narrow, immediately below upper keel, bordered by peripheral keel and a lira. Lateral face concave; ornamented with faint, irregular spiral threads. Ramp slightly concave and steeply inclined, almost equal in width to lateral face; one or two obvious spiral threads visible below sutures; occasionally also with very faint spiral threads. Left ramp projects at high angle from selenizone. Suture descends with age. Base nearly flat and smooth. Umbilicus narrow, without funicle.

MATERIAL EXAMINED.—Six well-preserved specimens plus several partial specimens from the middle part of Guojiashan Formation at Guojiashan.

TYPE SPECIMENS.—*Holotype:* USNM 485502; *Paratypes:* USNM 485500, 485503, 485509.

MEASUREMENTS.—As follows:

USNM catalog no.	Shell height (mm)	Shell width (mm)	Pleural angle (°)
485500	10.0	8.3	62
485502	10.5	8.8	55
485503	–	4.5	58

DISCUSSION.—The typical characters of this species are the high-spired, turreted shell with strong keels, steep sutural ramp, and concave lateral face. In overall shape this species is similar to "*Worthenia*" *marmolatae* Kittl (1894b:112, pl. 1:figs. 6, 7) except for the obviously larger pleural angle. On the other hand, features of the selenizone are unclear for both Kittl's species and Böhm's (1895) later descriptions and figures of this and related species. The selenizone is not clearly exposed in several of the Chinese specimens, so combining all of these specimens into a single species is not justified with the current material. This species is more pyramidal and less trochiform than the preceding species.

ETYMOLOGY.—The species name is based on the locality from which the material was recovered.

Family LOPHOSPIRIDAE Wenz, 1938

Genus *Worthenia* de Koninck, 1883

DISCUSSION.—This large, well-known Late Paleozoic genus is marked by a convex selenizone at the upper peripheral keel. Although some workers did not believe the genus extended into the Triassic, (e.g., Knight, 1945; Haas, 1953), Yin and Yochelson (1983a, fig. 3) showed the genus persisted into the Middle and early Late Triassic, following a gap near the Permo-Triassic boundary. Triassic species are usually much smaller than Permian forms (Yin and Yochelson, 1983a). Although the selenizones in the specimens described herein lack the typical crenulated selenizones of many species of *Worthenia,* they are very similar to those of *Worthenia corrugata* Chronic, 1952, as discussed by Batten (1989), and we follow Batten in assigning them to *Worthenia.*

Worthenia extendia, new species

PLATE 1: FIGURES 17–20

DIAGNOSIS.—Small- to medium-sized, moderately spired, trochiform shell with 75° pleural angle and greatly enlarged final whorl. Selenizone convex and smooth at upper peripheral angulation. Ornament of closely spaced fine spiral threads and growth cords.

DESCRIPTION.—Small- to medium-sized, medium-spired, trochiform pleurotomarioid. Pleural angle about 75° Sutural grooves shallow. Shell of five gradually increasing whorls and a rapidly expanding final whorl. Earlier whorls smoothly arched without distinct angulations. Two prominent keels on two final whorls, low and rounded. Selenizone apparently at upper keel, convex with faint crescent lines but not crenulated.

Ramp nearly equal in width to lateral face in spire whorls, but wider than lateral face in final whorl (5:4), and both flat to slightly concave. Whorls embracing at about mid-whorl. One weak and blunt spiral ribbon under suture. Shell of fine, regular, and closely spaced spiral threads and growth lines. Base convex with no spiral threads. Anomphalous.

MATERIAL EXAMINED.—Five specimens from the middle and upper parts of Guojiashan Formation at Guojiashan.

TYPE SPECIMENS.—*Holotype:* USNM 485505; *Paratypes:* USNM 485501, 485504.

MEASUREMENTS.—As follows:

USNM catalog no.	Shell height (mm)	Shell width (mm)	Pleural angle (°)	Apical angle, spire (°)
485501	8.0	7.5	70	58
485504	22.0	22.2	80	70
485505	16.5	16.0	75	65

DISCUSSION.—This species is similar to *Worthenia conica* Assmann (1924:9, pl. 1: figs. 11, 12) in the development of the keels, but *W. conica* exhibits a larger pleural angle and a narrower ramp on the spire whorls, and it lacks subsutural nodes (Yin and Yochelson, 1983a:171). As noted previously, this species differs from the typical *Worthenia* in the lack of a crenulated selenizone but is otherwise very similar to *W. corrugata* Chronic. The selenizone is very faint and is best seen after the specimen is coated with ammonium chloride.

ETYMOLOGY.—The species is named for the extended final whorl.

Worthenia? species indeterminate A

PLATE 1: FIGURES 21, 22

DESCRIPTION.—Small, moderately spired, trochiform shells of five rapidly expanding whorls. Pleural angle 80°–90°. Sutural grooves shallow. No marked spiral elements except for fine, nodose cord under suture. Two blunt keels on convex whorls. Ramp and lateral face each flat to slightly convex. Ramp of final whorl almost as wide as lateral face, but ramp of penultimate whorl wider than lateral face. Base roundly convex and anomphalous. Ornament of fine, closely and regularly spaced spiral threads, clearer on base.

MATERIAL EXAMINED.—Three specimens from the lower part of Guojiashan Formation: USNM 485506–485508.

MEASUREMENTS.—As follows:

USNM catalog no.	Shell height (mm)	Shell width (mm)	Pleural angle (°)
485506	4.95	5.00	90
485507	2.25	2.15	80
485508	4.75	5.15	87

DISCUSSION.—This form is characterized by the ramps being wider than the lateral faces until the final whorl, in which the ramp width is equal to that of the lateral face. The shape is similar to some Permian species described by Batten (1989) from the southwestern United States, but the earlier whorls of Batten's specimens were smooth, and the final whorl in these Chinese specimens is greatly expanded, although not as broadly as in *Worthenia extendia*. These specimens are also similar to *Worthenia pura* (Assmann, 1924:10, pl. 1: fig. 14) from the Upper Wellenkalk (Muschelkalk, Middle Triassic) of Upper Silesia; however, the shells have been recrystallized and the selenizones are unknown, making assignment to *W. pura* doubtful.

Worthenia? species indeterminate B

PLATE 1: FIGURE 23

DESCRIPTION.—Medium-sized, low-spired shell. Pleural angle 75°. Sutural grooves shallow. Whorls very convex and enlarging quickly, with sutural ramp twice as wide as lateral face. Ramp divided into two concave bands by strong, sharp spiral ridge. Selenizone convex and smooth at upper peripheral angulation. Lateral face slightly concave; lower keel rounded. Very fine spiral cords visible on lateral face. Base low, convex, and anomphalous.

MATERIAL EXAMINED.—One partly broken specimen from the middle to upper part of the Guojiashan Formation at Guojiashan: USNM 485514.

DISCUSSION.—This specimen has a low-spired shell and three almost equally spaced strong keels or ridges on the whorls, similar to *Worthenia esinensis* Kittl (Kittl, 1899:12, pl. 1: figs. 8–10) from the Esino Bed and the Marmolata Bed of the southern Alps. The European specimens, however, have one more keel under the lower keel, and their spiral elements are much more marked. Moreover, this specimen with a smooth, poorly defined, and convex selenizone differs from typical *Worthenia* species, which have the characteristic nodose selenizone, and from typical *Ananias* species, which have a concave selenizone.

Worthenia? species indeterminate C

PLATE 1: FIGURES 24, 25

DESCRIPTION.—Small, moderately spired wortheniid with obtuse apex. Pleural angle ~55° Sutures depressed. Shell of four to five whorls enlarging evenly in width but more slowly in height. One prominent but blunt keel on lower to middle whorls. Selenizone probably situated on upper keel, convex, and recognized by opisthocyrt growth lines without lirae. Sutural ramp broad, concave, and steeply inclined. Lateral face narrow and concave as a groove. Ramp almost twice as wide as lateral face. Subsutural row of tubercles found on some specimens. Ornament of very faint spiral threads. Aperture subquadrangular. Base convex, anomphalous.

MATERIAL EXAMINED.—Three specimens from the middle part of Guojiashan Formation of Guojiashan.

MEASUREMENTS.—As follows:

USNM catalog no.	Shell height (mm)	Shell width (mm)	Pleural angle (°)
485516	~8.0	5.3	57
485517	–	~5.0	52
485518	3.8	3.0	55

DISCUSSION.—The assignment of these specimens to *Worthenia* is questionable; although they have a relatively narrow, convex selenizone, it is smooth, lacks crenulations, and is located low on the whorl.

Family GOSSELETINIDAE Wenz, 1938

Genus *Gosseletina* Bayle in Fischer, 1885

TYPE SPECIES.—*Pleurotomaria callosa* de Koninck, 1843; by objective synonymy (Knight, 1841:138).

DISCUSSION.—The type species from the Lower Carboniferous of Belgium has a smooth surface, but the other species in this genus generally have spiral and collabral ornament. This genus is largely confined to the Carboniferous with a few species known from the Permian. Several Ladinian and Upper Triassic forms from the southern Alps have been referred to this genus (Kittl, 1891; Häberle, 1908; Bandel, 1991), although Koken (1897:30) questioned the assignment of these species to *Gosseletina.* The genus has also been reported from the Seven Devils material in Idaho, although these reports have not yet been published (Erwin, unpublished notes), and from southwestern China (Pan, 1977). No Early Triassic or Anisian forms have been previously reported. Specimens are placed in this genus with considerable uncertainty. They have smooth shells similar to ?*Gosseletina fasciolata* (Münster, 1841), but the final whorls are not as well inflated and lack the subsutural nodose row generally present in Paleozoic *Gosseletina.*

Gosseletina? dangchangensis, new species

PLATE 1: FIGURES 26, 27

DIAGNOSIS.—Small, ovoid, turbiniform pleurotomarioid; pleural angle ~60°. Spire small, final whorl remarkably high, and periphery at base of whorl. Selenizone flat to slightly convex in middle part of whorl. Shell surface smooth.

DESCRIPTION.—Apex obtuse and rounded. Spire small, only one-fourth height of shell. Sutural grooves shallow; very narrow and abaxial subsutural ramp under suture. Five whorls flat to slightly convex, gradually enlarging but increasing relatively rapidly in height. Selenizone narrow, nearly flat to slightly convex, and bordered by two fine lirae, with upper lira more prominent. Final whorl large, up to three-fourths height of entire shell. Periphery at base of final whorl, keeled. Shell surface smooth except for faint, strongly opisthocyrt growth lines. Base low, convex. Aperture circular with obvious labral slit. Thin inductura covering inner lip and umbilical area.

MATERIAL EXAMINED.—Four specimens from the middle to upper part of Guojiashan Formation of Guojiashan: USNM 485520, 485521.

TYPE SPECIMENS.—*Holotype:* USNM 485520; *Paratype:* USNM 485521.

MEASUREMENTS.—As follows:

USNM catalog no.	Shell height (mm)	Shell width (mm)	Final-whorl height (mm)	Pleural angle (°)
485520	8.0	6.2	6.2	60

DISCUSSION.—*Gosseletina fasciolata* (Münster) from a St. Cassian Formation of the southern Alps (Kittl, 1891; Bandel, 1991) is the only similar species; the two share a conical shell, obtuse spire, and a narrow selenizone at the middle of the whorl. The new species, however, has a higher spire, a nearly flat lateral whorl face, less swollen final whorl, a periphery at the base of the final whorl, and a somewhat cyrtoconoid form. These characters even indicate that it may not belong to the genus *Gosseletina.* In overall shape, these shells are very similar to the type species of the trochid *Cirsostylus* Cossmann, *Trochus glandulus* Laube (1868:38, pl. 34: fig. 7), but are clearly distinguished from trochids by the presence of a selenizone.

ETYMOLOGY.—The species is named for the local county, Dangchang, where the fossils were collected.

Family ZYGITIDAE Cox, 1960

Genus *Zygites* Kittl, 1891

TYPE SPECIES.—*Pleurotomaria delphinula* Laube, 1868; by original designation.

DISCUSSION.—Only the type species was assigned to this genus until Yin and Yochelson (1983a) reassigned two species to the genus and described a single new species, extending the range of *Zygites* from Anisian to Carnian. The specimens described herein are similar to the type species of *Zygites* in having a dome-like apex, wide umbilicus, and comb-like umbilical angulation—all important characters that define this genus (Kittl, 1891:200). Batten (pers. comm., 1998) noted that *Zygites* is remarkably similar to *Eirylsia* Batten, 1956, and likely to be synonymous. We agree with this assessment, but the current material seems insufficient to warrant synonymizing the two genera.

Zygites laevigatus, new species

FIGURE 4; PLATE 1: FIGURES 28–35

DIAGNOSIS.—Dome-like, low-spired shell. Slightly convex selenizone on middle to upper whorl face, visible on most whorls. Surface glossy; only ornament consisting of lower subsutural nodes. Umbilicus wide; smooth circular keel.

DESCRIPTION.—Medium-sized, low-spired, nearly gradate pleurotomarid, slightly wider than high. Apex obtuse and rounded. Pleural angle ~90°. Sutures impressed but shallow. Shell of six whorls, evenly convex, gradually enlarging. Selenizone narrow and slightly convex, evenly curved with outer whorl surface, visible on earlier whorls. Two fine lirae bounding selenizone and a third within lower portion of selenizone. Ornament mostly of very fine growth lines extending prosoclinally,

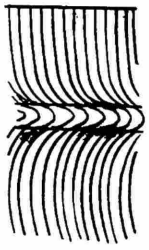

FIGURE 4.—Selenizone of *Zygites laevigatus*, new species (not to scale).

widely curving to selenizone and nearly straight close to sutures above selenizone; deep opisthocyrt on selenizone; growth lines forming several low, subsutural nodes. Sixteen subsutural nodes on final whorl. Periphery low on final whorl, narrowly rounded. Base low, convex. Umbilicus funnel-like, wide and deep, with an acute circumbilical keel. Aperture evidently subcircular to subquadrangular.

MATERIAL EXAMINED.—Four specimens from the middle to upper part of the Guojiashan Formation of Guojiashan.

TYPE SPECIMENS.—*Holotype:* USNM 485523; *Paratypes:* USNM 485522, 485524, 485525.

MEASUREMENTS.—As follows:

USNM catalog no.	Shell height (mm)	Shell width (mm)	Pleural angle (°)
485522	>14.0	>17.0	92
485523	10.0	12.2	89
485525	>11.0	12.2	91

DISCUSSION.—The gradually expanding whorls, wide umbilicus, and marked subsutural nodes easily distinguish this species from forms assigned to *Gosseletina* and *Codinella,* many of which have a similar shape. This species lacks the cancellate characteristic of *Zygites delphinula* (Laube) (Laube, 1868:65, pl. 27: fig. 9; see also Kittl, 1891:200; Bandel 1991, pl. 1: figs. 7, 8), but the remaining characters support placement within the genus.

ETYMOLOGY.— The species name is derived from the poor ornamentation of the whorls.

Family PHYMATOPLEURIDAE Batten, 1956

Genus *Euryalox* Cossmann, 1896

TYPE SPECIES.—*Sagana juvavica* Koken, 1894; by original designation.

DISCUSSION.—This Triassic form is characterized by a wide peripheral selenizone that extends to the earlier whorls, an open umbilicus with an angular margin, and a reticulate ornament. Most of the species assigned to this genus have a swollen final whorl as occurs in the type species; however, *Pleurotomaria subcancellata* (d'Orbigny), assigned to *Euryalox* by Yin and Yochelson (1983a), has a less extended final whorl. The specimen from Qinling also lacks the swollen final whorl.

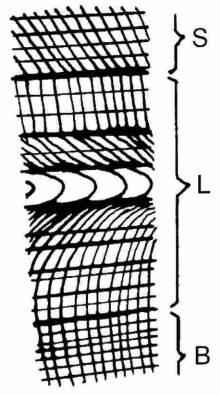

FIGURE 5.—Ornament and selenizone of *Euryalox* species indeterminate. S = sutural ramp; L = lateral face; B = base (not to scale).

Euryalox species indeterminate

FIGURE 5; PLATE 2: FIGURE 1

DESCRIPTION.—Moderately large, turbinate pleurotomarid. Spire obtusely conical. Sutures deeply impressed. Shell of more than four convex whorls, extending rapidly in width. Spire profile evenly curved. Final whorl with two prominent keels at middle of upper and lower whorl faces. Upper keel sharp, forming a shoulder, and lower keel narrowly rounded. Sutural ramp and lateral face join at 110° angle. Ramp slightly concave. Lateral face and base somewhat convex. Selenizone in middle of whorl face, ~1 mm wide, bounded by two prominent lirae. Shell entirely covered by fine, regular spiral threads. Growth lines faint and irregular, straight on ramp and base; opisthocyrt on lateral face, especially near selenizone, and within selenizone. Lunulae more widely spaced than growth lines, suggesting variable depth to slit. Umbilical opening deep, one-fourth diameter of shell.

MATERIAL EXAMINED.—A single well-preserved specimen from the middle to upper part of the Guojiashan Formation of Guojiashan: USNM 485526.

DISCUSSION.—The moderately high-spired shell, relatively unexpanded final whorl, and delicate ornament differ from most species of *Euryalox* other than *E. subcancellata* (d'Orbigny) (Laube, 1869:80, pl. 27: fig. 1); however, the relatively narrow selenizone of *E. subcancellata* does not lie exactly at the periphery of the whorl, and as figured by Laube it has no ramp.

Genus *Codinella* Kittl, 1899

TYPE SPECIES.—*Trochus generelli* Stoppani, 1858; by original designation.

DISCUSSION.—This genus is characterized by a high spire with numerous whorls, which is unusual for Triassic gastropods with a selenizone. The type species is anomphalous and has smaller, wider whorls and a small laterally elongated aperture. Some species referred to this genus by Kittl (1894b) have taller whorls and a wider aperture (e.g., *Codinella mammiformis*

(Kittl) (Kittl, 1894b:115, pl. 1: fig. 24)) or an umbilicus (e.g., *C. leda* (Kittl) (Kittl, 1894b:115, pl. 1: fig. 13)).

Codinella? species indeterminate

PLATE 2: FIGURES 2–4

DESCRIPTION.—High-spired shell with bluntly rounded apex. Sutural grooves deep. Shell of six whorls, with earliest three increasing rapidly in width followed by transition to more rapid growth in whorl height. Earlier whorls evenly arched. Final whorl with two blunt keels; whorl profile generally convex but with concave lateral face between keels. Moderately wide selenizone at upper keel. Growth lines fine and closely spaced, prosocyrt on concave lateral face, and opisthocline upward and downward, and then orthocline. Base convex. Umbilicus small but evident.

MATERIAL EXAMINED.—Two specimens from the middle to upper part of the Guojiashan Formation of Guojiashan: USNM 485527, 485528.

DISCUSSION.—The final whorls of these shells are similar to *Codinella leda* (Kittl) from the Alpine Marmolata bed, but that specimen lacks a spire and its upper keel is more sharply defined. The generic description of *Codinella* (Kittl, 1899:15) mentions an anomphalous umbilicus, although Kittl's description and figures of *C. leda* (Kittl, 1894b:115, pl. 1: fig. 13) indicate a wide umbilicus and serve as a key character to distinguish it from *C. mammiformis* (Kittl) (Kittl, 1899:17). These specimens have taller whorls, an aperture similar to *C. mammiformis,* but a small umbilicus like *C. leda.* Because these species differ markedly from the type species, they may represent a different clade, or the definition of the genus should be revised.

Family TROCHOTOMIDAE Cox, 1960

Genus *Trochotoma* Eudes-Deslongchamps, 1843

Subgenus *Discotoma* Haber, 1934

TYPE SPECIES.—*Ditremaria amata* d'Orbigny, 1850; by original designation.

DISCUSSION.—The low-spired turbiniform shells have transverse folds on the upper face. *Discotoma* was first reported from the Jurassic; the Chinese species *Trochotoma* (*Discotoma*) *gansuensis,* new species (described below), extends the range of this subgenus downward into the Middle Triassic.

Trochotoma (*Discotoma*) *gansuensis,* new species

PLATE 2: FIGURES 5–10

DIAGNOSIS.—Low-spired shell with small spire and acute apex. Row of low and slightly opisthoclinally elongated nodes on upper whorl face. Cancellate ornament well developed. Widely phaneromphalous.

DESCRIPTION.—Medium-sized to large, low-spired form with acute apex. Sutural grooves deep. Shell of five highly convex whorls with slightly angular upper whorl face, enlarging and rapidly expanding. Cancellate ornament of fine and regular, closely spaced spiral threads and nearly straight collabral lines. A row of low, rough, and slightly opisthoclinally elongated nodes on upper face. Spiral threads passing through nodose surfaces. Base convex. Umbilicus open and wide, about one-half diameter of shell.

MATERIAL EXAMINED.—Four specimens from the middle to upper part of the Guojiashan Formation of Guojiashan: USNM 485529–485531.

TYPE SPECIMENS.—*Holotype:* USNM 485530; *Paratypes:* USNM 485529, 485531.

DISCUSSION.—This new species can only be confused with the Middle Triassic *Discotoma planoconvexa* Yu, Pan, and Wang (Yu et al., 1974:322, pl. 171: figs. 1–3) from Qingyan, Guizhou Province, southwestern China. The Guizhou species has a much lower spire, blunt apex, and less well-defined spiral ornament.

ETYMOLOGY.—The species name is derived from Gansu Province, where the specimens were collected.

Superfamily TROCHOIDEA Rafinesque, 1815

Family TROCHIDAE Rafinesque, 1815

The relationship between Paleozoic and early Mesozoic "trochids" and the modern Trochoidea remains disputed.

Genus *Tylotrochus* Koken, 1896

TYPE SPECIES.—*Trochus konincki* Hörnes, 1856; by original designation.

DISCUSSION.—The collection from Qinling includes a single small specimen allied to this genus.

Tylotrochus elongatus Bandel, 1993

FIGURE 6; PLATE 2: FIGURE 11

Ziziphinus semipunctatus Zardini, 1978, pl. 14: fig. 13 [nomen nudum].—Bandel, 1993:929.

Tylotrochus elongatus Bandel, 1993, pl. 7: figs. 3, 5.

DIAGNOSIS.—Very small conical shell with acute apex and flat sides. Six low, wide whorls, with well-developed spiral threads on earlier whorls but only on lower part of last two whorls.

DESCRIPTION.—Pleural angle 58°. Sutures impressed but grooves shallow. Shell of six low and wide whorls, increasing rapidly in width and slowly in height. All whorls flat with fine and closely spaced spiral threads; lowest one or two spiral threads more prominent and acute than upper ones. On early whorls, all spiral threads clear and regular, but on last two whorls only lowest three to four spiral threads prominent;

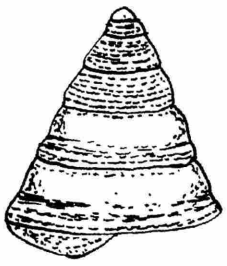

FIGURE 6.—*Tylotrochus elongatus* (not to scale).

upper spiral threads on last whorls faint or absent. Peripheral angulation at base of final whorl. Base low and evenly convex.

MATERIAL EXAMINED.—A single specimen from the middle part of the Guojiashan Formation of Saierlangshan.

MEASUREMENTS.—As follows:

USNM catalog no.	Shell height (mm)	Shell width (mm)
485532	2.45	2.00

DISCUSSION.—This conical shell with very low and wide whorls and prominent spiral threads is similar to the many "*Tectus*" species of the northern Alps (a group in need of redescription), most of which are currently placed in *Dimorphotectus*. The Chinese species, however, has a lower spire, fewer whorls, less-distinguished spiral ornament on the final whorls, and a less-developed keel above the suture. The specimen is remarkably similar to Bandel's *Tylotrochus elongatus,* so we have assigned this small specimen to that species.

Family TURBINIDAE Rafinesque, 1815

Genus *Natiria* de Koninck, 1881

TYPE SPECIES.—*Natica lirata* (Phillips, 1836); by monotypy.

DISCUSSION.—The Early Carboniferous type species of *Natiria* is characterized by whorls only barely in contact and by widely spaced laminar collabral or transverse flanges. Yin and Yochelson (1983b) transferred it to the Family Turbinidae from the Family Craspedostomatidae (Knight et al., 1960), comparing it with *Eucycloscala* and *Liontina*. Batten and Stokes (1986) followed Yin and Yochelson's family assignment but compared *Natiria* with *Collonia* and placed the genus in a different subfamily.

Natiria? species indeterminate

PLATE 2: FIGURES 12–14

DESCRIPTION.—Medium-sized, globular, naticiform shell. Spire protruding but obtuse. Sutures impressed. Four strongly convex whorls extending obliquely. Final whorl inflating abaxially, width greater than its height. Pronounced growth lines and faint, widely spaced transverse riblets visible on preserved steinkerns. Aperture large and subcircular. Central chink on base possibly an umbilicus. Inner lip not obviously thickened.

MATERIAL EXAMINED.—Two specimens from the Maresongduo Formation at Saierlangshan: USNM 485538.

DISCUSSION.—These two specimens have some small pieces of very thin shell wall, which, associated with the relatively thin inductura on the inner lip, suggest that they are not neritoids despite their more embraced whorls and naticiform shape. The shell wall and the ornament are similar to those of *Natiria costata* (Münster) (Frech, 1912:43, pl. 7: fig. 3). In the type species of *Natiria* the whorls are barely in contact and the ornament is composed of sparsely spaced laminar collabral flanges; these may have had a very different ecological function from ordinary ribs. We do not know whether the faint riblets on the steinkerns reflect the presence of flanges on the shells.

Superfamily AMBERLEYOIDEA Wenz, 1938

Family AMBERLEYIDAE Wenz, 1938

Genus *Amberleya* Morris and Lycett, 1851

TYPE SPECIES.—*Amberleya bathonica* Cox and Arkell, 1950; by original designation.

DISCUSSION.—This genus is distinguished from *Eunemopsis* by the columellar lip and umbilicus. *Amberleya* has a smooth concave columellar lip and no umbilicus whereas *Eunemopsis* has a denticle on the upper part of the columellar lip and a narrow umbilicus. In addition, *Eunemopsis* generally has two to three rows of laterally extended nodes with a more complicated ornament than *Amberleya.*

Amberleya? species indeterminate

FIGURE 7; PLATE 2: FIGURES 15, 16

DESCRIPTION.—Moderately pyramidal shell with acute apex. Sutures indistinct. Whorls convex, with two rows of strongly protruded nodes. Upper row of nodes very rough and rounded; lower row weaker and spirally elongated; both rows almost combined into one row on earlier whorls. Growth lines faint and straight. Base convex. Umbilical area shallowly depressed. Very thick shell.

MATERIAL EXAMINED.—A single partial specimen with a broken aperture and four whorls, from the lower part of the Zalishan Formation at Saierlangshan: USNM 485537.

DISCUSSION.—The Qinling collection includes a single specimen with two rows of loose nodes that is referred to *Amber-*

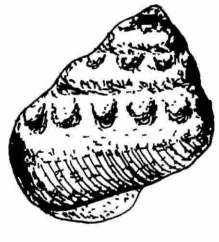

FIGURE 7.—*Amberleya*? species indeterminate (not to scale).

leya. Although the aperture is broken and the columellar lip is not preserved on this specimen, the relatively simple ornament suggests assignment to *Amberleya*. Most species of *Amberleya,* however, have more ornamentation than this specimen although they are usually not so elaborate as *Eunemopsis*.

Genus *Eunemopsis* Kittl, 1891

TYPE SPECIES.—*Turbo epaphus* Laube, 1869; by subsequent designation (Cossmann, 1916).

DISCUSSION.—These small shells have a delicate ornament. They became common after the Middle Triassic but were rare in the Paleozoic. *Glyptospira* from the Permian is quite similar, and the single specimen of *Eunemopsis* from this collection may represent a member of that clade.

?*Eunemopsis dolomitica* Kittl, 1891

FIGURE 8; PLATE 2: FIGURE 17

Eunemopsis dolomitica Kittl, 1891:257, pl. 7: fig. 30.—Zardini, 1978:31, pl. 16: figs. 6–8.—Bandel, 1993:45, pl. 13: figs. 1, 6, 8, 9.

DESCRIPTION.—Small, medium-spired, conical trochid. Suture deeply impressed. Transverse ribs prosoclinal, weakly extending on concave lateral face and ending in nodules near each suture. Base convex with marked spiral ribbons. Narrowly pseudomphalous. Aperture subcircular.

MATERIAL EXAMINED.—One partial specimen with the final two of six original whorls; other whorls broken during preparation. From the middle part of the Guojiashan Formation of Guojiashan: USNM 485620.

DISCUSSION.—The reconstruction of the shell is shown in Figure 8. The relatively large pleural angle and stronger upper row of nodes differentiate this shell from the other species of this genus (e.g., *Eunemopsis epaphus* (Laube) and *E. praecurrens* Kittl).

FIGURE 8.—?*Eunemopsis dolomitica,* with outline of portions (in dotted lines) broken during preparation of specimen (not to scale).

Suborder Uncertain

Superfamily MURCHISONIOIDEA Koken, 1896

Family MURCHISONIIDAE Koken, 1896

Genus *Cheilotomona* Koken, 1889

TYPE SPECIES.—*Pleurotomaria blumi* Münster, 1841; by subsequent designation (Diener, 1926).

DISCUSSION.—This Triassic genus, which probably arose from Paleozoic murchisoniids, is characterized by a peripheral keel in the middle of the whorl that forms the lower border of the selenizone. These easily identified specimens display extensive morphological variation in pleural angle at a single locality.

Cheilotomona acutocarinata, new species

PLATE 2: FIGURES 18–23

DIAGNOSIS.—Acutely conical shell with pleural angle of 45°–65° and with four to six strongly convex whorls divided by deep sutural grooves. Three prominent keels with middle keel forming whorl periphery. Spiral threads very fine and regular.

DESCRIPTION.—Small- to medium-sized, high-spired, acutely conical shells. Sutures deeply impressed. Keel at mid-whorl very prominent and acute, forming periphery; two weaker keels above and below this keel; faces between three keels slightly concave. Obscure selenizone between upper and middle keels. Subsutural face sloped, narrow, and feebly convex between upper keel and suture. Other ornament of very fine, regular, and closely spaced spiral threads; growth lines faint. Base low, convex, anomphalous. Aperture unknown.

MATERIAL EXAMINED.—Fourteen specimens from the lower part of the Guojiashan Formation of Saierlangshan.

TYPE SPECIMENS.—*Holotype:* USNM 485626; *Paratypes:* USNM 485621–485625, 485627.

MEASUREMENTS.—As follows:

USNM catalog no.	Shell height (mm)	Shell width (mm)	Pleural angle (°)
485621	>4.7	4.3	55
485622	6.5	5.5	65
485623	6.2	5.1	55
485624	>9.2	7.2	40
485626	7.4	5.2	45
485627	10.5	7.8	45

DISCUSSION.—*Cheilotomona avisii* Böhm (1895:227, pl. 15: fig. 21) from the Marmolata bed and *C. blumii* (Wissmann) (Laube, 1868:89, pl. 28: fig. 7) from the St. Cassian Formation of the Alps share the acute and conical shell and mid-whorl keel with this Chinese species. The Chinese species has a larger pleural angle, deeper sutural grooves, and stranger and more acute keels than *C. avisii*, whereas *C. blumii* has a much more prominent ornament but only one extra middle keel and no distinct upper or lower keels.

ETYMOLOGY.—The species name is based on the acute and strong keel at mid-whorl, which differentiates it from most other species of the genus.

Unnamed Clade (NERITOPSINA + COCCULINOIDEA) Ponder and Lindberg, 1997

Superfamily NERITOIDEA Rafinesque, 1815

DISCUSSION.—More than one-half of the gastropods in the West Qinling collection are neritoids, which likewise comprise

a very important part of Early Triassic assemblages worldwide and of Middle and Late Triassic gastropods assemblages in Europe. Distinguishing the many described genera and species in this group has been a difficult and confusing problem for more than 100 years. Despite much discussion (Koken, 1892b, 1897, 1898; Kittl, 1894b, 1899; Böhm, 1895; Cossmann, 1925; Wenz, 1938; Haas, 1953; and Yin and Yochelson, 1983b) this taxonomic morass persists.

The characters initially chosen to discriminate taxa in this clade were difficult to apply in practice, and their claimed phylogenetic significance was seldom demonstrated. The inner resorption of the early whorls was considered a key character distinguishing the Family Neritopsidae from the Family Neritidae. The teeth or protuberances on the inductura of the inner lip along with resorption of the inner whorl were used as the most important markers dividing genera. Yet observation of inner-whorl resorption on internal casts is not reliable, and sufficient numbers of well-preserved specimens have rarely been available to allow serial sectioning. Moreover, the teeth or protuberances on the inner lip lie immediately inside the aperture and are not continuous spiral ridges; thus observing this feature requires preservation of undamaged apertures. Because the characters that serve to define many genera or higher taxa can rarely be observed, it is hardly surprising that the taxonomy of this group has a troubled history. Even Kittl, who continuously emphasized the importance of these characters, actually described and figured these characters only in few species, and he surely did not see them in many of his type specimens. Furthermore, Kittl (1894b:138–139) suggested that some species of *Naticopsis* and *Hologyra* exhibited partial to complete inner resorption of the early whorls. At present the phylogenetic significance of these characters is unknown; detailed phylogenetic analysis of the group, beyond the scope of this study, will be required to fully resolve these problems.

In living neritoids, folds on the inductura of the inner lip enhance the positioning of the operculum within the aperture and are related to the ecology of the animal. These folds, however, differ from the inductural teeth or protuberances on the Triassic forms in shape and growth; the latter appear to be too small and isolated to strengthen the articulation. Kittl (1899:27) noted that his subgenus *Marmolatella* has two teeth or tubercles as well as the abaxially extended final whorl and long, straight columellar lip. No teeth or tubercles have been noted on specimens of apparent *Marmolatella* from the well-silicified specimens from the Permian of West Texas or from the Triassic Chinese collections. In the well-silicified Permian specimens of *Naticopsis* from West Texas, one clear tooth is seen inside the aperture in some specimens although many other specimens have only a smooth inductura. The evident variability in the presence or absence of teeth or tubercles on the inductura suggests this character may not be useful in distinguishing genera.

Finally, Haas (1953:159) wrote that "the shell substance regained goes into the callosity of the inner lip," suggesting a relationship between inner-whorl resorption and the inductura; yet, inductura formation also occurs in naticopsids in which no resorption of inner wall is known.

The remarkable abundance of neritomorphs in this collection is significant. A. Nützel (pers. comm. to Erwin, 1999) suggested the calcitic outer shell layer may have enhanced the preservation potential of this group relative to other groups.

Family NERITOPSIDAE Gray, 1847

DISCUSSION.—The Neritopsidae are distinguished from the Neritidae by the neritopsids' resorption of the inner wall during ontogeny. Nonetheless, recognition of many genera in this family is difficult. Forms such as *Neritopsis* and *Trachyspira* are recognizable from their peculiar ornament, whereas *Frombachia* and *Pachyomphalus* are distinguished by their unique shape. The classification of the *Naticopsis*-like group without distinctive ornament remains unresolved. The other naticopsid genera are characterized by seemingly more reliable characters and have received less attention. We cannot resolve this problem, but we do suggest a practical way to distinguish these genera and subgenera.

The more difficult Triassic naticopsid genera (and their type species) include *Naticopsis* M'Coy, 1844 (type species *Naticopsis phillipsii* M'Coy), *Dicosmos* Canavari, 1890 (*Dicosmos pulcher* Canavari), *Hologyra* Koken, 1892b (*Hologyra alpina* Koken), *Marmolatella* Kittl, 1894b (*Naticopsis* (*Marmolatella*) *applanata* Kittl), *Fedaiella* Kittl, 1894b (*Natica cuccensis* Mojsisovics), *Vernelia* Böhm, 1895 (*Natica fastigata* Stoppani = *Natica excelsa* Hauer), *Planospirina* Kittl, 1899 (*Nerita esinensis* Stoppani), and *Auricularia* Tichy, 1979 (*Marmolatella auriculata* Koken).

These genera were based on variable characters including the umbilicus, pseudoumbilicus, funicle (which varies during ontogeny), callosity of the inner lip, and teeth or tubercles on the inner lip, which may be difficult to observe. By the 1890s Koken (1892b, 1897), Kittl (1894b, 1899), and Böhm (1895) had recognized that inadequate description had caused problems in identifying the genera or subgenera they had each described. It is not clear that these workers actually understood the differences between these taxa themselves. For example, Böhm (1895:250) distinguished his *Vernelia* from *Hologyra* by the absence of the umbilical funicle because Koken (1892b: 193–194) only emphasized the existence of the juvenile umbilicus; but Kittl (1899:49) noted that the umbilicus of *Hologyra* was closed in the adult shell, so he did not admit Böhm's *Vernelia*. Koken (1892b:193–194) did not discuss the relationship of his *Hologyra* to Canavari's *Dicosmos* when he established the former. After Böhm (1895:257) reclarified the characters of *Dicosmos,* Koken (1897:69) realized that his *Hologyra* had the same umbilical characters as *Dicosmos,* and he rejected Canavari's *Dicosmos*. Yin and Yochelson (1983b:517, table 1) distinguished the four most troublesome taxa, but the characters used sometimes varied from the initial diagnoses of the genera. For instance, *Hologyra* was listed as having tubercles or teeth

on the inner lip, yet Koken (1892b:193) clearly wrote "ohne Zähne und Kerben" (no teeth and troughs), and many later authors (e.g., Kittl, 1899:49; Schmidt, 1928:226) also noted "no teeth."

Although this group clearly needs a thorough phylogenetic analysis, as a step in that direction we provide herein a comprehensive discussion of the characters. Among the other, less difficult neritopsid genera, basic shell form and whorl geometry appear to be useful. For example, *Planospirina* typically has a flat apex, *Pachyomphalus* has a medium-sized spire, and *Marmolatella* (and *Auricularia*) possesses a unique ear-like shell. Table 5 compares characters of the type species of nine taxa including *Dicosmos, Hologyra, Vernelia,* and *Fedaiella* as well as *Naticopsis* sensu stricto; the indices used are defined and illustrated in Figure 9. Although Kittl (1899:27) compared these taxa by integrating characters including shell form, apex, and upper whorl face, the characters played a minor role in his taxonomic decisions.

Pachyomphalus is distinguished by its high spire (large ratio of spire height to total height and relatively low ratio of apertural height to total height). The eight remaining forms fall into two groups based on shell shape: *Marmolatella, Auricularia,* and *Planospirina* all have a small ratio of spire height:total height (flattened or depressed spire) and a large ratio of apertural height:total height (high aperture); the second group includes the naticiform or globular *Naticopsis, Fedaiella, Hologyra, Dicosmos,* and *Vernelia*. Because of the intergradations of form within these groups, we accord each group generic rank (*Marmolatella* and *Naticopsis,* respectively) and accord subgeneric rank within the groups. *Hologyra* and *Dicosmos,* however, have few differences and are considered synonyms, with *Dicosmos* being the senior synonym. Similarly, *Naticopsis* and *Fedaiella* are very similar and can be distinguished only in features of the columella and umbilicus. This suggests that the Paleozoic *Naticopsis* sensu stricto may extend into the Triassic, with *Fedaiella* being the postextinction part of the lineage.

TABLE 5.—Comparison of characters among type species of selected genera and subgenera in Neritopsidae (s, h, a, b, w, e, and r are defined in Figure 9 legend; * = specimen could not be measured).

Genus or subgenus	Type species	Descriptive characters				Measured indices				
		Apex shape	Suture	Umbilicus	Columellar lip	s/h	a/h	b/w	e/w	r, shape
Marmolatella	*Naticopsis* (*Marmolatella*) *applanata*	Flat	Deep	None	Nearly straight	0	0.97	0.13	0.25	>90°, round
Auricularia	*Marmolatella auriculata*	Sunken	Deep	None	Curved, long	-0.13	1.15	0.16	0.24	>90°, round
Planospirina	*Nerita esinensis*	Flat	Deep	None	Curved, short	0.08	0.93	0.21	0.27	>90°, angular
Naticopsis	*N. phillipsii*	Acute	Shallow	None	Curved, short	0.07	0.81	*	0.37	90°, angular
Fedaiella	*Natica cuccensis* Mojsisovics	Acute	Deep	Open	Straight, long	<0.10	>0.86	0.25	0.37	90°, angular
Hologyra	*H. alpina*	Obtuse	Shallow	Closed	Curved, short	0	0.89	0.19	0.24	<90°, round
Dicosmos	*D. declivis*[1]	Obtuse	Shallow	Closed	Curved, short	0.07	0.86	0.21	0.32	<90°, angular
Vernelia	*Natica fastigata* = *N. excelsa*	Acute	Deep	None	Curved, short	0.18	0.63	0.38	0.31	<90°, acute
Pachyomphalus	*P. concinnus* Böhm	Acute	Deep	Unknown	Curved, short	0.27	0.50	0.48	0.33	<90°, acute

[1]Not the type species; used in place of type species because it shows all characters.

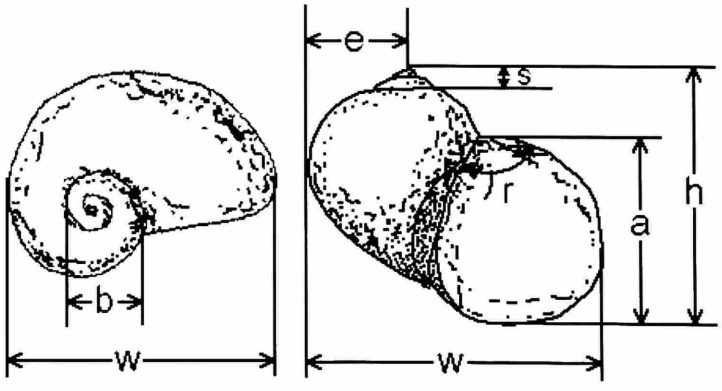

FIGURE 9.—Character measurements used in Table 5. Abbreviations: a = apertural height, b = spire width, e = spire radius, h = total height, r = pleural angle, s = spire height, and w = total width.

Both lineages are represented from the Permian into the Triassic. The *Marmolatella*-group seemingly developed from the earlier *Naticopsis* in the Late Paleozoic via *Planospira,* expanded in the Triassic, and produced *Auricularia* in the Middle Triassic. The *Naticopsis*-group generated a high-spired subgroup in the Late Paleozoic, including *Jedria, Vernelia,* and the Triassic *Pachyomphalus,* but its major expansion was in the Middle Triassic with a flattening of the spire and development of a globular and oblique shell, producing huge *Fedaiella* and *Dicosmos.*

Genus *Marmolatella* Kittl, 1894

Subgenus *Marmolatella* Kittl, 1894

Marmolatella (*Marmolatella*) *complanata* (Stoppani, 1857)

PLATE 2: FIGURES 24–31

Marmolatella complanata Stoppani, 1857 [*In* Stoppani, 1858–1860].—Kittl, 1899:46, pl. 8: figs. 7, 8; pl. 9: figs. 7–10.

Naticopsis (*Marmolatella*) *planoconvexa* Kittl, 1894b:144, pl. 4: figs. 1–3.—Kittl, 1899:46 [placed in synonymy].

Marmolatella planoconvexa (Kittl).—Böhm, 1895:255, pl. 10: figs. 15, 16b–f.

DESCRIPTION.—Medium-sized auricular naticopsid. Small spire, only slightly protruding from final whorl. Sutures deep and distinct. Whorls expanding rapidly, particularly abaxially and abapically. Final whorl expanding more rapidly than preceding whorls, with smoothly arched side surface. Shell wall composed of very thin outer layer (probably calcitic) and much thicker inner layer, with fine collabral ornament clearly observed on both; ornament seemingly slightly stronger on the outer layer. Collabral ornament irregular but tending to gather into bands. A few dark bands usually visible. Aperture large and oviform, narrowing at base but slightly produced anteriorly. Columellar lip straight and long, inner lip reflexed and markedly thickened by inductura, covering umbilical area; no teeth observed. Outer lip thin and circularly curved.

MATERIAL EXAMINED.—Six specimens, most complete, from the middle to upper part of the Guojiashan Formation of Guojiashan. A seventh specimen from the same locality (USNM 485543) is assigned to the species with less certainty.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width
485539	21.3	29.8	21.0	10.7	19.8	17.2
485540	24.0	31.0	22.0	11.4	20.0	16.5
485541	22.3	24.9	21.9	7.8	20.1	13.5
485542	32.0	36.0	29.0	10.5	27.0	25.0

DISCUSSION.—These specimens coincide with the southern Alpine specimens in all features except for the slightly higher spire of these, which is insufficient to separate the Chinese forms from the Alpine. *Naticopsis* (*M.*) *planoconvexa* was established by Kittl (1894b) who later (1899:46) recognized that it has the same deep sutures and dark bands as *M.* (*M.*) *complanata* and synonymized the two species.

Marmolatella (*Marmolatella*) *obtusangula* (Koken, 1897), new combination

PLATE 2: FIGURE 32

Hologyra obtusangula Koken, 1897:72, pl. 13: fig. 10.

DESCRIPTION.—Medium-sized auricular naticopsid. Spire obtuse and nearly flat. Width of shell close to height. Sutures canaliculate but very shallow and narrow, sinking close to aperture. Three and one-half rapidly expanding whorls largely embracing earlier whorls. Final whorl expanding abaxially and extending abapically. Growth lines faint, straight, and slightly prosoclinal. Aperture highly hemicircular, narrowed abapically. Inner lip long and almost straight, extending to the abapical terminal of shell. Inductura long and narrow, spreading inside aperture; flat but with a fold under umbilical area. Anomphalous.

MATERIAL EXAMINED.—Five specimens from the middle to upper part of the Guojiashan Formation.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width
485551	12.2	11.2	10.6	3.4	–	–
485552	5.2	5.7	4.9	1.9	4.4	2.5

DISCUSSION.—These specimens have a nearly flat upper surface but an obtuse and slowly elevating spire, coinciding with Koken's species.

Genus *Naticopsis* M'Coy, 1844

Subgenus *Dicosmos* Canavari, 1890

Naticopsis (*Dicosmos*) *applanatus* Kutassy, 1937, new combination

PLATE 2: FIGURES 33–36

Dicosmos applanatus Kutassy, 1937a:47, pl. 1: figs. 84–86.

DESCRIPTION.—Medium-sized, globular, naticiform shell. Apex obtuse; spire small but markedly protruding. Sutures impressed with narrow grooves. Shell of four rounded whorls. Final whorl expanding and evenly arched. Growth lines closely spaced, straight, and prosoclinal, but curved forward close to sutures. Aperture nearly hemicircular. Outer lip thin and sharp. Inductura mainly covering parietal lip, flat, and slightly concave in lower part. Umbilical chink visible.

MATERIAL EXAMINED.—Six specimens from the middle to upper part of the Guojiashan Formation: USNM 485544–485546.

DISCUSSION.—These specimens coincide with Kutassy's species and are distinguished from *N.* (*D.*) *impressa* (Münster)

by their elevated and pointed spire, evenly arched whorl profile, and prominent growth lines.

Naticopsis (Dicosmos) compressus, new species

PLATE 2: FIGURES 37–43; PLATE 3: FIGURES 1–6

DIAGNOSIS.—Spire very depressed, producing a wide, continuously curved upper whorl surface. Final whorl strongly arched. Columellar lip long and nearly straight. Inductura thin and wide.

DESCRIPTION.—Small- to medium-sized, subglobular naticopsid. Upper surface a continuous curve formed by small, low, obtuse spire and shallow, flat sutural grooves. Three to four whorls rapidly expanding laterally and markedly embracing preceding whorls. Final whorl expanding both abaxially and abapically; outer whorl strongly bowed. Growth lines fine, closely spaced, and straight, tending to gather close to upper edge of aperture. Aperture oviform, pointed adapically. Outer lip thin and sharp. Inductura on inner lip, mainly on parietal lip, thin and wide, smoothly convex, with no teeth. Umbilical area entirely covered.

MATERIAL EXAMINED.—Ten specimens from the middle to upper part of the Guojiashan Formation: USNM 485573–485581.

TYPE SPECIMEN.—*Holotype:* USNM 485581.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width
485573	11.4	12.7	10.9	3.9	10.0	7.4
485574	14.6	14.5	13.9	4.7	11.7	8.6
485575	9.3	10.7	9.2	3.9	7.8	5.8
485577	14.1	15.6	14.0	4.6	11.4	10.0
485578	10.0	11.1	9.8	3.8	8.2	6.2
485579	12.0	13.8	11.8	4.1	10.7	8.2

DISCUSSION.—*Naticopsis (Dicosmos) declivis* Kittl (1894b: 140, pl. 4: figs. 10–14) is the most similar species to this form in overall shell shape, but the Chinese species has a more depressed spire, a more curved final whorl, and a longer and straight columellar lip.

ETYMOLOGY.—The species name is derived from the short spire, which produces a compressed shape.

Naticopsis (Dicosmos) declivis (Kittl, 1894), new combination

PLATE 3: FIGURES 7–11

Hologyra declivis Kittl, 1894b:140, pl. 4: figs. 10–14.
Dicosmos declivis (Kittl).—Tommasi, 1913:40, pl. 3: fig. 17.

DESCRIPTION.—Large, oval but compressed naticopsid. Outline of upper surface of whole shell a smooth curve formed by low, obtuse apex and spire and by flush suture. Four adpressed whorls enlarging obliquely and extending adapically to embrace most part of preceding whorl. Final whorl inflating with slightly concave upper outer surface. Base convex. Surface ornamented with crowded growth lines and dark bands. Growth lines slightly curved and prosoclinal. Aperture large and ovoid, pointed adapically at suture. Inner lip sigmoid. Inductura very thick and wide, mostly thickened at meeting of parietal and columellar lips so that inductural surface almost flat; teeth absent. Umbilical area entirely covered.

MATERIAL EXAMINED.—Five mostly well-preserved specimens from the middle to upper part of the Guojiashan Formation.

MEASUREMENTS.—As follows (in mm; pleural angle in degrees):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width	Pleural angle
485547	>24.0	>30.0	>22.0	9.5	24.0	>22.0	126
485548	>25.0	33.0	>25.0	10.0	22.0	24.0	125
485549	25.0	~28.0	24.0	8.5	19.0	~19.0	130
485550	21.0	20.0	19.5	7.2	–	–	124

DISCUSSION.—This species is characterized by a compressed globular shell, flat sutures, low and very blunt spire, and a short but broadened final whorl with a flat to slightly concave sutural face.

Naticopsis (Dicosmos) eyerichi (Noetling, 1880), new combination

PLATE 3: FIGURES 12–16

Natica eyerichi Noetling, 1880:330, pl. 16: fig. 9.
Hologyra eyerichi (Noetling).—Picard, 1903:485, pl. 11: fig. 3.

DESCRIPTION.—Small to very small, globular, naticiform shell. Spire small but protruding slightly. Sutures impressed and grooves shallow, but suture on final whorl obviously enlarged. Three to four whorls evenly arched and extending obliquely, partly embracing preceding whorl. Final whorl inflated with height nearly equal to width. Growth lines closely spaced, regular, straight, and nearly orthoclinal. Aperture large, subcircular. Outer lip thin and sharp. Inner lip curved and thickened by an inductura. Umbilicus covered.

MATERIAL EXAMINED.—Many specimens in the limestone of the lower part of the Guojiashan Formation: USNM 485557–485561.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width
485557	4.0	4.2	3.8	1.7	3.2	2.4
485560	6.0	6.0	5.7	3.0	4.6	3.9
485561	4.2	4.5	3.9	2.0	3.2	2.6

DISCUSSION.—The oviform shape, small but conically raising spire, markedly impressed final whorl suture, and the thick inductura coincide with Picard's (1903) specimens from the Lower Muschelkalk.

Naticopsis (*Dicosmos*) *impressa* (Münster, 1841)

PLATE 3: FIGURES 17–22

Natica impressa Münster, 1841:99, pl. 10: fig. 9.—Laube, 1868:37, pl. 21: fig. 13.
Naticopsis impressa (Münster).—Kittl, 1892:81, pl. 7: figs. 13, 15–17.
Hologyra impressa (Münster).—Kittl, 1899:49 [no figures].

DESCRIPTION.—Medium-sized to large, hemispherical to subspherical, naticiform gastropod. Spire obtusely protruding and low. Shell of more than three abutted convex whorls. Body whorl extending upward and covering about two-thirds of earlier whorl, forming a flattened to slightly concave upper surface below suture. Final whorl expanding obliquely. Base convex. Growth lines irregular although almost straight and prosoclinal. Aperture large, subcircular to ovoid. Outer lip thin and sharp, with upper margin inclined to axis. Inner lip reflexed, covered by a low and narrow inductura.

MATERIAL EXAMINED.—Five specimens, three of which are well preserved, from the lower part of the Guojiashan Formation of Saierlangshan: USNM 485553–485556.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width
485553	15.0	6.5	14.0	6.1	10.0	10.0
485554	13.5	13.3	13.0	5.5	11.2	8.6

DISCUSSION.—These specimens have a whorl shape similar to *Naticopsis* (*Dicosmos*) *sichuanensis,* new species, from the same locality. The major differences distinguishing the two species are the oblique upper margin of the aperture in *N.* (*D.*) *impressa* versus the abaxial (horizontal) upper margin in and the less stair-like upper surface of the shell in *N.* (*D.*) *sichuanensis,* new species. Additionally, these specimens of *N.* (*D.*) *impressa* display a flattening or depression below the suture on the final whorl.

Naticopsis (*Dicosmos*) *sichuanensis*, new species

PLATE 3: FIGURES 23–34

DIAGNOSIS.—Spire low but clearly protruding on upper surface of shell. Apex obtuse. Upper side of shell stair-like. Upper margin of aperture extending abaxially. Inductura narrow and rib-shaped.

DESCRIPTION.—Small- to medium-sized, nearly hemispherical, naticiform shell. Spire small, low, obtuse, and protruding. Sutures shallow and impressed. Shell of three and one-half whorls, enlarging abaxially; strongly convex in middle to upper whorl face such that upper surface appears stair-like. Growth lines faint, almost straight, and slightly prosoclinal. Inner lip curved. Aperture large and subcircular, strongly expanding abaxially. Outer lip sharp and thin, broadly curved with narrowly rounded shoulder; upper and middle margins of outer lip divided by this shoulder. Inductura narrow and rib-like, extending from parietal lip to columellar lip and covering most of umbilicus but preserving an umbilical chink.

MATERIAL EXAMINED.—Thirty specimens from the lower and middle parts of the Guojiashan Formation of Saierlangshan and two from the lower part of the Guanggaishan Formation of Lagecaimo, Zoigê Xian, Sichuan Province: USNM 485562–485572.

TYPE SPECIMEN.—*Holotype:* USNM 485562.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width
485562	9.3	10.3	8.8	3.6	7.4	6.8
485563	9.0	9.0	8.4	3.6	7.1	6.1
485565	6.6	7.3	6.5	2.8	5.9	5.0
485568	6.9	7.9	6.8	3.0	6.7	5.5
485569	3.9	4.0	3.8	1.8	3.4	3.2
485570	9.5	11.9	9.2	4.4	8.8	8.0
485571	7.2	7.0	6.9	2.9	5.5	4.3

DISCUSSION.—These specimens are similar to *Naticopsis* (*Dicosmos*) *cassiana* (Wissmann) (Laube, 1869:36, pl. 21: fig. 10; Kittl, 1892:80, pl. 7: figs. 18–21) and *Naticopsis* (*Dicosmos*) *impressa* (Münster) (Laube, 1869:37, pl. 21: fig. 13; Kittl, 1892:81, pl. 7: figs. 13, 15–17), both of the Alpine St. Cassian Formation and Raibl bed, in the possession of a low and small but protruding spire, large aperture, and narrow but elongate inductura. The Chinese forms differ in having an obtuse but markedly protruding spire and a wider final whorl and aperture than in the Alpine species. The upper margin of the aperture also extends further abaxially in the Chinese forms rather than obliquely as in the two European species.

ETYMOLOGY.—This species is named for the Chinese province where the Guanggaishan Formation is located.

Subgenus *Vernelia* Böhm, 1895

Naticopsis (*Vernelia*) *sublimneiformis* Kittl, 1894

PLATE 3: FIGURES 35–40

Naticopsis sublimneiformis Kittl, 1894b:147, pl. 3: figs. 23, 25, 26 [not fig. 24].
Hologyra (*Vernelia*) *sublimneiformis* (Kittl).—Böhm, 1895:250, pl. 15: fig. 24.
Hologyra sublimneiformis (Kittl).—Kittl, 1899:52, pl. 4: fig. 10.

DESCRIPTION.—Moderately high naticiform shell. Shell higher than wide. Spire conical and protruding. Pleural angle about 100°. Sutures impressed. Shell of four evenly convex whorls enlarging obliquely and rapidly in height and partly embracing about one-third of preceding whorl. Last whorl inflated, a little higher than wide. Middle to lower part of whorl mostly convex. Growth lines faint, nearly straight, slightly prosoclinal, and closely spaced. Aperture ovoid with slightly narrowly rounded front. Outer lip somewhat thickened, with obliquely extending upper margin. Inner lip covered by smooth, concave inductura. Umbilical area depressed but without funicle.

MATERIAL EXAMINED.—Five specimens, including a very small one, from the middle and upper parts of the Guojiashan Formation of Guojiashan and two specimens from the lower part of the Guanggaishan Formation of Lagecaimo, Sichuan Province.

MEASUREMENTS.—As follows (in mm; pleural angle in degrees; all specimens listed below are from Guojiashan):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width	Pleural angle
485582	12.7	11.6	10.3	4.2	9.5	7.7	105
485583	10.2	7.2	8.8	3.6	7.3	5.0	101
485584	4.5	3.5	4.1	1.9	3.1	1.5	97
485585	15.0	12.0	13.0	5.0	10.8	7.8	93

DISCUSSION.—In his definitions of *Naticopsis* (*Vernelia*) *pseudoangusta* and *N.* (*V.*) *sublimneiformis,* Kittl (1894b:147) noted that the only distinguishing character between the two species was the relatively broader shell in the former species. The Chinese specimens are generally intermediate between Kittl's two species, although they seem closer to *N.* (*V.*) *sublimneiformis*; this may suggest that *N.* (*V.*) *pseudoangusta* and *N.* (*V.*) *sublimneiformis* are the same species. Kittl (1894b, pl. 3: fig. 22) figured a small, possibly juvenile, specimen of *N.* (*V.*) *pseudoangusta* with a highly oviform shell. The smallest specimen in this collection (USNM 485584) is similar, although slightly broader than Kittl's.

Subgenus Uncertain

Naticopsis? ribletella, new species

PLATE 3: FIGURES 41–44

DIAGNOSIS.—Small naticiform shell with a low but elevated spire and abaxially extended final whorl. Sutures impressed, grooves shallow. Collabral riblets closely and regularly spaced. Aperture hemicircular with thick, wide inductura entirely covering parietal and columellar lips.

DESCRIPTION.—Small naticiform shell with obtusely conical apex and small but markedly protruding spire. Three whorls increasing quickly in size with evenly curved side. Final whorl expanding abaxially, ornamented with uniform, closely spaced, and nearly orthoclinal riblets. Riblets narrow and round; intergrooves wide and flat-bottomed. Aperture large, highly hemicircular. Inner lip widely thickened by inductura; umbilical area completely covered by inductura with strong fold out of columellar lip. Umbilical area entirely covered.

MATERIAL EXAMINED.—One well-preserved specimen and one with the apex broken, from the middle part of the Guojiashan Formation: USNM 485586, 485587.

TYPE SPECIMEN.—*Holotype:* USNM 485586.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width
485586	8.8	8.7	7.7	2.7	7.3	4.6

DISCUSSION.—This new species is characterized by the ornament of regular riblets, which is similar to some species of *Natiria,* especially to *N. costata* (Münster) (Laube, 1868:43, pl. 22: figs. 11, 12) but these shells have a remarkable callosity on the inner lip that spreads over the umbilical area. The type species of *Natiria, Natica lirata* (Phillips) from the Lower Carboniferous (Knight, 1941), differs significantly from these specimens in its loosely spired whorls with deeply sunken sutures. The inductura of *Natiria* is very weak according to the generic diagnosis (e.g., Wenz, 1938:410; see also Knight, 1941) and in the species referred to *Natiria.* Therefore, both the inductura and the naticiform shell of these specimens support their assignment to the Neritimorpha.

ETYMOLOGY.—This species is named for the close and regularly spaced riblets on the specimens.

Genus *Neritopsis* Grateloup, 1832

TYPE SPECIES.—*Neritopsis monoliformis* Grateloup, 1832; by original designation.

DISCUSSION.—The ornament of this neritopsid easily distinguishes members of the genus from the smooth naticopsids. The genus may have originated from *Naticopsis* or *Trachydomia* or from a related clade during the Triassic recovery. This lineage survived the end-Triassic mass extinction, when most neritopsids became extinct.

Neritopsis planoplicatus, new species

PLATE 3: FIGURE 45; PLATE 4: FIGURES 1, 2

DIAGNOSIS.—Naticiform. Final whorl ornamented with regular cancellate sculpture produced by spiral ribbons and prominent growth lines. Spiral ribbons low and wide with flat top; grooves shallow and flat-bottomed, as wide as ribbons. Inductura smoothly concave and extending inside aperture.

DESCRIPTION.—Medium-sized, globular, naticiform gastropod. Shell width slightly greater than height. Spire small and obtuse but protruding. Sutures impressed; whorls abutted. Shell of four rapidly expanding convex whorls. Final whorl expanding abaxially with step-like upper surface, turning evenly to lateral face and to base. No visible ornament on spire, but cancellate sculpture covering final whorl. Spiral bands with wide, flat tops and bottoms of grooves with steep lateral sides; spiral ribbons low, as wide as grooves. Collabral elements more or less variable, mostly riblets with flat tops; riblets prosoclinal on upper part of final whorl. Aperture subcircular. Outer lip thick, having an oblique and sharpened margin; inner lip thickened by a thin inductura mainly on parietal lip. Inductura smoothly concave, extending inside aperture and covering umbilical area; inductura in umbilical area thin, forming a shallow pit.

MATERIAL EXAMINED.—A single well-preserved specimen from the middle part of the Guojiashan Formation in Guojiashan.

TYPE SPECIMEN.—*Holotype:* USNM 485588.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width
485588	13.7	14.0	12.5	5.5	10.0	8.8

DISCUSSION.—The naticiform shell, marked spiral ornament, and concave inductura mark this specimen as belonging to *Neritopsis*. Although we normally oppose describing a new species based on only a single specimen, the very low and wide spiral ribbons and equally wide grooves (sometimes appearing as dark bands) distinguish this new species from any others within the genus.

ETYMOLOGY.—The species name is derived from the wide, flat spiral ornament.

Family NERITIDAE Rafinesque, 1815

Genus *Neritaria* Koken, 1892

TYPE SPECIES.—*Neritaria similis* Koken, 1892b (=*Natica plicatilis* Klipstein, 1843); by original designation.

DISCUSSION.—The taxa assigned to this genus exhibit no significant differences from the unornamented neritopsids in external form, but the resorption of the inner wall on the early whorls is the standard character distinguishing this taxon from other groups in the clade. As noted earlier, the phylogenetic significance of resorption is unclear and requires further study. We have assigned several taxa to this group based on similarity of the external shell features to previously described European specimens.

Neritaria cf. *calcitica* (Kittl, 1894)

PLATE 4: FIGURES 3–10

Protonerita calcitica Kittl, 1894b:129, pl. 2: figs. 18–22.
Neritaria calcitica (Kittl).—Kittl, 1899:64, pl. 3: figs. 7, 8.—Assmann, 1924: 19, pl. 2: fig. 8.

DESCRIPTION.—Small- to medium-sized compressedly naticiform shell with an enlarged aperture. Spire small and low. Three adpressed whorls with rapid whorl expansion; final whorl greatly expanded. Spire height increasing more slowly, resulting in a compressed naticiform shell. Whorl profile round except for very convex upper part in final whorl. Shell surface smooth except for very fine collabral lines. Apertural plane highly inclined to columellar axis; aperture obliquely oviform, broadened at base, and narrowed adapically. Base clearly umbilicate.

MATERIAL EXAMINED.—Six deformed specimens from the middle and upper parts of the Guojiashan Formation of Guojiashan and additional, broken specimens from other beds at the same locality: USNM 485589–485592.

DISCUSSION.—The inducturas are not well preserved except on the smallest specimen (Plate 4: figure 9), but the trace of an inductura can be seen on others. The smallest shell has an unusual, very strong, highly elevated inductura completely covering the parietal and columellar lips, but with a small umbilical chink. Although slightly deformed, these specimens reveal a depressed shell shape (especially the final whorl) without a horizontal ramp below the barely impressed sutures, which are the major characters that Kittl (1894b:129) emphasized in establishing *Neritaria calcitica*, and that distinguish this species from the similar *N. incisa* (Kittl, 1894b:131, pl. 2: figs. 29–31) and *N. papilio* (Stoppani) (Kittl, 1899:64). The inducturas of these Chinese specimens differ from those of *N. calcitica*; inducturas in Kittl's Alpine specimens, although thickened, cover the umbilical area flatly.

Neritaria candida (Kittl, 1894)

PLATE 4: FIGURES 11–19

Protonerita candida Kittl, 1894b:130, pl. 2: fig. 23.
[For further synonymies see Diener, 1926:101; Kutassy, 1937b:320, 325.]
Neritaria candida (Kittl).—Yin and Yochelson, 1983b:535, fig. 3A–C, E–G.

DESCRIPTION.—Small globular neritopsid of three preserved whorls. Spire markedly protruding with obtusely conical apex. Pleural angle about 90°. Whorls rapidly enlarging in both height and width; even but strongly convex whorl profile. Final whorl expanding abaxially and obliquely. Shell surface smooth, whorls adpressed, with no visible collabral ornament. Aperture oviform and narrowed at base. Inner lip moderately thickened; inductura smooth, not very broad, and largely confined to the parietal lip.

MATERIAL EXAMINED.—Seven mostly well-preserved specimens; four have a flat sutural profile and three have a grooved sutural profile. Four shells have long, straight columellar lips. All are from the middle part of the Guojiashan Formation: USNM 485593–485598.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width
485593	8.8	7.9	6.5	4.0	5.5	3.7
485595	8.2	8.1	7.7	3.5	6.3	5.3
485596	6.2	5.8	5.8	2.7	4.2	3.2
485597	7.4	7.8	6.3	3.2	5.6	4.2
485598	6.0	6.4	5.0	2.7	4.2	3.7

DISCUSSION.—The distinctive characters of this species are the conical apex, tall shell shape producing a pleural angle less than 90°, and shallow sutures. The specimens from Qinling have a pleural angle of about 90° and a slightly larger final whorl, but it is appropriate to include them in this species. Of other similar species, *N. calcitica* (Kittl, 1894b:129, pl. 2: figs. 18–22) has a much lower shell and larger pleural angle, and *N. papilio* (Stoppani) (Kittl, 1899:65, figs. 9–12) has a smaller spire and more impressed sutures.

Neritaria ingrandita (Kittl, 1894)

PLATE 4: FIGURES 20–23

Protonerita ingrandita Kittl, 1894b:132, pl. 3: fig. 1.
Neritaria ingrandita (Kittl).—Böhm, 1895:236, pl. 11: fig. 3.

DESCRIPTION.—Medium-sized to large, hemispherical, broad naticiform gastropod. Spire low and only slightly protruding with an obtusely round apex. Sutural grooves narrow and shallow but deepening close to aperture. Two to three whorls evenly convex and enlarging quickly. Final whorl broad and markedly expanding laterally. Growth lines closely spaced and irregularly prominent, straight but shifting slightly forward below sutures; occasional dark bands parallel to growth lines. Shell wall thick. Aperture subcircular, extending obliquely. Outer lip thin and sharp. Inner lip covered with thin, wide, smooth, and markedly concave inductura covering umbilicus but forming wide depression in umbilical area.

MATERIAL EXAMINED.—Six specimens from the lower and middle parts of the Guojiashan Formation, Guojiashan, and one from the lower part of the Guojiashan Formation, Saierlangshan.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width
485606	21.2	24.4	20.8	8.2	18.1	~16.2
485607	17.3	20.1	16.9	7.3	13.9	13.0

DISCUSSION.—These specimens are identical to *Neritaria ingrandita* (Kittl) in the broad naticiform shape, fewer whorls, and sunken suture close to the aperture. The type specimen of *N. ingrandita* (Kittl, 1894b: 132, pl. 3: fig. 1) has a slightly convex inductura, and the Chinese specimens have markedly concave inducturas. However, Kittl (1894b:132) emphasized the sutural character in naming the species, and in his description the inductura is variable ("abgeplattet, flach oder wenig convex").

Neritaria plicatilis (Klipstein, 1843)

PLATE 4: FIGURES 24–26

Natica plicatilis Klipstein, 1843:195, pl. 13: fig. 9.
Neritaria plicatilis (Klipstein).—Kittl, 1892:88, pl. 7: figs. 34–36.
Neritaria similis Koken, 1892b:192–193, pl. 12: figs. 1–6, 9.
Protonerita plicatilis (Klipstein).—Kutassy, 1937a:55, pl. 2: figs. 29–31.

DESCRIPTION.—Medium-sized, hemispherical, naticiform gastropod. Spire small but markedly protruding. Sutures impressed, grooves narrow and shallow. Three whorls strongly and evenly convex, enlarging quickly. Final whorl considerably inflated and outside profile widely curved. Collabral ornament fine, crowded, straight, and prosoclinal, with some faint growth rugae. Aperture highly oviform but base unknown. Outer lip thin and sharp. Inductura on inner lip strong and rib-like. Umbilicus partly covered, occupied by a long, narrow depression.

MATERIAL EXAMINED.—A single specimen from the lower part of the Guanggaishan Formation, Lagecaimo, Sichuan Province: USNM 485608.

DISCUSSION.—The shell shape and the markedly protruding spire of this specimen supports its assignment to *Neritaria plicatilis*, an intermediate form between *N. mandelslohi* (Klipstein), with a lower shell and smaller spire, and *N. angusta* (Münster), with a higher shell and more protruding spire (Kittl, 1892:88–89). Another related species in this series is *N. transiens* (Kittl) with an even higher shell and spire.

Neritaria sphaeroidica Picard, 1903

PLATE 4: FIGURES 27–40; PLATE 5: FIGURES 1, 2

Neritaria sphaeroidica Picard, 1903:490, pl. 11: fig. 7.

DESCRIPTION.—Medium-sized, globular, naticiform shell with an obtuse apex and low, conical spire. Sutures flush. Four adpressed whorls enlarging obliquely and extending adapically, embracing most of preceding whorl. Final whorl convex, strongly expanding abaxially such that upper surface slightly concave. Growth lines closely spaced, faint, irregular, and prosocyrt. Aperture large and more oval, pointed adapically at suture. Outer lip thin and sharp. Inner lip curved with smooth, moderately wide, and slightly convex inductura, mainly on parietal lip.

MATERIAL EXAMINED.—Seventeen generally well-preserved specimens from the middle and upper parts of the Guojiashan Formation, Guojiashan.

MEASUREMENTS.—As follows (in mm; pleural angle in degrees):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width	Aperture height	Aperture width	Pleural angle
485599	16.4	–	15.6	7.0	–	–	–
485600	12.0	15.5	11.8	5.1	10.8	10.2	124
485601	13.8	17.4	13.8	5.2	12.5	11.2	–
485602	9.5	9.1	9.3	3.2	7.4	5.9	128
485603	8.1	8.7	7.8	3.1	7.4	6.2	118
485604	7.2	9.0	7.1	3.2	6.2	5.7	130
485605	8.2	9.5	8.0	3.3	–	–	–

DISCUSSION.—The spherical shape, flat upper surface of final whorl, and adapically acute aperture are distinctive in this species. Our specimens from Qinling coincide with Picard's (1903) description except that some specimens are slightly larger than Picard's.

Genus *Platychilina* Koken, 1892

TYPE SPECIES.—*Platychilina woehrmanni* Koken, 1892b; by original designation.

DISCUSSION.—This genus is characterized by a strong, laterally extended final whorl producing a very eccentric low spire and a very wide sutural ramp, as well as by nodose ornament. The West Qinling collections include two species assigned to

this genus, although the nodose ornament is not as well developed as in other known species of this genus (see discussion of *Platychilina sinensis,* new species). Previously described Ladinian and Carnian species of *Platychilina* have two or more rows of nodes. Species with a single row of nodes are found only in the Anisian.

Kittl (1899:28) outlined the evolutionary relationships among some genera of neritoids. He placed *Platychilina* in a different lineage from *Naticopsis* and considered it a descendant of the Paleozoic *Platycheilus* Gemmellaro (=*Trachyspira* Gemmellaro) and *Trachydomia* Meek and Worthen. However, the latter two genera have a more constant increase in whorl expansion during shell growth; that is, the pattern of their shell growth is different from *Platychilina.* Our two Chinese species suggest the Triassic *Platychilina* may have a similar evolutionary history to *Trachynerita* (Kittl, 1894b:133), being derived from *Naticopsis* and distinguished by the development of more complex ornament during the Triassic.

Platychilina sinensis, new species

PLATE 5: FIGURES 3–11

DIAGNOSIS.—Final whorl expanding abaxially. Sutural ramp very wide. Lateral whorl face only slightly convex. One row of opisthoclinally elongated nodes on periphery of final whorl.

DESCRIPTION.—Medium-sized, globular, naticiform gastropod. Spire small but protruding with a rounded apex. Sutures shallow. Three to four whorls expanding rapidly and forming stair-like whorl profile. Final whorl strongly expanding laterally. Angle between sutural ramp and lateral face 110°. Sutural ramp very wide, flat, and extending obliquely (abaxially). Lateral whorl face flat to slightly convex. Obscure collabral ornament on spire. Angular periphery of final whorl bearing a row of seven to 10 strong nodes elongated opisthoclinally and imbricated. Final whorl covered with crowded and regular, straight, and prosoclinal growth riblets passing through nodes with angle of 50° to elongation of nodes. Base strongly convex with narrowly round transitional band between lateral face and base. Aperture oval to subquadrangular with narrowly round abapical margin. Outer lip thin. Inductura narrow, smooth, and slightly concave, extending inside aperture from parietal to columellar lips with thickened inner margin. Umbilicus covered.

MATERIAL EXAMINED.—Twenty specimens from the middle to upper part of the Guojiashan Formation, Guojiashan: USNM 485609–485614.

TYPE SPECIMEN.—*Holotype:* USNM 485611.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width
485609	17.5	15.4	15.6	5.8
485610	10.8	9.5	9.8	3.9
485611	14.5	12.4	13.0	6.0
485612	15.5	12.8	14.0	5.2
485614	11.2	9.4	10.0	4.1

DISCUSSION.—This new species is similar to *Trachynerita nodifera* Kittl (1894b:136, pl. 3: figs. 15, 16) in the presence of only one row of nodes and the step-like whorl profile. The new Chinese species differs from *T. nodifera* in having a laterally extended final whorl, whereas *T. nodifera* has a more regular rate of whorl expansion. The type species of *Trachynerita, T. fornoensis* Kittl (1894b), has the same shell outline as *T. nodifera,* but the differences in whorl and spire morphology exclude these specimens from this genus. Other genera with similar shell growth patterns to these Chinese specimens (very eccentric spire and very wide ramp), as well as nodose ornament, are *Platychilina* Koken and *Delphinulopsis* Laube. The type species of *Delphinulopsis, D. binidosa* (Münster), has open-coiled whorls, as emphasized by Laube (1870 [1869], pl. 33: fig. 3) when he established this genus. The type species of *Platychilina, P. woehrmanni* Koken (1892b, pl. 11: figs. 5–8), has three rows of nodes on the final whorl, although in his description Koken did not discuss the nodes on the final whorl. Because of the significance of shell growth patterns in distinguishing genera (see "Discussion" in the superfamily Neritoidea), we include our specimens in the genus *Platychilina.*

ETYMOLOGY.—The species name is derived from the prefix "Sino-," of Greek and Arabic origin, meaning Chinese.

Platychilina obliqua, new species

PLATE 5: FIGURES 12–18

DIAGNOSIS.—Apex acute. Spire small and conical, eccentric. Peripheral angulation widely rounded, with few opisthoclinally elongated nodes. Final whorl extending obliquely.

DESCRIPTION.—Moderately depressed naticiform gastropod. Spire very small but obviously protruding, with acute apex. Sutural grooves shallow. Four whorls enlarging rapidly in width. Final whorl strongly extended obliquely to axis of coiling; width two times greater than base. Periphery widely rounded and lacking keel. Sutural ramp very wide, slightly convex, and extending abaxially. Lateral face strongly convex, turning evenly to basal surface. Periphery of last half of final whorl carrying row of low, but distinct, opisthoclinally elongated nodes; nodes absent on earlier whorls. Growth lines fine and closely spaced, straight and prosoclinal, passing through nodes, and only covering final whorl. Aperture oviform, extending obliquely. Outer lip thin and sharp. Inner lip sigmoid. Inductura narrow and long, concave and smooth, spreading mainly on parietal lip, and extending inside aperture to columellar lip. Umbilical area covered. Holotype displaying a color pattern of spiral stripes.

MATERIAL EXAMINED.—Six specimens from the middle part of the Guojiashan Formation of Guojiashan, and one from the middle to upper part of the Guojiashan Formation of Saierlangshan: USNM 485615–485619.

TYPE SPECIMEN.—*Holotype:* USNM 485617.

MEASUREMENTS.—As follows (in mm):

USNM catalog no.	Shell height	Shell width	Final-whorl height	Spiral-base width
485616	~6.0	5.5	~5.5	2.4
485617	13.2	11.4	12.0	4.0
485619	13.0	11.2	12.0	4.2

DISCUSSION.—Most specimens have very rare (one to three) but distinct nodes. A few specimens have five to six smaller nodes. All nodes are solid and cannot be seen on the steinkerns. This species is similar to *Platychilina tuberculata* Kittl from the Alpine Marmolata bed (Kittl, 1894b:126, pl. 2: fig. 12) in having a small and conical spire, rounded peripheral angulation, and obliquely extended final whorl. The Alpine species, however, is richly ornamented. This new species is distinguished from *P. sinensis,* new species, by the small spire, sharpened apex, round periphery, and poorly developed nodes.

ETYMOLOGY.—The species name is derived from the oblique extension of the final whorl.

Order APOGASTROPODA Salvini-Plawen and Haszprunar, 1987, sensu Ponder and Lindberg, 1997

Suborder CAENOGASTROPODA Cox, 1960

Superfamily LOXONEMATOIDEA Koken, 1889

Family SPIROSTYLIDAE Cossmann, 1909

Genus *Spirostylus* Kittl, 1894

TYPE SPECIES.—*Melania subcolumnaris* Münster, 1841; by subsequent designation.

DISCUSSION.—This genus was established by Kittl (1894b:197), and the type species was subsequently designated by Cossmann (1909:73). The genus may have originated from *Coelostylina* (Kittl, 1899:101) in the Triassic or earlier. We have a single specimen that preserves the key last two whorls and matches well the characters of the type species. A second specimen differs only in the slightly larger pleural angle and the wider whorls.

Spirostylus cf. *linctus* (Böhm, 1895)

PLATE 5: FIGURE 20

Omphaloptycha lincta Böhm, 1895:277, pl. 14: fig. 2.
Omphaloptycha porrecta Böhm, 1895:280, pl. 15: fig. 7b,c.—Kittl, 1899:103.
Spirostylus linctus (Böhm).—Kittl, 1899:103.

DESCRIPTION.—Small, acutely conical shell with 32° pleural angle. Sutures shallowly impressed. Shell of more than seven gradually enlarging whorls; earlier whorls flat; final two to three whorls widely and evenly depressed in upper part and convex in middle and lower parts of whorl profile. Whorls twice as wide as high. Ornament only of faint spiral threads on middle and upper faces of two final whorls and weak sinuous growth lines. Base highly arched.

MATERIAL EXAMINED.—One specimen from the lower part of the Guojiashan Formation, Saierlangshan: USNM 485629.

DISCUSSION.—This shell differs from most species of *Spirostylus* in its relatively larger pleural angle and smaller ratio of whorl height to width, but the twisted whorl face, sinuous growth lines, and extended base of this specimen are all key features of this genus. The specimen is most similar to those of Böhm (1895) from the Alpine Marmolata bed that were assigned to *Spirostylus linctus* (Böhm) by Kittl (1899:103).

Spirostylus species indeterminate

PLATE 5: FIGURE 19

DESCRIPTION.—Small, high-spired loxonematid. Sutural grooves narrow and oblique. Whorls slightly wider than high, with widely and evenly concave upper face and convex middle to lower surface. Base highly arched, anomphalous. Growth lines faint, nearly straight, and slightly prosoclinal. Aperture ovoid with adapical angulation. Outer lip round, parietal lip relatively straight, and columellar lip extending at an inclined angle.

MATERIAL EXAMINED.—One specimen consisting of two well-preserved final whorls from the lower part of the Zalishan Formation, Saierlangshan, Sichuan Province: USNM 485628.

DISCUSSION.—The shape of the whorl surface and base and the character of the aperture coincide with *Spirostylus subcolumnaris* (Münster) (Kittl, 1894a:198, pl. 7: fig. 28). Because the earlier whorls are unknown, no species name is given here.

Family COELOSTYLINIDAE Cossmann, 1909

Genus *Toxoconcha* Kittl, 1899

TYPE SPECIES.—*Chemnitzia brocchii* Stoppani, 1858–1860; by subsequent designation.

DISCUSSION.—This large Triassic form is easily identified by the high-spired shell with flattened whorl sides, a flat base but extended columellar lip, and commonly marked subsutural facelets. Kittl (1899) noted that the open columella of this genus served to separate *Toxoconcha* from *Undularia, Anoptychia,* and *Atorcula.* Members of the genus were common in the Middle and Upper Triassic, and these Chinese specimens extend the range of the genus into the Early Triassic; no specimens assigned to the genus have been reported from the Paleozoic.

Toxoconcha uniformis (Stoppani, 1858)

PLATE 5: FIGURES 21–25

Chemnitzia uniformis Stoppani, 1858–1860:32, pl. 7: fig. 23.
Undularia (Toxoconcha) uniformis (Stoppani).—Kittl, 1899:168, pl. 12: fig. 28.—Tommasi, 1913:59, pl. 4: fig. 12.
Toxoconcha uniformis (Stoppani).—Wenz, 1938:395.

DESCRIPTION.—Medium-sized to large, high-spired, conical turitelliform with a 35° pleural angle. Sutural grooves shallow. Subsutural facelet quite narrow and distinct only in final whorl.

Whorl sides flattened, twice as wide as high. No marked ornament observed. Peripheral angulation acute at base of final whorl, separating low convex base from flat apical lateral surface. Aperture oval, with angularly adapical end and narrowly rounded basal margin. Outer lip curved; inner lip thickened and reversed to cover umbilical area. Columellar lip extending straight at about 15° angle with coiling axis.

MATERIAL EXAMINED.—Seven specimens from the lower part of the Zalishan Formation, Saierlangshan: USNM 485630–485634.

DISCUSSION.—These shells are very similar to *Toxoconcha uniformis* in the possession of shallow sutural grooves, less developed subsutural facelets, and the basal angulation in the final whorl. The evident subsutural facelets, relatively lower spire, and larger pleural angle identify USNM 485635 (Plate 5: figure 26) as Kittl's subspecies (or variety) *T. brocchii brevis*. This specimen, however, has a basal angulation, but it may have been intensified by preservation.

Genus *Coelostylina* Kittl, 1894

TYPE SPECIES.—*Melania conica* Münster, 1841; by original designation.

DISCUSSION.—Distinguishing this genus from *Omphaloptycha* Ammon has long been confusing, largely because the forms are intergrading and especially because Ammon's types are not well known (A. Nützel, pers. comm. to Erwin, 1999). Koken (1898:34, 35) separated the genera based on the existence or absence of the subsutural facelets; however, Cossmann (1909:42, 45) differentiated the two genera based on the ratio of the final whorl to the spire without discussing the relationship between his standard and Koken's. With some species, each definition gives the same generic assignment; with others the taxonomic assignments are ambiguous. Because Cossmann (1909) assigned a type species for each genus whereas Koken (1898) did not, later workers have tended to use Cossmann's definition to separate the two genera (e.g., Wenz, 1938; Haas, 1953; Yin and Yochelson, 1983c; Batten and Stokes, 1986; Erwin in Stanley et al., 1994), with the relatively low-spired forms assigned to *Omphaloptycha* and the higher spired forms assigned to *Coelostylina*.

Coelostylina ahlburgi (Assmann, 1924), new combination

FIGURE 10; PLATE 5: FIGURES 27, 28

Omphaloptycha ahlburgi Assmann, 1924:33, pl. 3: figs. 31–33.—1937:88, pl. 16: figs. 33–35.

Omphaloptycha ecki Assmann, 1924:35, pl. 3: fig. 37.—[Not Hohenstein, 1913] [new synonymy].

DESCRIPTION.—Small loxonematid with an acute apex. Pleural angle about 30°. Sutural grooves shallow. Subsutural facelets indistinct. Shell of five to six whorls, lower face convex, about twice as wide as high, gradually enlarging except for relatively higher final whorl. Base slightly convex. Growth lines faint and slightly opisthocyrt. Aperture unknown.

FIGURE 10.—*Coelostylina ahlburgi* (not to scale).

MATERIAL EXAMINED.—Three specimens from the middle part of the Guojiashan Formation, Saierlangshan.

MEASUREMENTS.—As follows:

USNM catalog no.	Shell height (mm)	Shell width (mm)	Pleural angle (°)
485637	4.2	1.9	28
485638	4.2	2.1	30
485639	4.2	2.8	33

DISCUSSION.—Although the apertures of these specimens are not preserved, the acute apex, pleural angle, slightly larger final whorl, and whorl shape support their assignment to *C. ahlburgi*.

Coelostylina cf. *waageni* Kittl, 1894

PLATE 5: FIGURES 29, 30

Coelostylina waageni Kittl, 1894a:188, pl. 5: fig. 47 [not fig. 48].—Zardini, 1978:45, pl. 29: fig. 8; pl. 30: fig. 4.

DESCRIPTION.—Small- to medium-sized, conical caenogastropod with no distinct subsutural ramps. Sutures widely and shallowly impressed. Whorls smoothly arched. Final whorl slightly inflated. Spiral whorls twice as wide as high. No distinct ornament. Base convex with umbilical chink. Aperture oviform with an acute adapical end and narrowly rounded abapical edge.

MATERIAL EXAMINED.—One specimen from the lower part of the Zalishan Formation, Saierlangshan, and one from the middle part of the Guojiashan Formation. Both have only the last three whorls preserved: USNM 485640, 485641.

DISCUSSION.—These shells coincide with Kittl's description of *Coelostylina waageni* Kittl (1894a:188, pl. V: fig. 47) although they are incomplete. Figure 48 of Kittl, however, differs from our specimens in that the increase of the last two whorls is incompatible with its earlier whorls. Because the Chinese specimens are not fully preserved, we are unable to comment further on the species.

Coelostylina? species indeterminate

PLATE 5: FIGURE 31

DESCRIPTION.—Relatively large *Coelostylina* having shallow sutural grooves. Whorls flat to slightly convex. Final whorl convex and roundly curved to low pyramidal base. No marked or-

nament except for faint sigmoidal growth lines. Aperture evidently hemicircular and strongly extended abapically with an acute adapical end.

MATERIAL EXAMINED.—A single specimen preserving the final one and one-half whorl, from the lower part of the Zalishan Formation, Saierlangshan: USNM 485644.

DISCUSSION.—The progressive increase of the preserved whorls suggests assignment to *Coelostylina*. This specimen is similar to *Coelostylina irritata* Kittl (Kittl, 1894a:159, pl. 5: figs. 16, 17, 19) except for the final whorl, which differs in the Chinese specimen from those in the Alps.

Genus *Omphaloptycha* Ammon, 1892

TYPE SPECIES.—*Chemnitzia nota* Ammon, 1878; by original designation.

DISCUSSION.—This genus is distinguished from *Coelostylina* by the expanded final whorl as discussed under *Coelostylina*. This genus is rare in China although specimens have been found at many horizons. For example, Pan (1977) examined two specimens of this genus from the Upper Triassic of Yunnan; Yin and Yochelson (1983c) described a species from the Middle Triassic of Guizhou; Wang and Qi (1986) reported a steinkern from the Middle Triassic of Qinghai; Pan (1982b) distinguished a species from the Lower Triassic of Sichuan; and Wang (1982) assigned a specimen from the Upper Permian of Guangxi Province to the genus.

Omphaloptycha gansuensis, new species

PLATE 5: FIGURES 32, 33

DIAGNOSIS.—Moderately high-spired omphaloptychid with acute apex and pleural angle of 50°. Four to five whorls with constant whorl expansion, and a final whorl slightly higher than the whole spire. Spiral whorls strongly convex; final whorl with flattened upper surface and convex middle and lower parts.

DESCRIPTION.—Acutely conical shell. Sutures impressed. Spiral whorls evenly but strongly convex. Final whorl inflated. Ornament of faint, slightly prosocyrtal growth lines and fainter spiral threads. Base strongly convex.

MATERIAL EXAMINED.—Two specimens from the middle to upper part of the Guojiashan Formation: USNM 485642, 485643.

TYPE SPECIMEN.—*Holotype:* USNM 485643.

DISCUSSION.—Although this new species has an enlarged final whorl, it is only slightly higher than the spire. In *Omphaloptycha* similar forms have been assigned to *Phasianella muensteri* Wissmann (Laube, 1869:18, pl. 31: fig. 5), a synonym of *Omphaloptycha jaworskii* Haas (Haas 1953:137), and *Omphaloptycha cochlea* (Münster) (Laube, 1869:40, pl. 25: fig. 2). This species is distinguished from others by the flattened upper part and convex middle and lower parts of the final whorl, imparting a slight twist to the whorl. It is uncommon in our collection from Qinling.

ETYMOLOGY.—The species name is derived from the Chinese province where it was discovered.

Genus *Gradiella* Kittl, 1899

TYPE SPECIES.—*Chemnitzia gradata* Hörnes, 1856; by original designation.

DISCUSSION.—This genus is easy to identify by the gradate shell with pronounced subsutural ramps having an angular edge; the final whorl is almost one-half of the shell height. This genus is rarely found in China. One specimen was reported from the Upper Triassic of Qinghai (Wang and Qi, 1986).

Gradiella species indeterminate

PLATE 5: FIGURES 34, 35

DESCRIPTION.—Small- to medium-sized, gradate, conical gastropod. Sutures canaliculate. Four whorls rapidly enlarging. Whorls low and wide with low, convex to flat lateral face. Subsutural ramps wide and extending abaxially with narrowly rounded to angular edge. Final whorl obviously expanding, nearly as high as spire. Base arched.

MATERIAL EXAMINED.—Three partial specimens from the lower part of the Zalishan Formation and from the upper part of the Maresongduo Formation: USNM 485652, 485653.

DISCUSSION.—The Qinling collection includes a few steinkerns from the Lower Triassic, but they are usually more or less broken and often associated with larger gastropods. The gradate conical shell and the wide and horizontally extended subsutural ramps are characteristic of *Gradiella* and are similar to *Gradiella semigradata* (Kittl) (Kittl, 1894b:163, pl. 6: fig. 10; 1899:148, pl. 15: figs. 22, 23) and the type species *Chemnitzia gradata* Hörnes (Kittl, 1899:152, pl. 15: fig. 24). Because the final whorls and aperture of these shells are not well preserved, no species identification can be made.

Genus *Trypanostylus* Cossmann, 1895

TYPE SPECIES.—*Eustylus militaris* Kittl, 1894b; by original designation.

DISCUSSION.—This Triassic genus was established by Cossmann (1895:63), who had distinguished two groups within the genus *Eustylus* Kittl (1894a:192). Blaschke (1905) proposed the subgeneric name *Turristylus* for Kittl's *Eustylus triadicus* group, although this proposal has not been followed by later authors. Cossmann doubted the separation of *Turristylus* (the *Eustylus triadicus* group) from *Trypanostylus* (the *Eustylus militaris* group), suggesting the solid or hollow columella might not reflect a clear division within this genus. Haas (1953) extracted the genus *Kittlistylus* based on *Turritella flexuosa* Münster (=*Eustylus flexuosus* Kittl, 1894a), which has an ornament "dominated by a rather dense though not prominent transverse costa which persists throughout development" (Haas, 1953: 244). More recently, Bandel (1995) observed a heterostrophic

larval shell in *Turristylus* and placed this genus within the Mathildoidea (Heterostropha).

Trypanostylus konincki (Münster, 1841)

PLATE 6: FIGURES 1–3

Melania koninekeana Münster, 1841.—Kittl, 1894a:194, pl. 6: figs. 39–47.
Melania konninkeanu Münster, 1841:95, pl. 9: fig. 25 [lapsus calami].—Kittl, 1894a:194, pl. 6: figs. 39–47.
Melania longissima Münster, 1841:95, pl. 9: fig. 24.—Kittl, 1894a:194, pl. 6: figs. 39–47.
Eustylus konincki (Münster).—Kittl, 1894a:194, pl. 6: figs. 39–47.—Koken, 1898:33, pl. 5: figs. 3, 4.
Trypanostylus konincki (Münster).—Kittl, 1899:95, pl. 11: figs. 20, 21.—Assmann, 1924:28, pl. 3: figs. 1, 2, 4–6.

DESCRIPTION.—Small to medium-sized, slender loxonematid. Sutures markedly impressed. Whorls flat to slightly convex in the middle to lower part; ratio of whorl height to width slowly and gradually increasing from 1:2 to 2:3. Growth lines very faint and slightly opisthocyrt. Base convex without any umbilicus. Aperture narrowly oviform with narrow rear channel.

MATERIAL EXAMINED.—Six specimens from the middle part of the Guojiashan Formation of Guojiashan: USNM 485647–485650.

DISCUSSION.—Kittl (1894a:194) listed six key features aiding identification of this species; our specimens concur with these, although they are not as tall as the figure given by Kittl (1894b, fig. 39).

Trypanostylus cf. *pseudoscalatus* Assmann, 1924

PLATE 6: FIGURE 4

Trypanostylus pseudoscalatus Assmann, 1924:28, pl. 3: figs. 3, 7–9.

DESCRIPTION.—Medium-sized, slender, high-spired gastropod with deeply engraved sutures and eight weakly convex whorls. No ornament observed on steinkern. Peripheral angulation at base of final whorl. Base slightly convex. Aperture subquadrangular.

MATERIAL EXAMINED.—A single deformed steinkern from the upper part of the Zalishan Formation, Saierlangshan: USNM 485651.

DISCUSSION.—The specimen is similar to *Trypanostylus pseudoscalatus* Assmann (1924) from Upper Silesia, Poland.

Superfamily PSEUDOMELANIOIDEA Fischer, 1885

Family PSEUDOMELANIIDAE Fischer, 1885

Genus *Ramina* Wenz, 1938

TYPE SPECIES.—*Macrochilina ptychitica* Kittl, 1894b; by subsequent designation.

DISCUSSION.—The generic name was proposed by Wenz (1938:370) to replace *Rama* of Böhm (1895). Confusion developed when Kittl's figures of the type species *Macrochilina ptychitica* were assigned to this genus by Cossmann (1909:119). Kittl's figures were cited by Böhm (1895) when he established *Rama,* but Böhm reversed the order of the text-figures to Kittl's plates. That is, Böhm's text-figure 88 is Kittl's figure 30 of plate 6, and Böhm's text-figure 89 is Kittl's figure 29. This reversion was not noticed by Kittl (1899) when he revised his 1894 figures and assigned his figure 30 (that is, text-figure 88 of Böhm, 1895) to a new species of a different genus: *Euchrysalis laevis* Kittl, 1899. Wenz (1938) did not notice the problem when he renamed Böhm's genus, resulting in an incorrect figure of the type species and an improper generic diagnosis. Kittl's mistake had been noticed by Cossmann (1909), so we return to Cossmann's (1909:119) diagnosis for this genus. As Haas (1953) noted, Wenz's generic name is still available.

Ramina ptychitica (Kittl, 1894)

FIGURE 11; PLATE 6: FIGURE 6

Macrochilina ptychitica Kittl, 1894b:173, pl. 6: fig. 29 [not fig. 30].
Rama ptychitica (Kittl).—Böhm, 1895:295, fig. 89, pl. 14: figs. 3, 3a [not fig. 88 or pl. 14: lower two figures].
Ramina ptychitica (Kittl).—Wenz, 1938:370, fig. 875.

DESCRIPTION.—Small, high-spired shell with acute apex. Pleural angle about 30°. Sutural grooves narrow and shallow. Shell of more than six whorls; earlier whorls increasing fast in width and later in height. Proportions of height to width in last four whorls separately as follows: 1:2, 1.5:2, 1.8:2, and 2:1.8. Final whorl almost equally high to spire. Upper face of whorls slightly concave; lower face convex. Base roundly arched. No ornament but very faint spiral threads near base.

MATERIAL EXAMINED.—One specimen from the middle part of the Guojiashan Formation of Saierlangshan.

DISCUSSION.—This specimen is conspecific to fig. 29 of Kittl (1894b) and the upper two figures of Böhm's (1895) fig. 3 for the type species *Ramina ptychitica* (Kittl). The lower two figures of Böhm (1895) have a larger final whorl and are much different from this specimen.

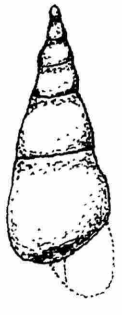

FIGURE 11.—*Ramina ptychitica* (not to scale).

Subclass HETEROSTROPHA Fischer, 1885

Superfamily STREPTACIDOIDEA Knight, 1931

Family STREPTACIDAE Knight, 1931

Genus *Neodonaldina* Bandel, 1996

TYPE SPECIES.—*Spirocyclina elongata* Zardini, 1978; by subsequent designation.

DISCUSSION.—Only the type species of *Spirocyclina* had been reported until Zardini (1978) named another species. Bandel (1996) created the new genus *Neodonaldina* based on Zardini's species. The genus is characterized by an anomphalous shell with deep sutures, inflated whorls, and prominent spiral threads. The second species shares these characters with the type species but has an obviously higher and narrower shell than the latter.

Neodonaldina cf. *elongata* (Zardini, 1978)

PLATE 6: FIGURE 5

Spirocyclina elongata Zardini, 1978:55, pl. 40: fig. 5a,b.
Neodonaldina elongata (Zardini).—Bandel, 1996:335, fig. 5a–e.

DESCRIPTION.—Medium-sized, high-spired streptacid with deeply impressed sutures and strongly and evenly convex whorls. Whorls enlarging gradually. Final whorl twice as high as wide. Ornament of regular spiral threads and faint, slightly opisthocyrtal growth lines. Base pyramidal and anomphalous.

MATERIAL EXAMINED.—One specimen with only the last five whorls; from the middle to upper part of the Guojiashan Formation, Guojiashan: USNM 485645.

DISCUSSION.—This specimen is most similar to Zardini's *Spirocyclina elongata,* and although the aperture is not preserved, it is clearly different from the *Spirocyclina* type species, *S. eucycla* (Münster), which has a relatively lower shell, more rapidly enlarging whorls, and a stronger spiral ornament (Laube, 1869:14, pl. 30: fig. 8).

Superfamily MATHILDOIDEA Dall, 1889

Family MATHILDIDAE Dall, 1889

Genus and species indeterminate

PLATE 6: FIGURE 7

DESCRIPTION.—Medium-sized, conical mathildid with deeply impressed sutures. Whorls convex, gradually enlarging, with two prominent spiral carinae at lower and upper whorl margins; upper one stronger and acute, forming periphery. A third prominent carina positioned between two margined carinae, but lying closer to lower one. Subsutural face somewhat sloped, with a carina in the middle. In addition to fine carinae, closely spaced spiral threads cover surface including base. Growth lines clear, slightly curved. Base convex and anomphalous, with cancellate ornament. Aperture subcircular, with zigzag outer lip and long columellar lip.

MATERIAL EXAMINED.—One partial specimen of last three whorls, from the middle part of the Guojiashan Formation: USNM 485654.

DISCUSSION.—This specimen is similar to *Proturba intermittens* (Kittl, 1894a), which is known only from the type species, three specimens of Kittl (1894a) from the St. Cassian Formation of the southern Alps, and one steinkern described by Kutassy (1937) from the upper Carnian of Transylvania. The Qinling collection includes one specimen that is very similar to Kutassy's specimen, but it dates from the Anisian.

PLATE 1

FIGURES 1, 2.—*Tongweispira sichuanensis,* new species, USNM 485493: apical and abapertural views, respectively (×56).

FIGURES 3–5.—*Tongweispira sichuanensis,* new species, USNM 485494, holotype: apical, apertural, and basal views (×35).

FIGURES 6, 7.—*Tongweispira sichuanensis,* new species, USNM 485495: apical and basal views (×21).

FIGURE 8.—*Tongweispira sichuanensis,* new species, USNM 485496: apical view (×34).

FIGURE 9.—*Tongweispira sichuanensis,* new species, USNM 485498: apical view (×47).

FIGURE 10.—*Ananias johannisaustriae,* USNM 485511: abapertural view (×2.5).

FIGURE 11.—*Ananias johannisaustriae,* USNM 485513: apertural view (×5.6).

FIGURE 12.—*Ananias johannisaustriae,* USNM 485515: abapertural view (×2.7).

FIGURE 13.—*Ananias guojiashanensis,* new species, USNM 485500: apertural view (×2.7).

FIGURES 14, 15.—*Ananias guojiashanensis,* new species, USNM 485502, holotype: abapertural and basal views (×2.7).

FIGURE 16.—*Ananias guojiashanensis,* new species, USNM 485509: abapertural view (×2.6).

FIGURES17–19.—*Worthenia extendia,* new species, USNM 485505, holotype: abapertural, apical, and apertural views (×2.2).

FIGURE 20.—*Worthenia extendia,* new species, USNM 485501: abapertural view (×3.1).

FIGURE 21.—*Worthenia*? species indeterminate A, USNM 485506: apertural view (×5.0).

FIGURE 22.—*Worthenia*? species indeterminate A, USNM 485508: abapertural view (×4).

FIGURE 23.—*Worthenia*? species indeterminate B, USNM 485514: abapertural view (×3.2).

FIGURE 24.—*Worthenia*? species indeterminate C, USNM 485516: apertural view (×3.5).

FIGURE 25.—*Worthenia*? species indeterminate C, USNM 485518: apertural view (×7.1).

FIGURE 26.—*Gosseletina*? *dangchangensis,* new species, USNM 485520, holotype: apertural view (×3.2).

FIGURE 27.—*Gosseletina*? *dangchangensis,* new species, USNM 485521: abapertural view (×3.9).

FIGURES 28–30.—*Zygites laevigatus,* new species, USNM 485523, holotype: apertural, basal, and apical views (×2.9).

FIGURES 31, 32.—*Zygites laevigatus,* new species, USNM 485522: apical and abapertural views (×1.7).

FIGURES 33, 34.—*Zygites laevigatus,* new species, USNM 485525: abapertural and apical views (×2.3).

FIGURE 35.—*Zygites laevigatus,* new species, USNM 485524: abapertural view (×2.4).

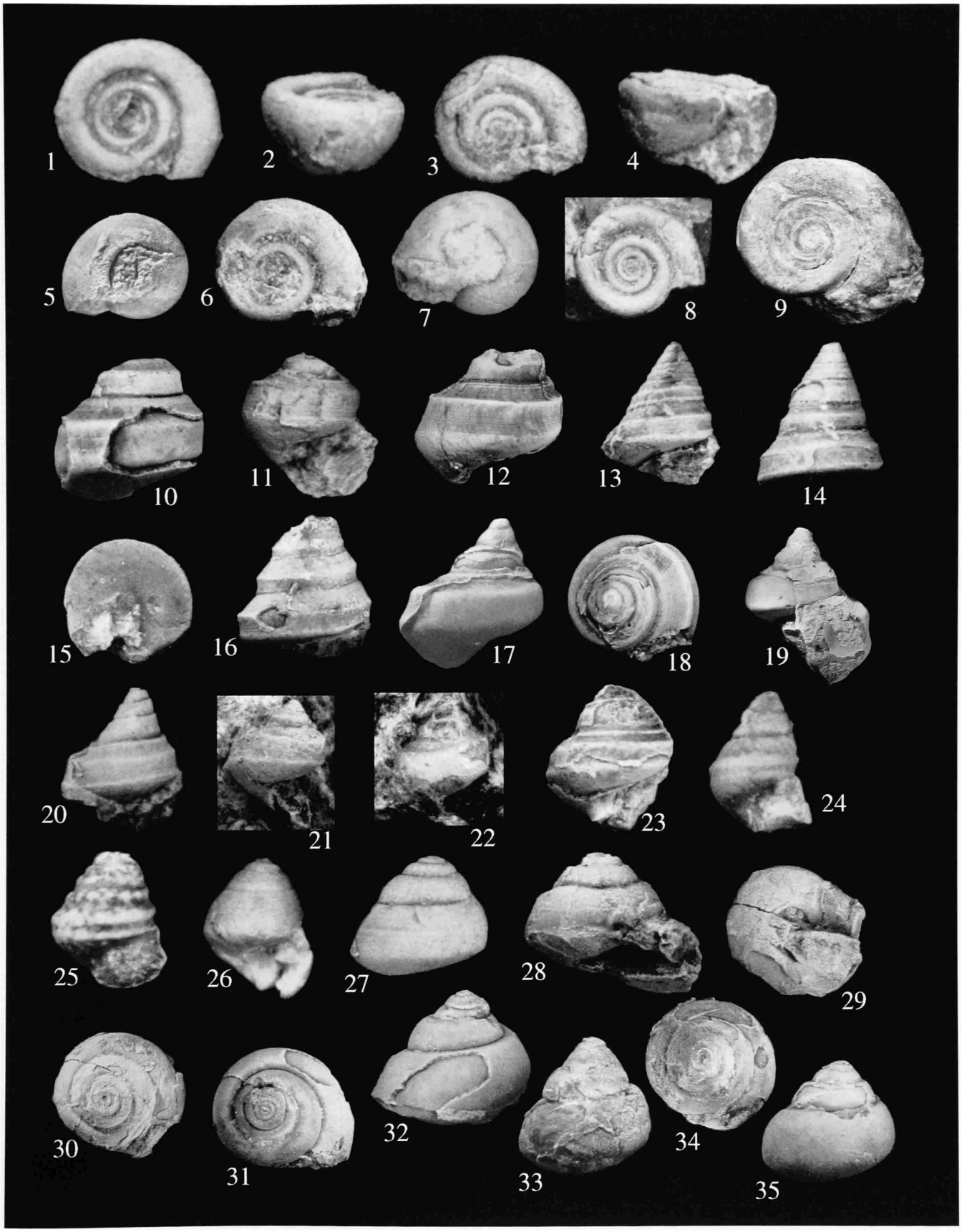
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PLATE 2

FIGURE 1.—*Euryalox* species indeterminate, USNM 485526: abapertural view (×1).

FIGURE 2.—*Codinella*? species indeterminate, USNM 485527: abapertural view (×2.4).

FIGURES 3, 4.—*Codinella*? species indeterminate, USNM 485528: abapertural and apertural views, respectively (×1.9).

FIGURE 5.—*Trochotoma* (*Discotoma*) *gansuensis*, new species, USNM 485529: apical view (×1.3).

FIGURES 6–8.—*Trochotoma* (*Discotoma*) *gansuensis*, new species, USNM 485530, holotype: apical, apertural, and basal views (×1.4).

FIGURES 9, 10.—*Trochotoma* (*Discotoma*) *gansuensis*, new species, USNM 485531: apical and basal views (×1.2).

FIGURE 11.—*Tylotrochus elongatus*, USNM 485532: oblique abapertural view (×2.6).

FIGURES 12–14.—*Natiria*? species indeterminate, USNM 485538: apical, abapertural, and apertural views (×1.5).

FIGURES 15, 16.—*Amberleya*? species indeterminate, USNM 485537: apical and abapertural views (×1.5).

FIGURE 17.—?*Eunemopsis dolomitica*, USNM 485620: abapertural view (×4.2).

FIGURE 18.—*Cheilotomona acutocarinata*, new species, USNM 485626, holotype: oblique abapertural view (×2.9).

FIGURE 19.—*Cheilotomona acutocarinata*, new species, USNM 485624: apertural view (×2.5).

FIGURE 20.—*Cheilotomona acutocarinata*, new species, USNM 485622: oblique abapertural view (×3).

FIGURE 21.—*Cheilotomona acutocarinata*, new species, USNM 485623: oblique abapertural view (×2.9).

FIGURE 22.—*Cheilotomona acutocarinata*, new species, USNM 485625: abapertural view (×2.7).

FIGURE 23.—*Cheilotomona acutocarinata*, new species, USNM 485627: oblique abapertural view (×2.7).

FIGURES 24–26.—*Marmolatella* (*Marmolatella*) *complanata*, USNM 485539: apical, apertural, and abapertural views (×1.3).

FIGURES 27–29.—*Marmolatella* (*Marmolatella*) *complanata*, USNM 485541, apical, apertural, and abapertural views (×1).

FIGURES 30, 31.—*Marmolatella* (*Marmolatella*) *complanata*, USNM 485542: abapertural and apertural views (×0.8).

FIGURE 32.—*Marmolatella* (*Marmolatella*) *obtusangula*, USNM 485551: abapertural view (×2.1).

FIGURES 33–35.—*Naticopsis* (*Dicosmos*) *applanatus*, USNM 485544: apical, apertural, and abapertural views (×2.3).

FIGURE 36.—*Naticopsis* (*Dicosmos*) *applanatus*, USNM 485546: abapertural view (×2.4).

FIGURES 37–39.—*Naticopsis* (*Dicosmos*) *compressus*, new species, USNM 485581, holotype: apical, apertural, and abapertural views (×2.1).

FIGURES 40–42.—*Naticopsis* (*Dicosmos*) *compressus*, new species, USNM 485573: apical, apertural, and abapertural views (×2.2).

FIGURE 43.—*Naticopsis* (*Dicosmos*) *compressus*, new species, USNM 485574: apical view (×1.8).

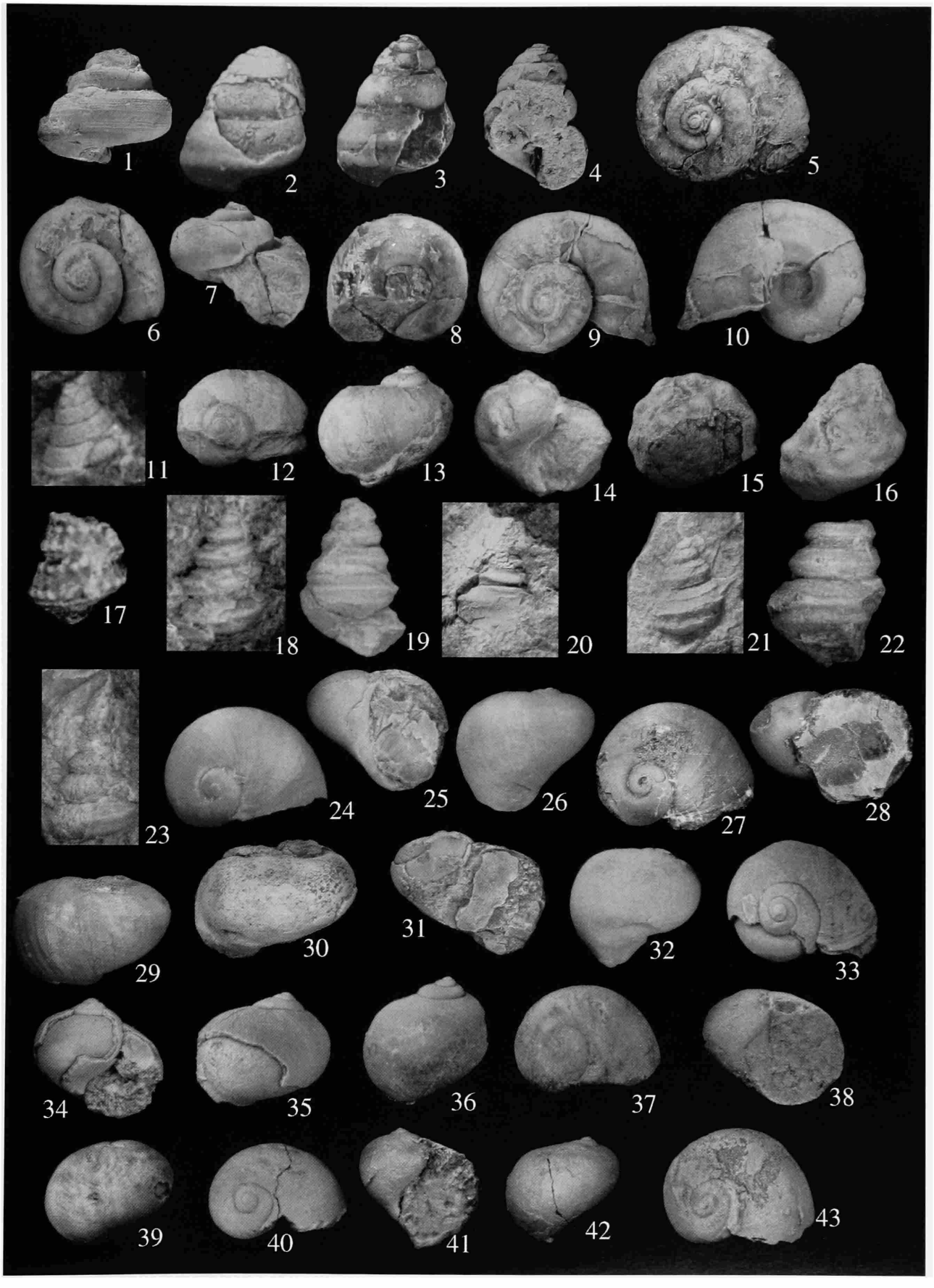
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PLATE 3

FIGURES 1, 2.—*Naticopsis* (*Dicosmos*) *compressus*, new species, USNM 485574: apertural and abapertural views, respectively (×2.3).

FIGURES 3, 4.—*Naticopsis* (*Dicosmos*) *compressus*, new species, USNM 485578: apertural and abapertural views (×2.2).

FIGURE 5.—*Naticopsis* (*Dicosmos*) *compressus*, new species, USNM 485579: apertural view (×2).

FIGURE 6.—*Naticopsis* (*Dicosmos*) *compressus*, new species, USNM 485580: abapertural view (×2.8).

FIGURES 7–9.—*Naticopsis* (*Dicosmos*) *declivis*, USNM 485547: apical, apertural, and abapertural views (×0.9).

FIGURES 10, 11.—*Naticopsis* (*Dicosmos*) *declivis*, USNM 485548: apertural and abapertural views (×0.88).

FIGURES 12–14.—*Naticopsis* (*Dicosmos*) *eyerichi*, USNM 485557: apical, apertural, and abapertural views (×3.9).

FIGURES 15, 16.—*Naticopsis* (*Dicosmos*) *eyerichi*, USNM 485560: apical and abapertural views (×3.6).

FIGURES 17–19.—*Naticopsis* (*Dicosmos*) *impressa*, USNM 485553: apical, apertural, and abapertural views (×1.6).

FIGURES 20–22.—*Naticopsis* (*Dicosmos*) *impressa*, USNM 485554: apical, apertural, and abapertural views (×2.1).

FIGURES 23–25.—*Naticopsis* (*Dicosmos*) *sichuanensis*, new species, USNM 485570: apical, apertural, and abapertural views (×2.3).

FIGURES 26–28.—*Naticopsis* (*Dicosmos*) *sichuanensis*, new species, USNM 485563: apical, apertural, and abapertural views (×2.5).

FIGURES 29–31.—*Naticopsis* (*Dicosmos*) *sichuanensis*, new species, USNM 485565: apical, apertural, and abapertural views (×3).

FIGURES 32, 33.—*Naticopsis* (*Dicosmos*) *sichuanensis*, new species, USNM 485566: apical and abapertural views (×4.3).

FIGURE 34.—*Naticopsis* (*Dicosmos*) *sichuanensis*, new species, USNM 485571: abapertural view (×3.3).

FIGURES 35–37.—*Naticopsis* (*Vernelia*) *sublimneiformis*, USNM 485583: apical, apertural, and abapertural views (×2.3).

FIGURES 38–40.—*Naticopsis* (*Vernelia*) *sublimneiformis*, USNM 485585: apical, apertural, and abapertural views (×1.8).

FIGURES 41–43.—*Naticopsis*? *ribletella*, new species, USNM 485586, holotype: apical, apertural, and abapertural views (×2.6).

FIGURE 44.—*Naticopsis*? *ribletella*, new species, USNM 485587: oblique apertural view (×2.8).

FIGURE 45.—*Neritopsis planoplicatus*, new species, USNM 485588, holotype: apical view (×2.2).

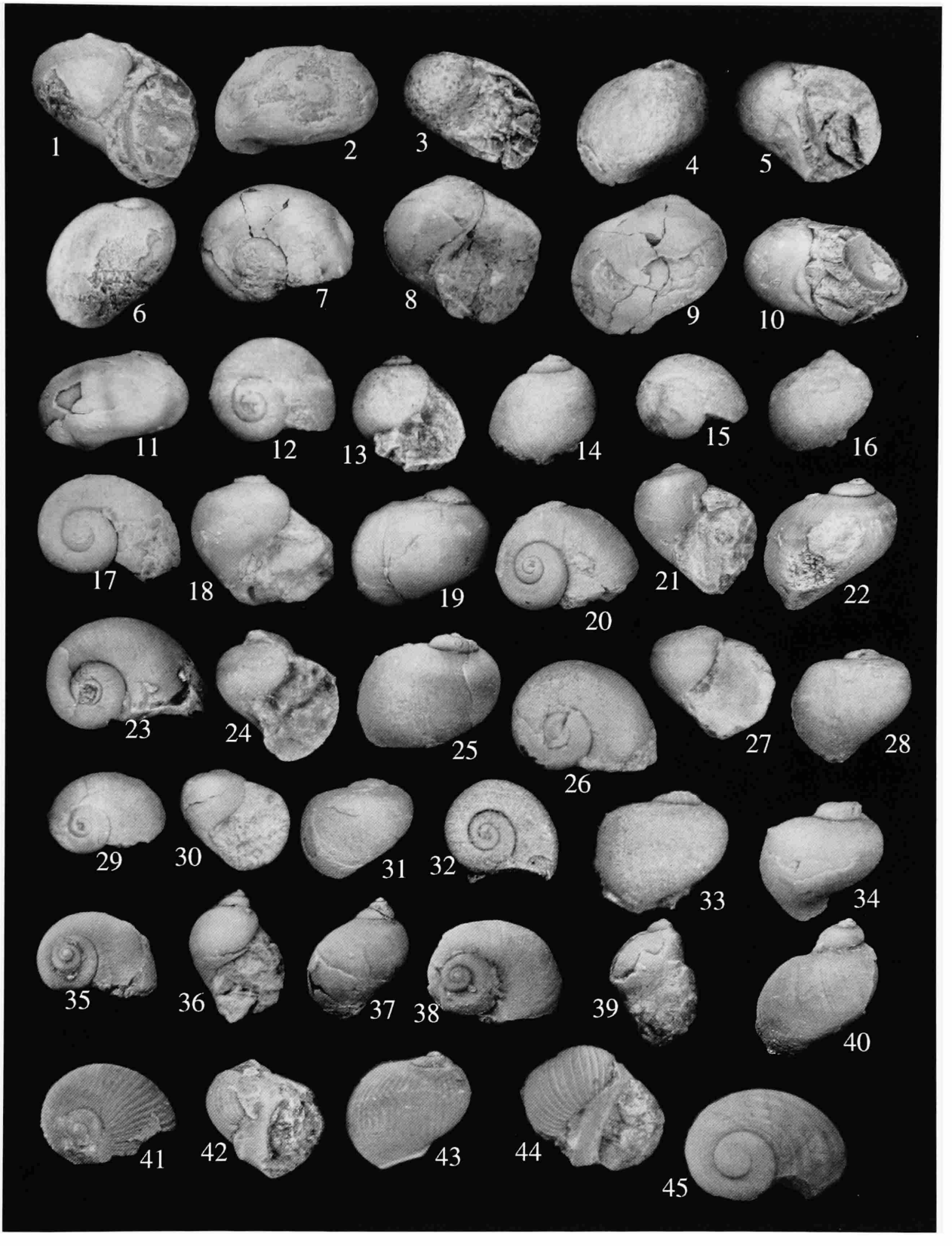
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PLATE 4

FIGURES 1, 2.—*Neritopsis planoplicatus,* new species, USNM 485588, holotype: apertural and abapertural views, respectively (×2).
FIGURES 3–5.—*Neritaria* cf. *calcitica,* USNM 485589: apical, apertural, and abapertural views (×2.3).
FIGURES 6, 7.—*Neritaria* cf. *calcitica,* USNM 485590: abapertural and apertural views (×2.1).
FIGURE 8.—*Neritaria* cf. *calcitica,* USNM 485591: apertural view (×2.1).
FIGURES 9, 10.—*Neritaria* cf. *calcitica,* USNM 485592: apertural and abapertural views (×4).
FIGURES 11, 12.—*Neritaria candida,* USNM 485593: abapertural and apertural views (×3.1).
FIGURES 13, 14.—*Neritaria candida,* USNM 485596: apical and abapertural views (×4.5).
FIGURES 15–17.—*Neritaria candida,* USNM 485597: apical, apertural, and abapertural views (×2.7).
FIGURES 18, 19.—*Neritaria candida,* USNM 485598: apertural and abapertural views (×3.4).
FIGURE 20.—*Neritaria ingrandita,* USNM 485606: abapertural view (×3.3).
FIGURES 21–23.—*Neritaria ingrandita,* USNM 485607: apical, apertural, and abapertural views (×1.5).
FIGURES 24–26.—*Neritaria plicatilis,* USNM 485608: apical, apertural, and abapertural views (×1.9).
FIGURES 27, 28.—*Neritaria sphaeroidica,* USNM 485599: apical and abapertural views (×1.5).
FIGURES 29–31.—*Neritaria sphaeroidica,* USNM 485600: apical, apertural, and abapertural views (×1.9).
FIGURES 32, 33.—*Neritaria sphaeroidica,* USNM 485601: abapertural and apertural views (×1.7).
FIGURES 34–36.—*Neritaria sphaeroidica,* USNM 485602: apical, apertural, and abapertural views (×2.7).
FIGURES 37, 38.—*Neritaria sphaeroidica,* USNM 485603: apertural and abapertural views (×3).
FIGURES 39, 40.—*Neritaria sphaeroidica,* USNM 485604: apertural and abapertural views (×2.7).

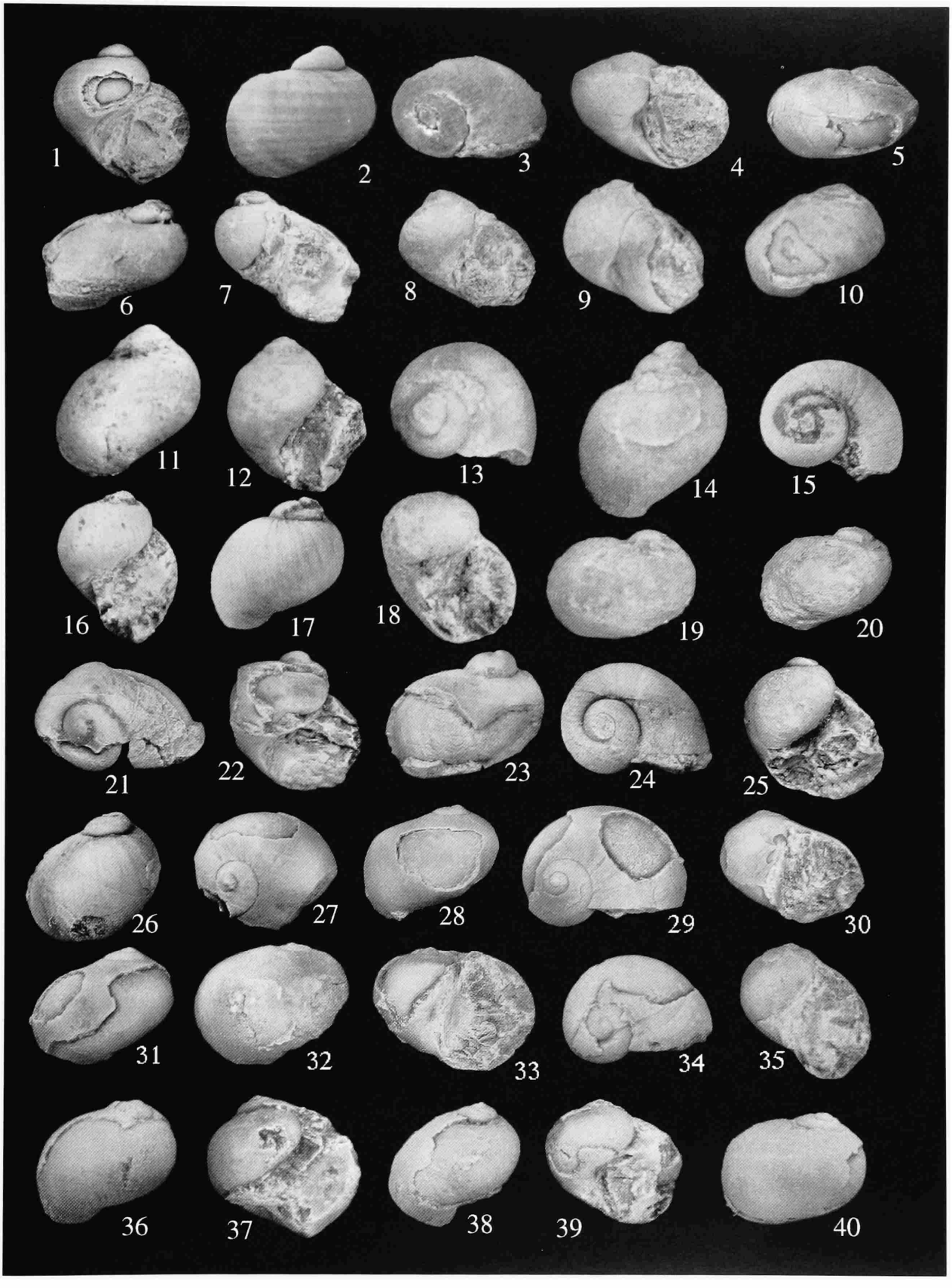
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PLATE 5

FIGURES 1, 2.—*Neritaria sphaeroidica,* USNM 485605: apical and abapertural views, respectively (×2.6).
FIGURES 3–5.—*Platychilina sinensis,* new species, USNM 485611, holotype: apical, apertural, and abapertural views (×1.8).
FIGURES 6, 7.—*Platychilina sinensis,* new species, USNM 485609: apical and apertural views (×1.7).
FIGURES 8, 9.—*Platychilina sinensis,* new species, USNM 485612: apical and abapertural views (×2.1).
FIGURES 10, 11.—*Platychilina sinensis,* new species, USNM 485613: apertural and abapertural views (×2.3).
FIGURES 12–14.—*Platychilina obliqua,* new species, USNM 485617, holotype: apical, apertural, and abapertural views (×2.1).
FIGURE 15.—*Platychilina obliqua,* new species, USNM 485616: apertural view (×3.6).
FIGURES 16–18.—*Platychilina obliqua,* new species, USNM 485618: apical, apertural, and abapertural views (×2.2).
FIGURE 19.—*Spirostylus* species indeterminate, USNM 485628: abapertural view (×2.7).
FIGURE 20.—*Spirostylus* cf. *linctus,* USNM 485629: oblique abapertural view (×2.9).
FIGURE 21.—*Toxoconcha uniformis,* USNM 485630: abapertural view (×1.5).
FIGURE 22.—*Toxoconcha uniformis,* USNM 485631: abapertural view (×1.6).
FIGURE 23.—*Toxoconcha uniformis,* USNM 485632: abapertural view (×2.1).
FIGURE 24.—*Toxoconcha uniformis,* USNM 485633: apertural view (×2.1).
FIGURE 25.—*Toxoconcha uniformis,* USNM 485634: apertural view (×1.7).
FIGURE 26.—*Toxoconcha brocchii brevis,* USNM 485635: oblique abapertural view (×1.8).
FIGURE 27.—*Coelostylina ahlburgi,* USNM 485637: oblique abapertural view (×7.6).
FIGURE 28.—*Coelostylina ahlburgi,* USNM 485639: oblique abapertural view (×6.2).
FIGURE 29.—*Coelostylina* cf. *waageni,* USNM 485640: apertural view (×2.7).
FIGURE 30.—*Coelostylina* cf. *waageni,* USNM 485641: abapertural view (×5.9).
FIGURE 31.—*Coelostylina*? species indeterminate, USNM 485644: apertural view (×1.1).
FIGURE 32.—*Omphaloptycha gansuensis,* new species, USNM 485643, holotype: abapertural view (×2).
FIGURE 33.—*Omphaloptycha gansuensis,* new species, USNM 485642: abapertural view (×1.5).
FIGURE 34.—*Gradiella* species indeterminate, USNM 485652: abapertural view (×2.9).
FIGURE 35.—*Gradiella* species indeterminate, USNM 485653: oblique abapertural view (×2.8).

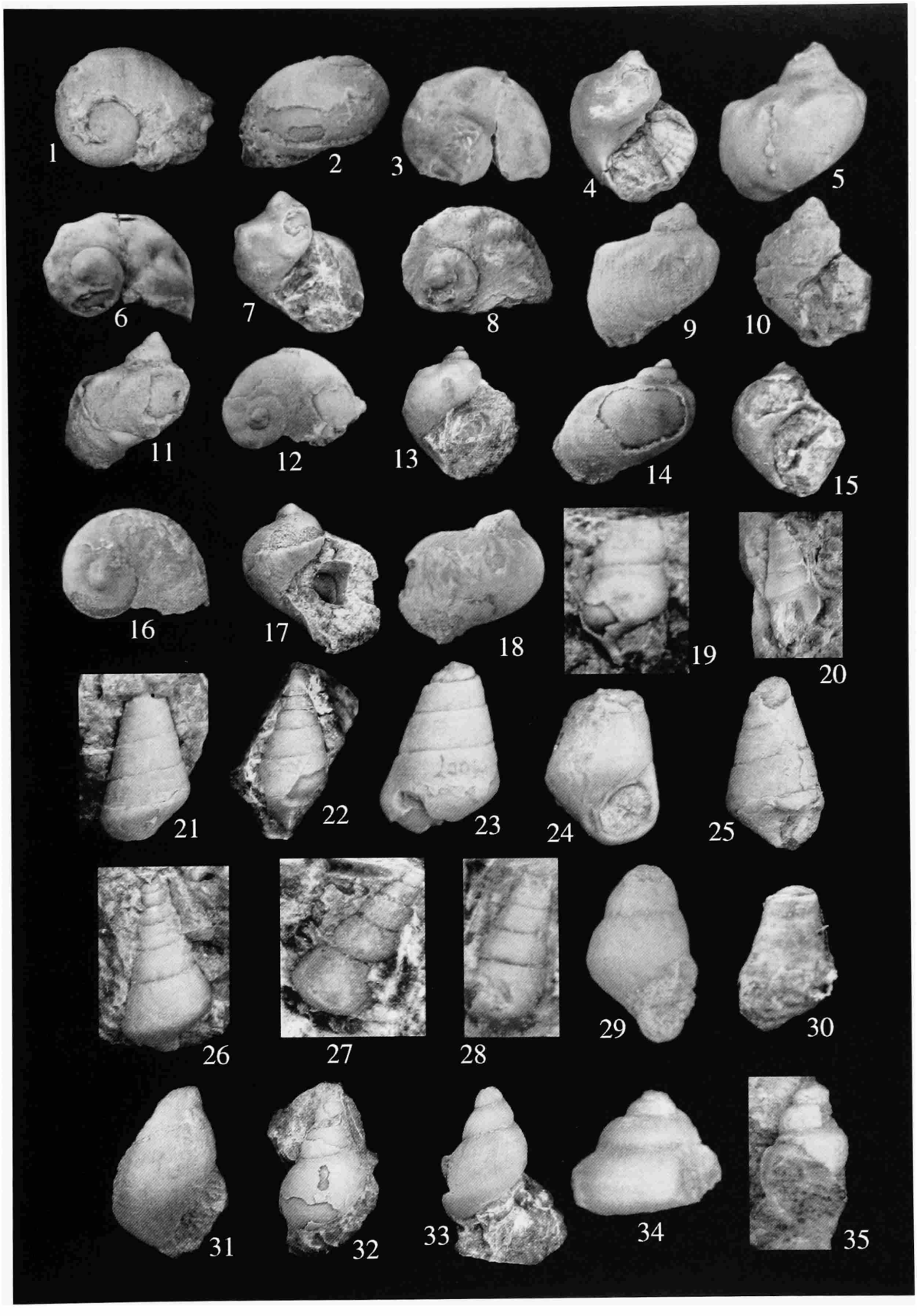
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PLATE 6

FIGURE 1.—*Trypanostylus konincki,* USNM 485647: abapertural view (×2.3).
FIGURE 2.—*Trypanostylus konincki,* USNM 485648: abapertural view (×5).
FIGURE 3.—*Trypanostylus konincki,* USNM 485650: apertural view (×3.1).
FIGURE 4.—*Trypanostylus* cf. *pseudoscalatus,* USNM 485651: abapertural view (×2.4).
FIGURE 5.—*Neodonaldina* cf. *elongata,* USNM 485645: apertural view (×1.9).
FIGURE 6.—*Ramina ptychitica,* USNM 485656: abapertural view (×4).
FIGURE 7.—Mathildidae genus and species indeterminate, USNM 485654: apertural view (×1.9).


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