Conodonts and ostracods from the section at Longdianshan (upper Tournaisian of Guangxi, China)

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Abstract

The section at Longdianshan was studied in the context of the search for a new Tournaisian-Viséan boundary stratotype. It was not retained as a potential stratotype but the upper Tournaisian strata yielded an excellent conodont fauna and some of these beds also provided silicified and non-silicified ostracods. The conodont fauna is characterized by the relative abundance of *Dollymae* and *Bactrognathus* species. Of these, *Bactrognathus bultyncki* n. sp. is described as new. The ostracod fauna consists of abundant bairdioids, locally abundant paraparchitoids, and additional elements (*Bohlenatia, Tricornina*, and others) of the Thuringian assemblage. The faunas recovered are illustrated and briefly commented on. The environment deduced from both conodont and ostracod assemblages is discussed as well.

Key-words: Conodonts, Ostracods, Tournaisian (upper), China.

Résumé

Considérée comme un stratotype possible de la limite Tournaisien-Viséen, la coupe de Longdianshan fut tout d'abord étudiée dans ce but. Elle fut ensuite écartée. Du Tournaisien supérieur nous vient une faune, conodontes et ostracodes, assez remarquable pour qu'il soit néanmoins souhaitable de la faire connaître. La faune de conodontes se caractérise par la relative abondance des *Dollymae* et des *Bactrognathus*. Parmi ceux-ci, *Bactrognathus bultyncki* est décrit comme espèce nouvelle. Parmi les ostracodes dominent tout d'abord les Paraparchitoïdes, ensuite les Bairdioïdes avec, en sus, un certain nombre de représentants (*Bohlenatia, Tricornina* et autres) de l'écotype de Thuringe. Conodontes et ostracodes sont illustrés et discutés brièvement. Le milieu de dépôt qu'indique l'une et l'autre de ces faunes est également débattu.

Mots-clés: Conodontes, Ostracodes, Tournaisien (supérieur), Chine.

Introduction

The section at Longdianshan was studied in the context of the search for a new Tournaisian-Viséan boundary stratotype (HANCE *et al.*, 1997a; DEVUYST *et al.*, 2003). It is one of three sections around Liuzhou and two other sections south of Guilin studied in this context (Fig. 1). The sections south of Guilin (Huaqiao Farm, Mopanshan) are thought to represent a restricted platform facies, Longdianshan an open platform facies, Yajiao a slope facies, and Pengchong

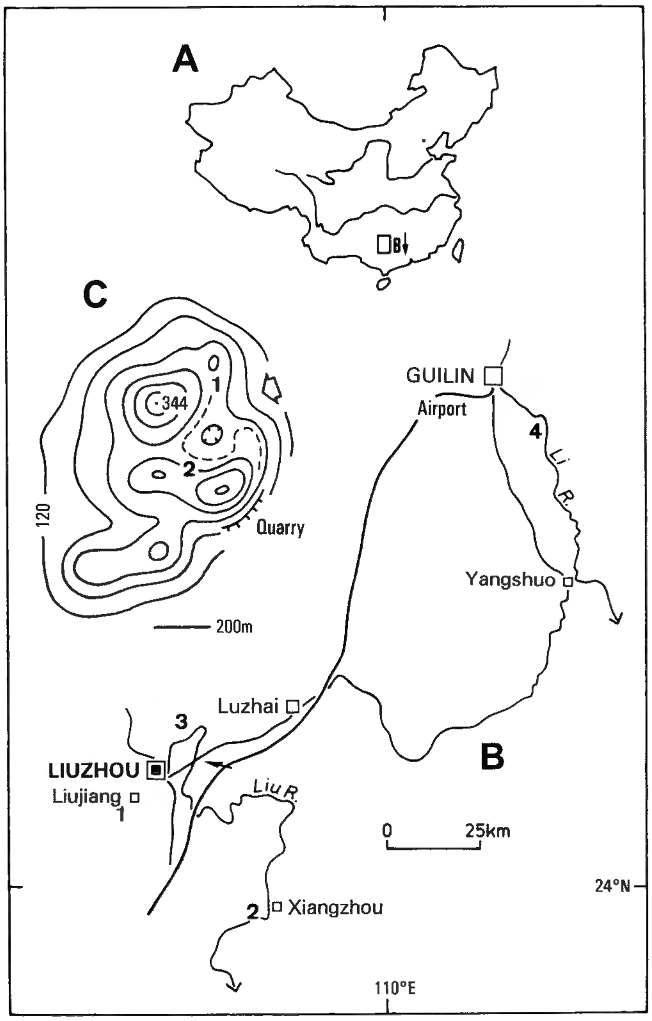

Fig. 1 — Location maps. A) general. B) regional, with 1: Longdianshan, 2: Yajiao, 3: Pengchong, and 4: Huaqiao Farm, Mopanshan. C) detail of the hill of Longdianshan, with 1: cave section, 2: south section, arrow: way to climb. Elevations in metres, contour interval 40 m.

a basinal facies (see HANCE *et al.*, 1997b for more detail and a full set of lithostratigraphic units). First sampled in 1993, Longdianshan was soon discarded as a potential stratotype because of the poor preservation of the foraminiferal fauna. Although promising, Pengchong was similarly discarded due to road conditions and limited accessibility. The search then focused on the sections in the vicinity of Guilin on the one hand, and the section at Yajiao on the other hand (HANCE *et al.*, 1997b). These too had to be abandoned because of either a stratigraphical gap (at Huaqiao Farm) or dolomitization (at Yajiao) of the Tournaisian-Viséan transition beds. Three years later, however, the conditions had completely changed: a motorway from Guilin to Liuzhou and a new road to Pengchong resulted in this previously out-of-the-world village being no more than 3-4 hours by car from Guilin international airport. The section was sampled bed by bed in 2000, and the critical interval sampled again in 2001. In order to complete the picture, the hill of Longdianshan was reexamined in 2001, and again in 2002. Coen was responsible for the cave section (see description below), Hance, Devuyst and Sevastopulo for the south section.

The hill of Longdianshan

Longdianshan (Hill of the Dragon Palace) is a complex karstic hill (Fig. 1C) with a double southern peak, a main central peak, and a northern, smaller peak into which opens a cave. In the eastern part of the southern peak there is a carbonate mudmound. One section was measured west of this mound; it is referred to as the south section (Fig. 1C/2). Another section was studied beneath the cave; it is referred to as the cave section (Fig. 1C/1). Massive limestone (bed 44) that caps the south section may be traced to the northern summit, above the cave, and fragments of argillaceous limestone like that beneath the cave were found in the soil below the mudmound. Despite increased thickness besides the mound, it is thus clear that the cave section continues downwards the south section. The lithological logs in Fig. 2 are related to each other based on this interpretation. Samples from the south section are prefixed LS; they are numbered in ascending order. Samples from the cave section are prefixed LC (for conodonts) and L (for ostracods); they are numbered in descending order. After the ostracod study had been completed, what remained of the samples was processed for conodonts. Similarly, the light fraction of the conodont residues was checked for silicified ostracods. It is clear that the study of larger samples and the extension of the sampling into higher strata would result in a better understanding of a number of taxa, and better correlations. The faunas recovered so far are judged good enough, however, for being illustrated and briefly commented on.

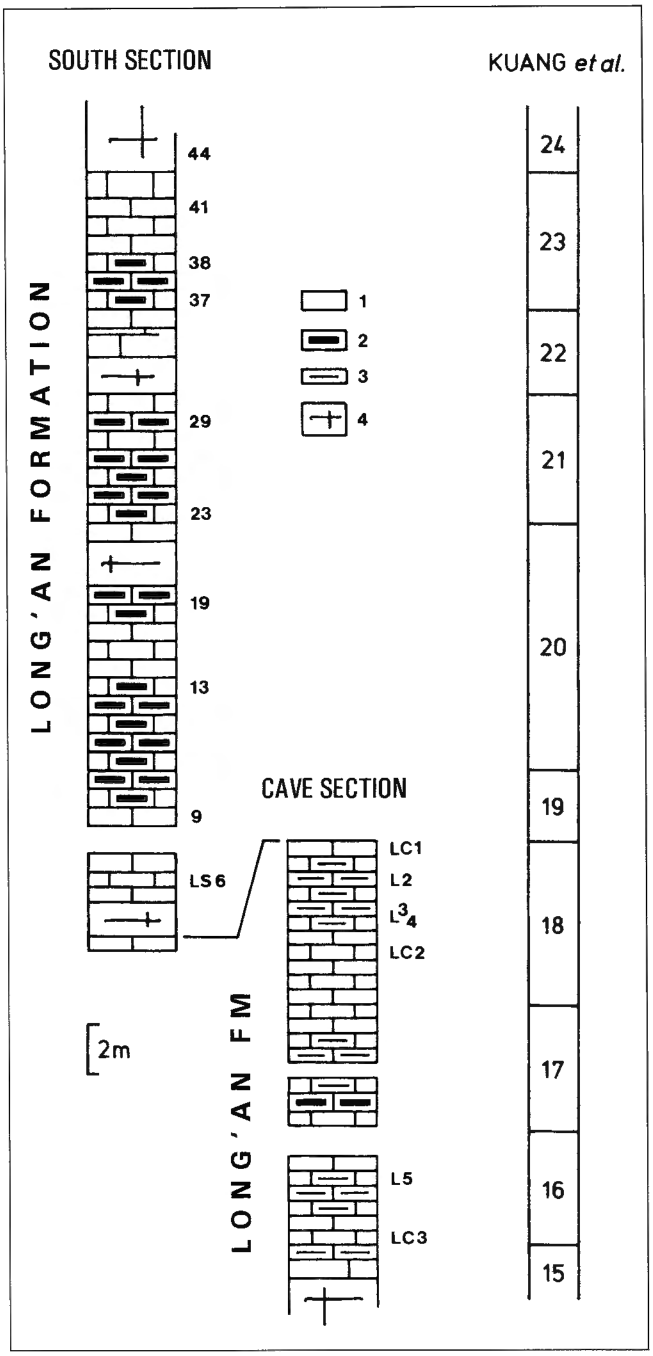

Fig. 2 — Position of the samples studied, and correlation (right) with the succession described in KUANG *et al.* (1999). 1: limestone, 2: cherty limestone, 3: thin-bedded argillaceous limestone, 4: massive limestone.

Previous works

Longdianshan was first studied by members of the Petroleum Geological Team of Guangxi who produced a description, including rugose coral and conodont determinations, which is reproduced in KUANG *et al.* (1999, pp. 21-23, and Fig. 2 herein). XU (*in* XU & POTY, 1997) resumed the rugose coral study and distinguished three zones. These are, from bottom to top: the *Keyserlingophyllum* Zone, the *Keyserlingophyllum-Dorlodotia* interval Zone, and the (inferred) *Dorlodotia* Zone. It is not the place to discuss rugose corals. One point can be made, however. The last occurrence of the genus *Keyserlingo-*

phyllum in bed 015 of Xu may be correlated with the last occurrence of the same genus in unit 19 of Kuang *et al.*. When compared to the conodont succession, this suggests a much lower horizon than the RC3/RC4 transition proposed by Xu & Poty (*op. cit.*, p. 358).

Conodonts

The conodont distribution is shown in Table 1. A solid dot indicates an undoubted occurrence, an open dot a questionable occurrence. The latter can result from juvenile or imperfectly preserved specimen(s) or, in some cases, from specimen(s) to be treated as cf. or transitional form(s). The so-called *Pseudopolygnathus multistriatus* group includes a few specimens that perhaps could be named more precisely. However, forms of this group are rare and small. We thus preferred not to enter into detail. *Gnathodus* species are restricted to the cave section where they are represented by *G. cuneiformis* and a few *G. semiglaber*. *Protognathodus* species are present in both sections with *P. praedelicatus* the dominant taxon in the lower part of the succession, and *P. cordiformis* more frequently occurring in the upper part. Small specimens or those with the outer cusp imperfectly preserved may be difficult to separate, and transitional forms between *P. praedelicatus* and *G. cuneiformis* are not rare. As a whole, the distribution pattern outlined above is rather clear, however. Quantitatively, it is also clear there is a drop in the abundance of the gnathodid elements from sample LS6 upwards. Taking into account the ostracod data (see that chapter), and referring to the model by Sandberg & Gutschick (1979), it may be concluded that one is passing at that level from the foreslope to the platform margin.

Elements illustrated in Pl. 1, Figs. 1, 2 combine the long, high, blade of a *Bispathodus* and a platform that consistently extends farther anteriorly on the right side like that, for example, of *Pseudopolygnathus multistriatus*. They are unlikely to be ancestral forms of the latter,

Table 1 — Conodont distribution. Solid dot: undoubted occurrence. Open dot: questionable occurrence. *BP* transition: *Bispathodus-Pseudopolygnathus* transition. *Ps: Pseudopolygnathus.*

Taxa / sample	LC3	L5	LC2	L4	L3	L2	LC1	LS6	9	13	19	23	29	37	38	41	44
Dollymae hassi	●	○															
Bispathodus ac. aculeatus	●	●			●												
BP transition	●							●	○								
Polygnathus c. carinus	●	○	●	●	○	●	●		●								
Gnathodus cuneiformis	●	●			●												
Eotaphrus bultyncki		●		○													
Ps. gr. *multistriatus*		●	●		●			●	●	●	●	●	●	●	●		●
Protognathodus praedelicatus		●	●	●		○						●					
Protognathodus cordiformis			●	○	●	●	●	●	○	●	●	●	●			●	○
Polygnathus cf. *purus*			●					●			●						
Pseudopolygnathus pinnatus			●	●	●		●	●	●		●		○	○			
Staurognathus cruciformis							●										
Pseudopolygnathus simplex								●	●			●					
Dollymae aff. *bouckaerti*												●	●	●			
Bactrognathus bultyncki												●		●	●	●	●
Eotaphrus burlingtonensis													○				
Bactrognathus hamatus														●		●	○
Polygnathus semidictyus															●	●	
sample weight (kg)	1	.7	1.5	.5	1	1	1	1.5	1	1	1	1	1	.7	1	1.5	1
platform elements / kg	65	86	31	42	13	13	21	12	50	6	16	30	40	20	6	8	5
gnathodids / kg	5	28	9	22	7	9	7	1	2	1	1	3	4	0	0	2	1

which more probably evolved from the *Pseudopolygnathus primus* stock. The combination of characters is interesting, nevertheless. On the left side, the platform may not reach the posterior tip (Pl. 1, Fig. 2). More commonly, however, it does.

Specimens compared to *Polygnathus purus* (Pl. 2, Figs. 2, 3) are very similar to that species but most have a node on the right side of the platform.

Dollymae aff. *bouckaerti* (Pl. 2, Figs. 17-22; Pl. 3, Fig. 6) differs from the nominate species in the platform which extends farther anteriorly, and the ornamentation which is more complicated, especially in adult specimens. In the opinion of the second author, these are minor differences.

Bactrognathus hamatus is a well-known species. *Bactrognathus* sp. (Pl. 2, Fig. 16) and *B. bultyncki* n. sp. (see description below) are more exotic. The occurrence of the genus outside North America is worth noticing, however.

Dollymae hassi, together with *Polygnathus communis carinus* and *Gnathodus cuneiformis*, indicates a level close to the base of either the *carinus* Zone of GROESSENS (1975) or the *cuneiformis* Zone of BELKA (1985). This is supported by the occurrence, just above, of *Eotaphrus bultyncki* and, just below, of *Siphonodella obsoleta* (KUANG *et al.*, 1999: unit 15). Higher, the picture is less clear. *Eotaphrus burlingtonensis* PIERCE & LANGENHEIM, 1974 would be an indicator of the *anchoralis* Zone. Yet, the specimen (Pl. 2, Fig. 11) is broken, and could be identified as *Staurognathus dionantensis* BELKA & GROESSENS 1986, the range of which is not the same. This species is known from the *anchoralis* Zone in Germany (see *Eotaphrus?* n. sp. V and the revision of VOGES' material by LANE, SANDBERG & ZIEGLER, 1980). In Belgium (BELKA & GROESSENS, *op. cit.*), *S. dionantensis* is reported from just below the entry of *Scaliognathus anchoralis fairchildi* succeeded, 1.2 m higher, by *Sc. anchoralis europensis*. In Poland (BELKA, 1985), it has been found as low as the base of the *cuneiformis* Zone. The species, identified as *Eotaphrus* sp. V (VOGES), is also reported from Limiao of Xincheng, an exposure about 80 km west of Liuzhou (WANG & XU, 1989). The range chart in that paper is somewhat puzzling, but the species is present and therefore, it could be present in Longdianshan as well. As an indicator of the *anchoralis* Zone, the specimen tentatively identified as *Eotaphrus burlingtonensis* is thus a rather weak evidence. Last occurrence, in sample LS9, of *Polygnathus communis carinus* may be a better mark. This species locally ranges into the lowest part of the *anchoralis* Zone, but it is rare to find it mentioned higher. *Protognathodus cordiformis* ranges from the *carinus* into the *anchoralis* Zone. However, it was never observed reaching to the top of this zone. The same is true of *P. praedelicatus*. Even though the *anchoralis* Zone is reached, it is thus clear that the top is not. Regarding Chinese species, *Pseudopolygnathus simplex* JI, 1987 is reported from the *carinus* to the *anchoralis* Zone (units 22-26 of JI, *op. cit.*). It thus adds nothing that may be useful. *Polygnathus semidictyus*, together with *Pseudopolygnathus multicostatus*, gives name to the *semidictyus-multicostatus* Assemblage (units 27-28) said to postdate the *anchoralis* Zone. This may be questioned given the parallel occurrence of *Hindeodella segaformis*, now recognized as an S element of *Sc. anchoralis*.

Conodont taxonomy

Genus *Bactrognathus* BRANSON & MEHL, 1941

Bactrognathus bultyncki n. sp.
Plate 3, Figures 7-10

Derivation of name: In honour of Pierre Bultynck.

Types: Four platform elements out of sample LS 37.
Holotype - IRScNB b4423 (Pl. 3, Fig. 8). L = 0.78 mm, W = 0.61 mm.
Paratype A - IRScNB b4424 (Pl. 3, Fig. 7). L = 0.77 mm, W = 0.57 mm.
Paratype B - IRScNB b4425 (Pl. 3, Fig. 9). L = 0.64 mm, W = 0.50 mm.
Paratype C - IRScNB b4426 (Pl. 3, Fig. 10). L = 0.60 mm, W = 0.40 mm.

Type locality: Longdianshan near Liuzhou, Guangxi, South China. Latitude N 24°13.250', longitude E 109°17.430' (in WGS 84).

Type level: Upper Tournaisian, upper part of the Long'an Formation.

Material: 12 specimens.

Diagnosis: *Bactrognathus* species with two anteriorly-directed lateral processes and one short, untwisted, posterior process.

Description: Depressed unit with anteriorly-directed lateral processes which develop a platform. This platform continued into a short posterior process and a longer anterior one. Carina made of fused nodes passing anteriorly to more distinct denticles. Ill-defined or, in some cases, better defined anterior blade, depending on the development of the platform. No posterior twist (as observed in other *Bactrognathus* species) or only a faint suggestion of this. Posterior third of the unit arched downwards. Upper surface ornamented with granules, the anterior process marginally ridged. Lower surface entirely occupied by the basal cavity posteriorly, continued anteriorly by a groove. Additional median fissure extending from the posterior end to a point at about mid-length of the anterior process, deeper in the middle.

Comparisons: *Bactrognathus bultyncki* n. sp. resembles *B. anchorarius* (HASS, 1959) from which it differs by better developed platforms and lack of post-lateral process. It also much resembles *Gnathodus hunanensis* JI, 1987 which lacks the anterior platform but, otherwise, is very similar.

Occurrence: Known only from the type locality, samples LS 23-44.

Ostracods

Only two samples are rich enough to discuss the associations: sample L3 (silicified), and sample L5 (non-silicified). In sample L5, i.e. at the base of the cave section, *Shishaella alekseevae* is clearly the dominant species. It is accompanied by varied *Bairdia* species, common *Healdianella* (*H. cuneola*) and a few, less frequent, taxa. Such an association corresponds to the "marine shallow offshore realm" of BLESS (1983), and the "Bairdiacean and Paraparchitacean ecozone" of CRASQUIN (1984). Ten metres higher (sample L3), paraparchitoids have practically disappeared and bairdioids strongly dominate, especially *Bairdia* species. Associations of that kind were discussed by BLESS (*in* DREESEN *et al.*, 1985) who distinguished the following categories:

Category A - Kirkbyoids, of which one fine example is given in Pl. 4, Fig. 6.

Category B - Thuringian ostracods, considered to be indicative of low-energy environments. They are represented here by four species, namely: *Tricornina robusticerata* (Pl. 4, Fig. 8), *Bairdia feliumgibba* (Pl. 4, Fig. 9), *B. dorsokonvexa* (Pl. 4, Figs. 10, 11), and *Bohlenatia rhenothuria* (Pl. 4, Fig. 12).

Category C - Smooth-shelled *Microcheilinella* and *Microcheilinella*-like spinose ostracods such as illustrated in Pl. 4, Fig. 18.

Category D - A rather heterogeneous group, in which may be included the *Coryellina* species illustrated in Pl. 4, Fig. 17.

Category E - Bairdioids (*Acratia, Bairdia, Bairdiacypris*) and bairdiocypridoids (*Praepilatina, Bairdiocypris*), all represented here with, however, a greater abundance of the former group.

Category F - Paraparchitoids, divided into spineless genera (*Paraparchites, Chamishaella, Shemonaella*) that are common members of the littoral associations, and genera with a spine on one (*Shishaella*) or both valves (*Shivaella*), more commonly encountered in offshore communities.

Category G - Healdioids, the distribution of which is not clearly understood.

The association from sample L5 is characterized by categories C, E, F and G. It was said to correspond with a platform facies. The refined analysis discussed above confirms this point. The association from sample L3 (with two illustrated specimens out of sample L4) is characterized by categories A, B, C, D and E. Except for the Thuringian component (B) that is here better expressed, it much resembles the assemblages described by BLESS (*op. cit.*) from eastern Belgium, northeastern Siberia, and southwestern Morocco. It has much in common, as well, with the fauna studied by COEN (1996) from the basal Malanbian Formation at Oujiachong, central Hunan (COEN, *op. cit.*, p. 56: samples O 215-219). In every case, ostracods of category F are completely or practically absent. The most typical members of the Thuringian association, i.e. forms with very long spines, are absent as well and the contribution of other Thuringian-type ostracods is low, in terms of number of individuals. BLESS (*op. cit.*) and COEN (*op. cit.*) agree in interpreting associations like these as inhabiting a relatively deep open marine environment.

In addition to those discussed above, the following taxa are worth a few comments.

Although first described from Thuringia and a member of unquestioned Thuringian associations, the genus *Fellerites* GRÜNDEL, 1962 is also frequently reported from shallow water communities. The specimen illustrated here (Pl. 4, Fig. 13) is from sample L5.

Paracypris?, even with a question mark, is a somewhat provocative determination. According to MADDOCKS (1988), the genus *Paracypris* may be present in the Jurassic, but it is not known with certainty until the Cretaceous. It is characterized by branching radial pore canals and a broad zone of concrescence. The radial pore canals cannot be seen on the material at hand and the zone of concrescence, as observed in transmitted light on specimens soaked in glycerine, is narrow. It is none the less suggested that such forms are better treated as possible ancestral members of the family Paracyprididae than, for example, as representatives of an *Acratia* species. The left valve is the larger.

The record of *Coronakirkbya* (Pl. 4, Fig. 6) is similarly a rather early occurrence of a genus that BECKER (1997) reports from the Pennsylvanian to the Permian.

First described from the Middle-Upper Tournaisian Taidon and Fominskoe Horizons of Kuzbass, *Bairdia submongoliensis* BUSHMINA, 1968 was subsequently reported from the analogue deposits of N Altai and other units of about the same age in NW Altai and Rudnii Altai (BUSHMINA *et al.*, 1984). It is also known from the Upper Tournaisian K-VI complex of the Kamenka river, Kolyma (BUSHMINA, 1975; GAGIEV & KONONOVA, 1990), and the upper part of the Kassina Horizon, Karaganda basin, Kazakhstan (BUSHMINA, 1977). No ventral view was ever given, but it was stated (BUSHMINA, 1977, p. 118) that "the ventral border of the right valve is turned out in the middle part". COEN *et al.* (1988) referred to this particular feature and illustrated it in material from the Waulsortian of the Ardennes (*op. cit.*, pl. 8, fig. 5; pl. 9, fig. 2b). Three specimens are further illustrated herein (Pl. 3, Figs. 12-14) of which two ventral views are given.

Shishaella alekseevae CHIZHOVA, 1977 is recognized through the lateral outline, the position of the spine, and the dorsal border slightly arched (a character that is not present until a total length of about 1 mm is reached). First described from the basal Tournaisian of the Dnepr-Donets depression, it was subsequently reported from the Devonian-Carboniferous transition beds at Berchogur, Mugodzhary, Kazakhstan (BARSKOV *et al.*, 1984; KOCHETKOVA & JANBULATOVA, 1987).

First described by GRÜNDEL (1961), *Bairdia dorsokonvexa* is referred to only by BECKER (in BECKER *et al.*, 1993). Similar forms are subsequently included within the range of variation of *Bohlenatia rhenothuria* (BECKER & BLUMENSTENGEL, 1995, fig. 4/1; BECKER, 1999, pl. 17, figs. 12, 13). This view is not accepted. *Bairdia dorsokonvexa* is thus treated as a separate species, thought to be conspecific with *Bairdianella obesa* WANG, 1988 from the Wangyou Formation of Nandan, northern Guangxi.

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Explanation of Plates

Plate 1

All Figures x 55.

Figs. 1, 2 — *Bispathodus-Pseudopolygnathus* transition forms. LC3. 1a: left lateral view; 1b: upper view. 2a: upper view; 2b: lower view.
Figs. 3, 4 — *Pseudopolygnathus pinnatus* Voges, 1959. LC2. Upper views.
Figs. 5, 13 — *Polygnathus communis carinus* Hass, 1959. 5: LC3; 13: LC2. Upper views.
Figs. 6-9 — *Gnathodus cuneiformis* Mehl & Thomas, 1947. LC3. Upper views.
Fig. 10 — *Gnathodus semiglaber* Bischoff, 1957. L5. Upper view.
Figs. 11, 12 — *Dollymae hassi* Voges, 1959. LC3. Upper views.
Figs. 14, 15 — *Eotaphrus bultyncki* (Groessens, 1971). L5. Left lateral views.
Figs. 16, 17 — *Protognathodus praedelicatus* Lane, Sandberg & Ziegler, 1980. L5. Upper views.
Fig. 18 — *Bispathodus stabilis* (Branson & Mehl, 1934). L5. Upper view.
Fig. 19 — *Bispathodus aculeatus aculeatus* (Branson & Mehl, 1934). LC3. Upper view.

Plate 2

All Figures x 55. All upper views.

Fig. 1 — *Pseudopolygnathus simplex* Ji, 1987. LS6.
Figs. 2, 3 — *Polygnathus* cf. *purus* Voges, 1959. LS6.
Fig. 4 — *Protognathodus praedelicatus* Lane, Sandberg & Ziegler, 1980. LC2.
Figs. 5-10, 23 — *Protognathodus cordiformis* Lane, Sandberg & Ziegler, 1980. 5: LS6; 6: LS19; 7,10: L2; 8,9: LC1; 23: LS29.
Fig. 11 — *Eotaphrus burlingtonensis?* Pierce & Langenheim, 1974. LS29. Posterior cusp broken, see discussion in text.
Fig. 12 — *Pseudopolygnathus pinnatus* Voges, 1959. LC1.
Fig. 13 — *Staurognathus cruciformis* Branson & Mehl, 1941. LC1.
Fig. 14 — *Pseudopolygnathus multistriatus* Mehl & Thomas, 1947. L5.

Fig. 15 — Conodont gen. et sp. undetermined. LS9.
Fig. 16 — *Bactrognathus* sp. LS9.
Figs. 17-22 — *Dollymae* aff. *bouckaerti* Groessens, 1971. LS29.

Plate 3

All Figures x 55 except Figs. 12-14 x 48.

Fig. 1 — *Bactrognathus hamatus* Branson & Mehl, 1941. LS37. Lower (a) and upper (b) views.
Fig. 2, 11 — *Polygnathus* sp. LS37. 2a: right lateral, 2b: upper, and 2c: lower view. 11: upper view, anterior blade broken.
Figs. 3, 4 — *Pseudopolygnathus* gr. *multistriatus* Mehl & Thomas, 1947. LS37.
Fig. 5 — *Polygnathus semidictyus* Ji, 1987. LS41. Anterior blade broken.
Fig. 6 — *Dollymae* aff. *bouckaerti* Groessens, 1971. Upper view. LS37.
Figs. 7-10 — *Bactrognathus bultyncki* n. sp. LS37.
  7: Paratype A. IRScNB b4424, upper view.
  8: Holotype. IRScNB b4423, lower (a) and upper (b) views.
  9: Paratype B. IRScNB b4425, upper view.
  10: Paratype C. IRScNB b4426, juvenile specimen, upper view.
Figs. 12-14 — *Bairdia submongoliensis* Bushmina, 1968.
  12 – silicified carapace, right lateral (a) and ventral (b) views. L3.
  13, 14 – non-silicified carapaces. L5. 13: right lateral view; 14a: right lateral, and 14b: ventral view.

Plate 4

All Figures x 48 except Figs. 7, 14, 15 x 60

Figs. 1-3 — *Acratia* sp.
  1: Silicified carapace, right lateral view. L3.
  2: Silicified left valve, inner (a) and dorsal (b) views. L3.
  3: Silicified right valve, inner view. L3.
Fig. 4 — *Paracypris?* sp. Silicified right valve, inner view. L3.
Fig. 5 — *Shishaella alekseevae* Chizhova, 1977. Complete carapace, right lateral view. L5.
Fig. 6 — *Coronakirkbya* sp. Silicified left valve. L3.
Fig. 7 — *Editella dawubaensis* Olempska, 1998. Silicified left valve. L4.
Fig. 8 — *Tricornina robusticerata* Blumenstengel, 1969. Silicified left valve, dorsal view. L4.
Fig. 9 — *Bairdia feliumgibba* Becker, 1982. Silicified carapace, right lateral view. L3.
Figs. 10, 11 — *Bairdia dorsokonvexa* Gründel, 1961. 10: silicified left valve inner view; 11: silicified carapace dorsal view. L3.
Fig. 12 — *Bohlenatia rhenothuria* Becker, 1993. Silicified carapace, right lateral (a) and dorsal (b) views. L3.
Fig. 13 — *Fellerites* sp. Complete carapace, right lateral view. L5.
Figs. 14, 15 — *Healdianella cuneola* (Jones & Kirkby, 1886) *sensu* Bushmina, 1968. Complete carapaces, dorsal (14) and right lateral (15) views. L5.
Fig. 16 — *Bairdianella protracta* Zanina, 1956. Silicified carapace, right lateral view. L3.
Fig. 17 — *Coryellina* sp. Silicified right valve, dorsal (a) and lateral (b) views. L3.
Fig. 18 — *Ampuloides* sp. Silicified carapace, dorsal view. L3.

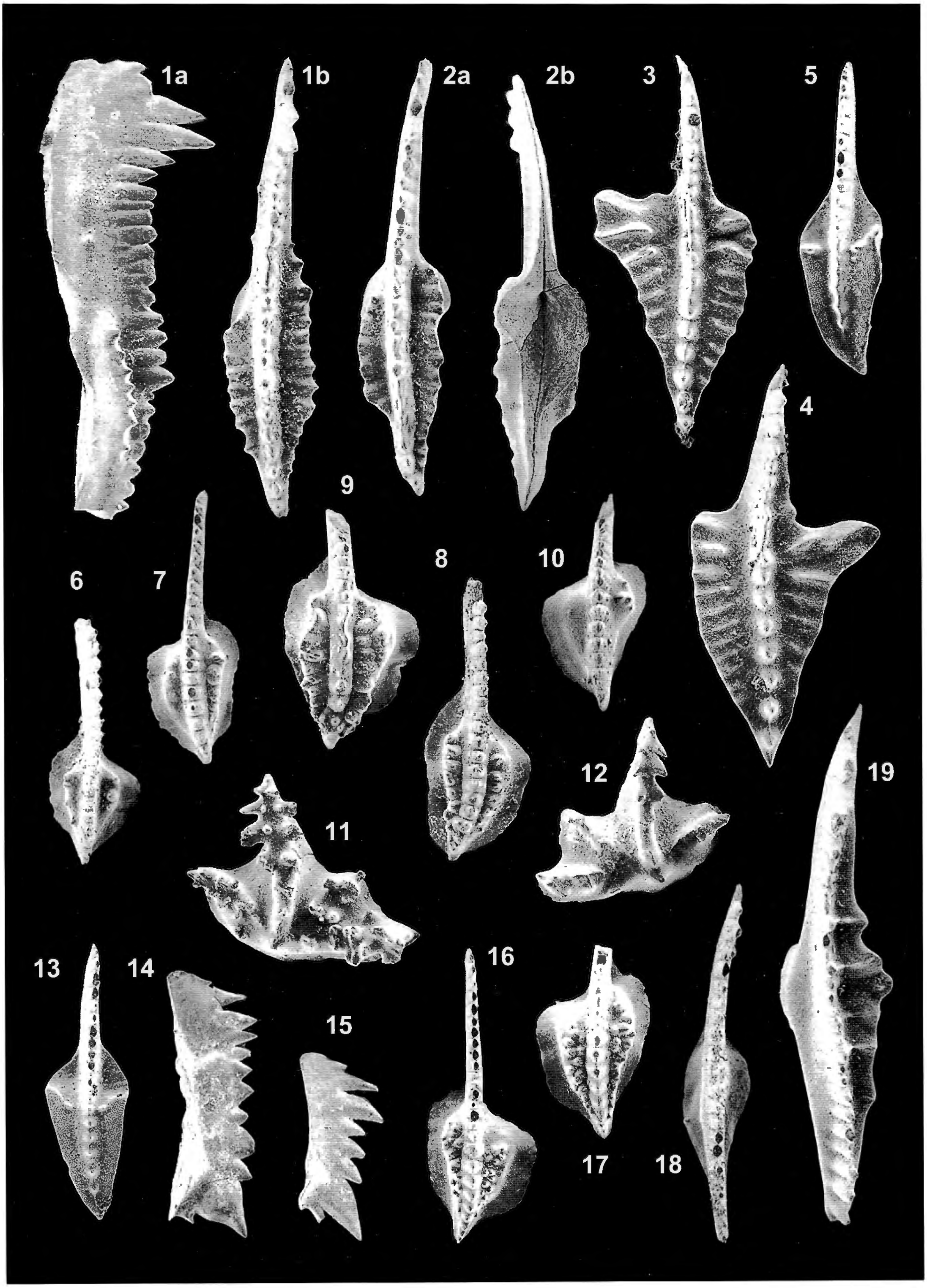

PLATE 1

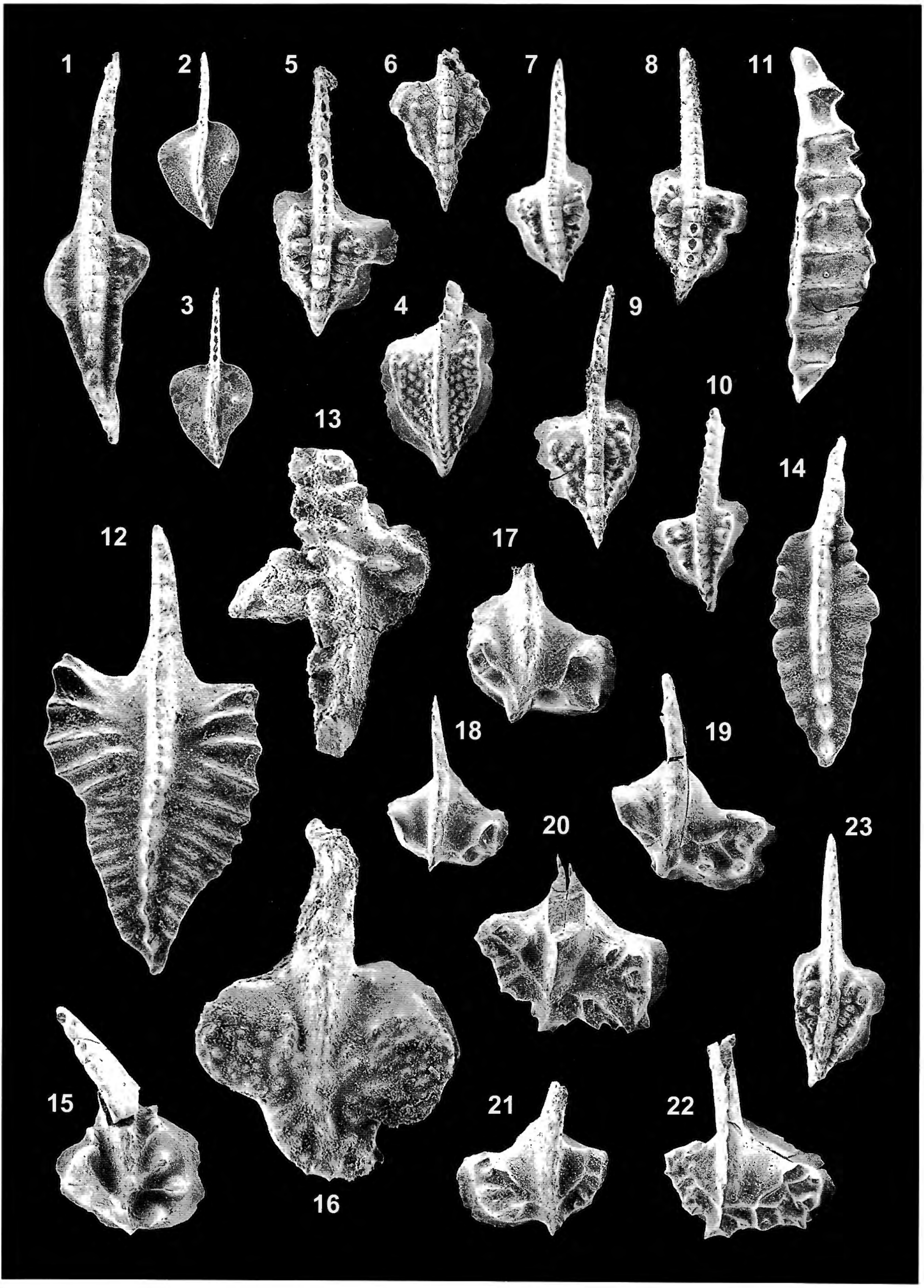

PLATE 2

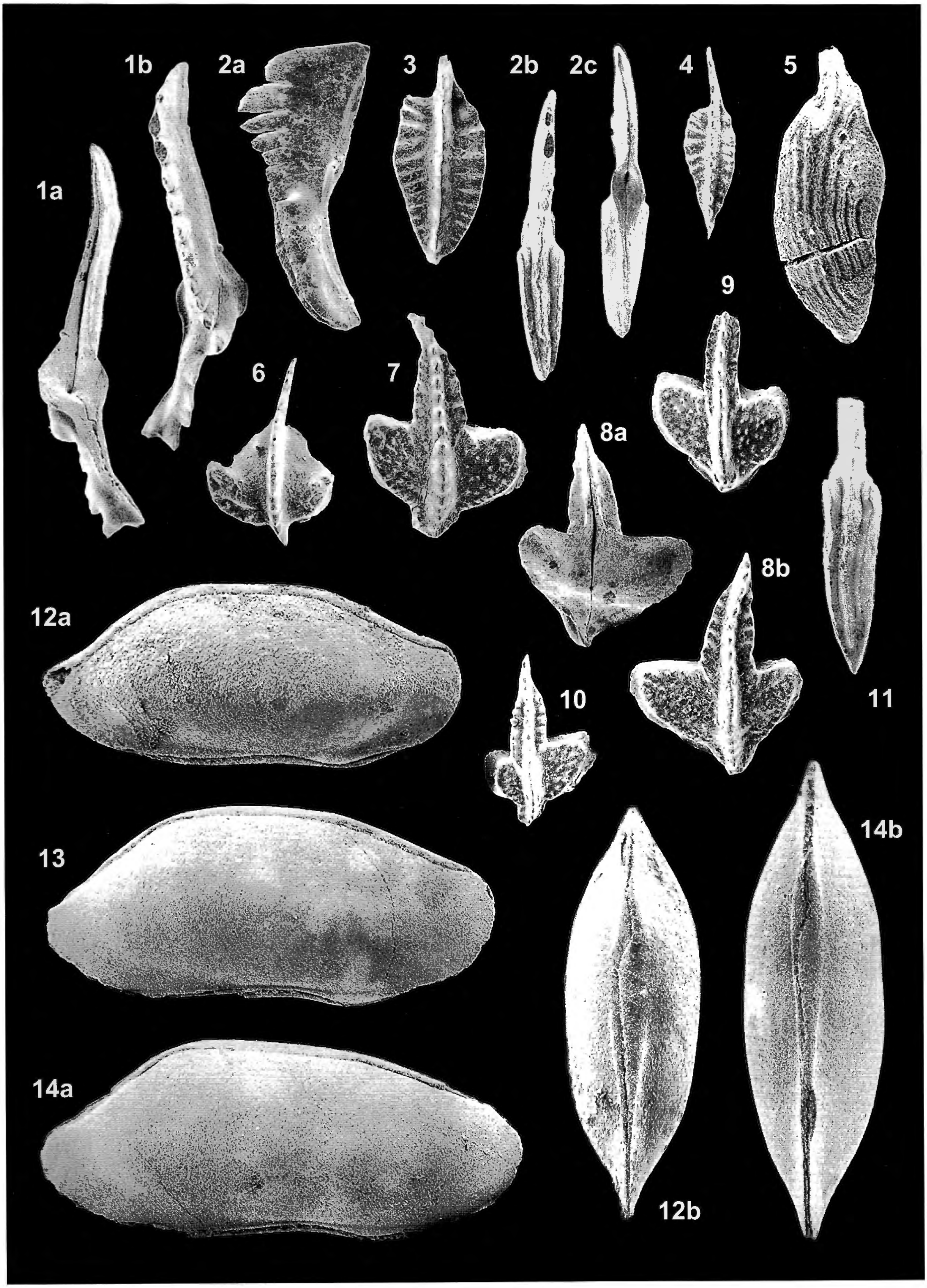

PLATE 3

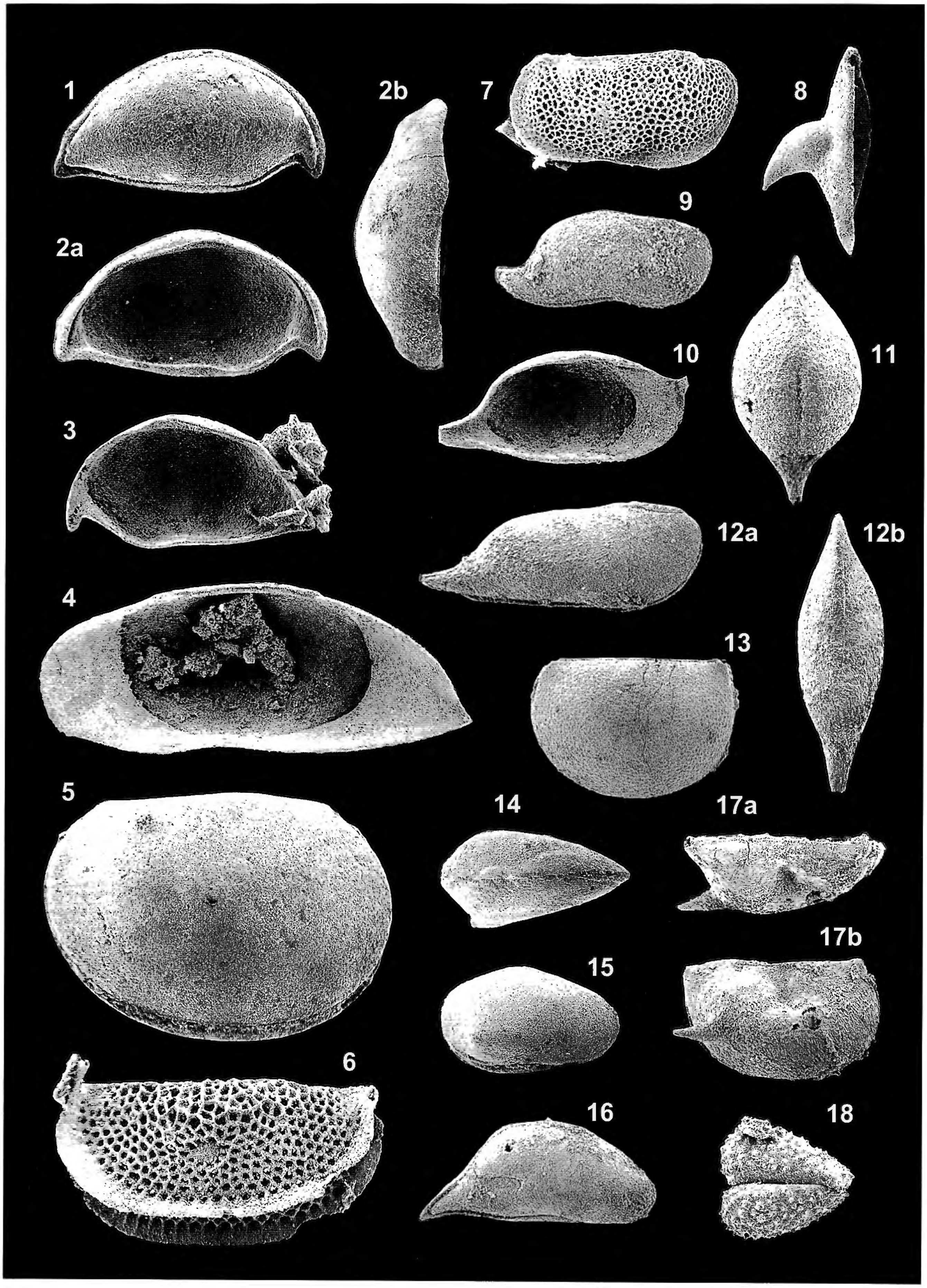

Plate 4