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Bajocian – Bathonian ammonite fauna of the Czorsztyn Unit, Pieniny Klippen Belt (Western Carpathians, Slovakia); its biostratigraphical and palaeobiogeographical significance

JÁN SCHLÖGL[1], MILOŠ RAKÚS[2], CHARLES MANGOLD[3] & SERGE ELMI[3]

[1]*Department of Geology and Paleontology, Faculty of Sciences, Comenius University, Mlynská dolina - G, SK-842 15 Bratislava, Slovakia. E-mail: schlogl@nic.fns.uniba.sk*
[2]*Geological Survey of Slovak Republic, Mlynská dolina 1, SK-817 04 Bratislava, Slovakia. E-mail: rakus@gssr.sk*
[3]*UMR 5125 Paléoenvironnement et Paléobiosphére, 2 rue Dubois, Université Claude Bernard Lyon1, 69 622 Villeurbanne Cedex, France*

ABSTRACT:

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The *Parkinsoni* Zone of the Late Bajocian and the *Zigzag, Aurigerus* and *Retrocostatum* Zones of the Bathonian have been identified on the basis of relatively highly diversified ammonite assemblages within seven ammonitico rosso sections belonging to the Czorstyn Unit, Pieniny Klippen Belt. The ammonite fauna has features in common with both the Mediterranean Province and the Sub-Mediterranean Province, containing abundant Phylloceratina and Lytoceratina on the one hand, but numerous *Parkinsonia* on the other. Ammonites of Arabian affinities belonging to the genus *Micromphalites* occur rarely in the Early Bathonian *Zigzag* Zone assemblage. *Lytoceras joniaki*, *Lissoceras compressus* and *Cadomites (Polyplectites) minutus* are proposed as new taxa.

Key words: Jurassic, Bajocian, Bathonian, Ammonites, Biostratigraphy, Palaeobiogeography, Systematics, Pieniny Klippen Belt, Carpathians, Slovakia.

INTRODUCTION

Ammonitico rosso deposits are among the most widespread and most fossiliferous facies in the Western Carpathian Jurassic, especially in the Czorsztyn Unit, one of the units belonging to the Pieniny Klippen Belt (PKB). The PKB is an exceptional structure of the Western Carpathians. With its characteristic elongate and narrow shape and a length of several hundred kilometres it forms a dividing zone between the Outer and Central Western Carpathians (Text-fig. 1). It started to develop its identity during the Jurassic at the southern margin of the European plate, but its typical structural and morphological form is a result of younger, mainly Tertiary tectonics. Although the structure of the area is complicated and locally even chaotic, it is basically made of two Jurassic–Cretaceous sequence-groups (the relatively shallow Czorsztyn Unit, and the deep-water Pieniny-Kysuca Unit), with a series of transitional developments (including the Niedzica, Czertezic and Orava Units). The

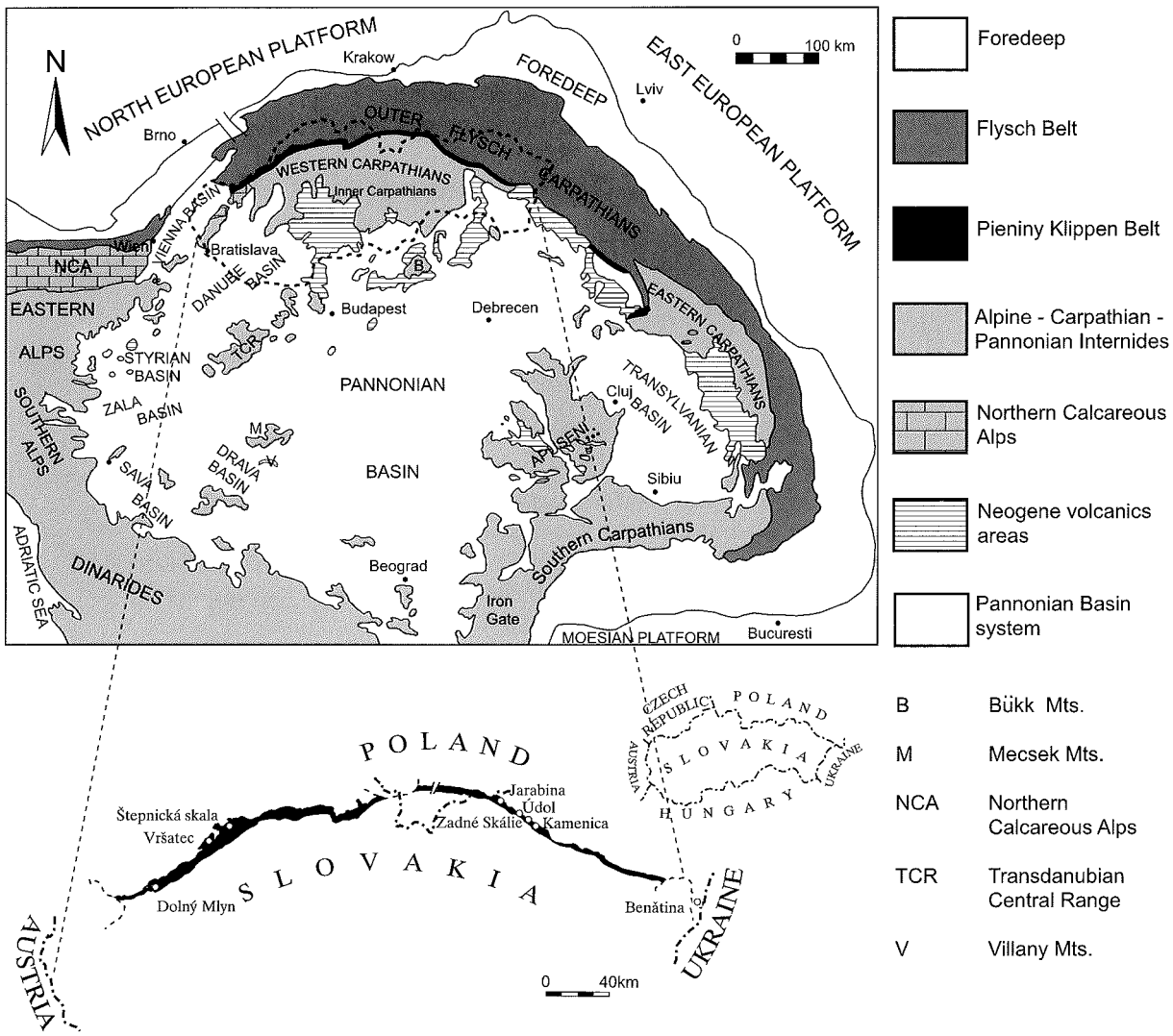

Fig. 1. Geological scheme of Central Europe, with the position of the Pieniny Klippen Belt and the localities studied

Czorsztyn Unit is considered to be the shallowest of all the known Pieninic units (for details see e.g. BIRKENMAJER 1977; AUBRECHT & *al.* 1997), deposited on the former Czorsztyn Ridge and its southern slope.

Although the ammonitico rosso facies has attracted the attention of Carpathian geologists for over 150 years (e.g. STUR 1860; ANDRUSOV 1931; 1945), detailed biostratigraphical research was only rarely the aim of their studies and such work has been concentrated on mainly during the last 20 years. In 1990, RAKÚS published the first, more detailed biostratigraphical study from selected Slovakian and Ukrainian localities of the Czorsztyn Unit. A part of his fauna is also integrated into this study. In recent years, microfacies, sedimentological and palaeontological research on the facies in the Polish segment of the Pieniny Klippen Belt was summarized by BIRKENMAJER & MYCZYNSKI (1984) and new data were provided mainly by WIERZBOWSKI (1994; MYCZYNSKI & WIERZBOWSKI 1994; WIERZBOWSKI & *al.* 1999).

The data reported in this paper are the main results of the PhD study of the first author (SCHLÖGL 2002) and partly also a revision of the fauna published by the second author (M. R.) in 1990.

GEOGRAPHICAL AND GEOLOGICAL SETTING

The sections of Dolný Mlyn, Vršatec and Štepnická skala are situated in the West-Slovakian segment of the PKB, and Jarabina, Údol, Zadné Skálie, Kamenica and Beňatina in its East-Slovakian segment (Text-fig. 1). The Jurassic strata are characterized by a deepening-upward succession. Lias sediments are preserved in the Dolný Mlyn and Beňatina quarries only. Highly fossili-

ferous Hettangian to Toarcian oxygen-depleted dark deposits (Dolný Mlyn Formation, Allgäu Formation) were replaced by neritic detritic sedimentation of various crinoidal limestones during the Aalenian and Bajocian (Smolegowa and Krupianka Formations). A sudden facies change during the Late Bajocian or Early

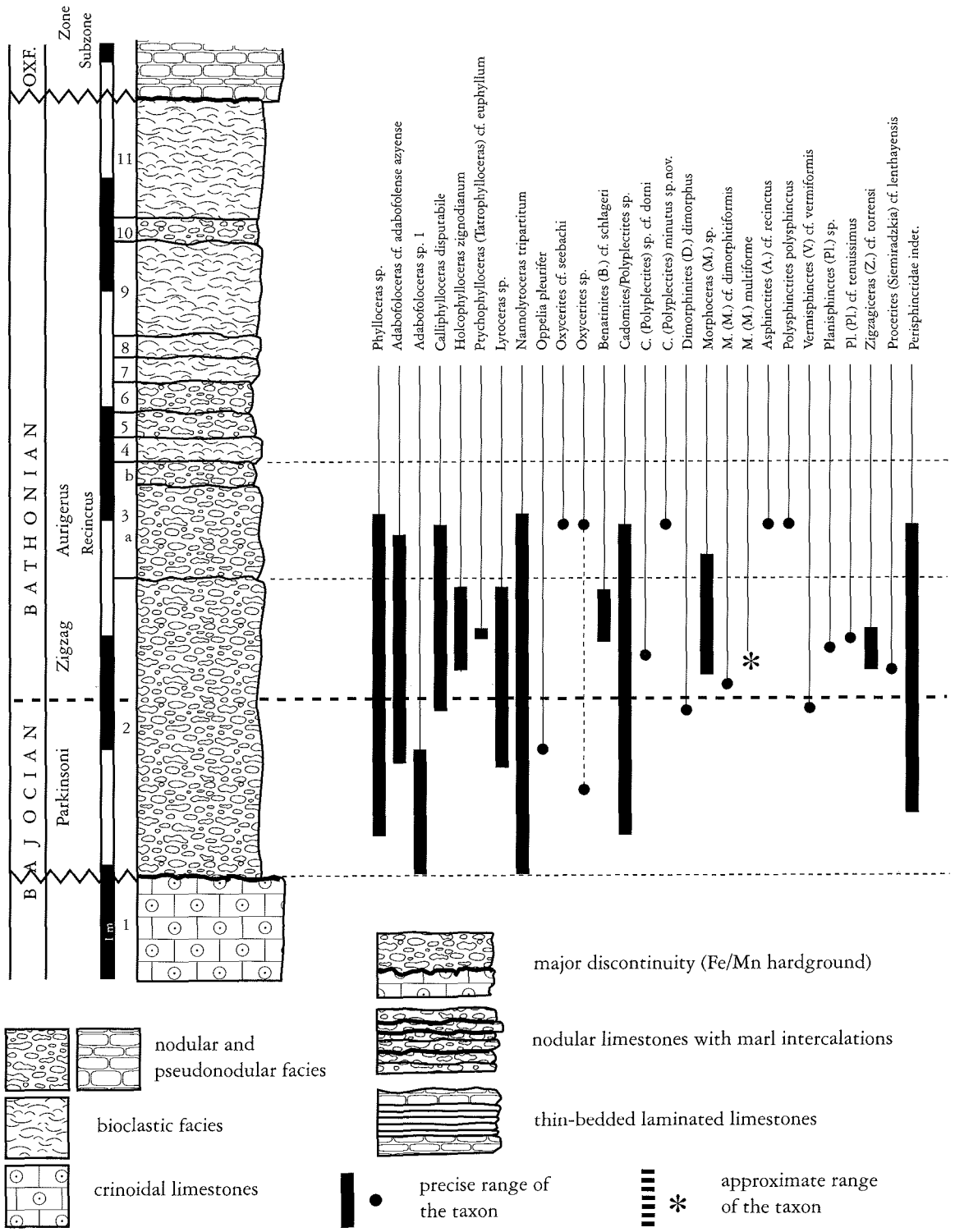

Fig. 2. Dolný Mlyn section

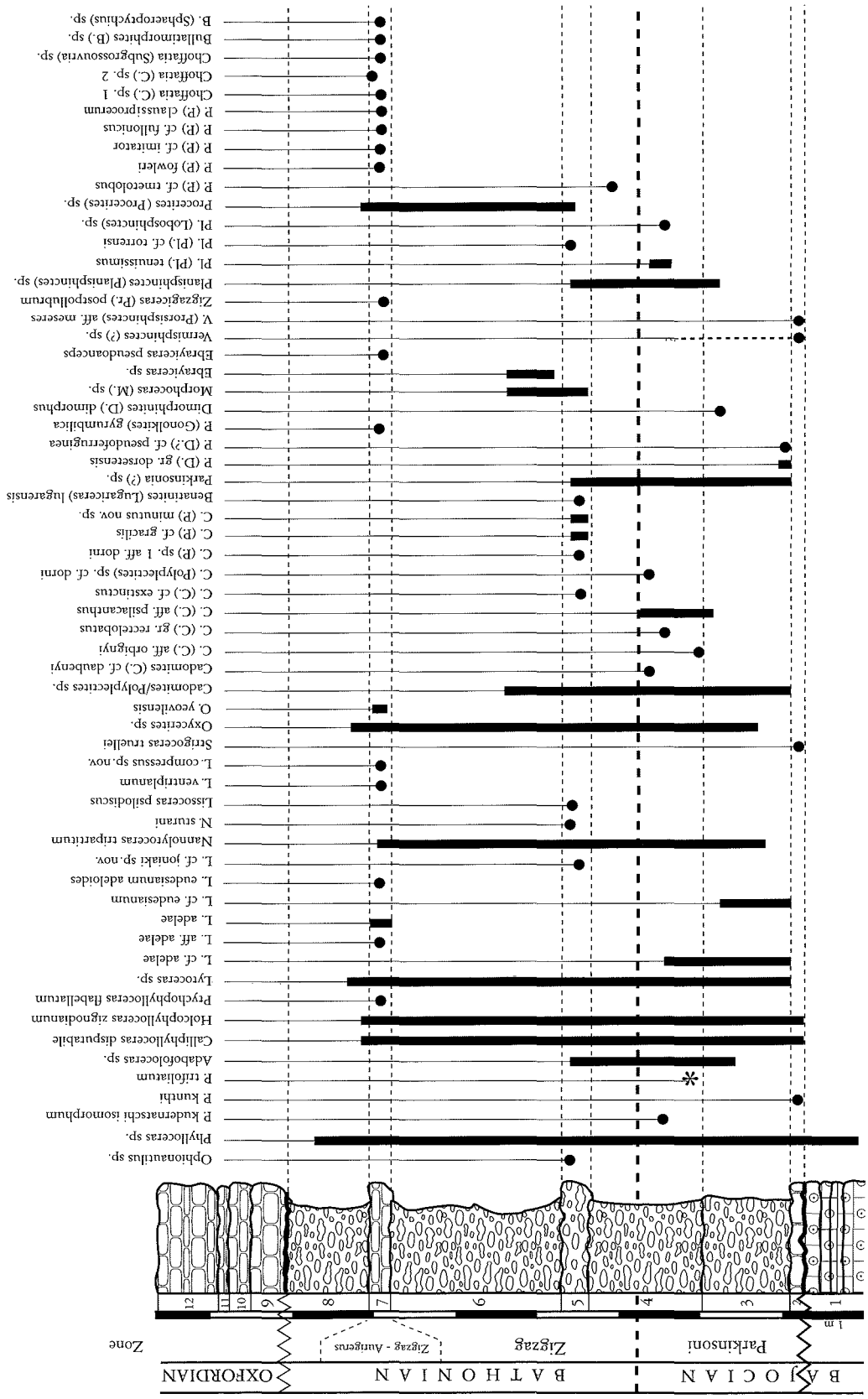

Fig. 3. Vršatec section

Bathonian is marked by a discontinuity which is accentuated by a Fe/Mn hardground with microbial encrustations. Pelagic sedimentation of different types of nodular limestones (Czorsztyn Limestone Formation) follows. The microfacies changes from crinoidal grainstones and packstones to wackestones with filament microfacies. Ammonitico rosso sediments of this formation vary in thickness, stratigraphical extent, and type of macrofaunal preservation (SCHLÖGL 2002). Another major discontinuity with a Fe/Mn hardground lies at the boundary between the filament microfacies and the *Globuligerina* microfacies. In the Carpathian region the bloom of the planktonic foraminifer *Globuligerina* is already considered to be of Oxfordian age, proved by scarce Middle and Late Oxfordian ammonites collected from these beds just above the hardground (SCHLÖGL 2002, WIERZBOWSKI & *al.* 1999). The overall stratigraphical extent of the ammonitico rosso facies is from the Late Bajocian (Dolný Mlyn, Vršatec, Beňatina) up to the Late Kimmeridgian (Dolný Mlyn) or Early Tithonian (Vršatec, Údol). It passes gradually into pinkish and creamy coloured, massive or bedded micritic limestones of the Dursztyn Limestone Formation (mainly Tithonian and Berriasian).

This study is focused on the most fossiliferous, Upper Bajocian to Bathonian part of the Czorsztyn Limestone Formation. Although all the sections studied share similar sedimentological features, such as a basal discontinuity with Fe/Mn encrustations or a nodular facies prevailing over other facies (bioclastic or pseudonodular, see Text-figs 2-7), nevertheless there are some small but important differences. The Vršatec section (Text-fig. 3) and the exposed part of the Beňatina section (Text-fig. 7) are the only ones consisting entirely of the nodular facies (sensu CLARI & *al.* 1984) and intraclastic nodular facies (sensu SAVARY 2000). The upper part of the Dolný Mlyn (Text-fig. 2) and Štepnická skala (Text-fig. 4) sections are made of bioclastic facies (massive limestones or marlstones with the *Bositra* coquina). The Kamenica section (Text-fig. 6) is composed of numerous thin intraclastic nodular beds, separated by thin marly intercalations. Its upper part also contains intercalations of thin laminated, non-nodular limestones. Pseudonodular facies (sensu MARTIRE 1996) predominates in the Štepnická skala (Text-fig. 4) and Jarabina sections (see RAKÚS 1990, fig. 3). The lower part of the Údol section (Text-fig. 5) is covered by debris, the exposed part consists of both nodular and pseudonodular facies.

BIOSTRATIGRAPHY

The ammonite zonation applied in the study is that of MANGOLD & RIOULT (1997) for the Sub-Mediterranean Province. The ammonites are illustrated in plates 1-15.

Late Bajocian

Parkinsonia (P.) parkinsoni Zone

The first ammonitico rosso bed in the Vršatec section just above the hardground yielded a reworked ammonite association including *Phylloceras kunthi, Calliphylloceras disputabile, Holcophylloceras zignodianum, Strigoceras truellei* (Pl. 3, Fig. 4) and *Vermisphinctes* (*Prorsisphinctes*) aff. *meseres*. Some specimens show signs of corrosion, encrustation and reworking (inverted geopetal structures). The upper surface of this bed is irregular and mineralized, with hemisphaeroidal *Frutexites*-like structures growing on it and, in places, even directly on the ammonites. The succeeding bed contains a rich ammonite fauna, composed mainly of Parkinsoniinae of the Late Bajocian *Parkinsoni* Zone.

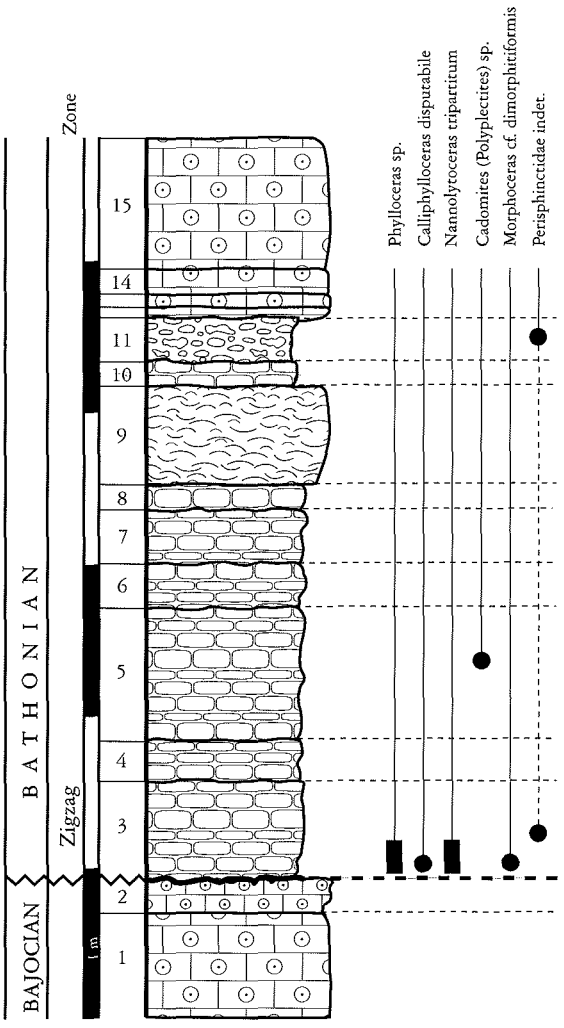

Fig. 4. Štepnická skala section

Dimorphinites (*D.*) *dimorphus* was found in the uppermost part of the bed, still indicating the same zone. An abundance of Late Bajocian *Parkinsonia* is a common feature shared by the Vršatec and Beňatina sections (Pl. 11, Figs 1, 5, Pl. 13, Figs 1, 9). They are associated with *Digonioceras excavatum* (Pl. 1, Fig. 6), *Phylloceras trifoliatum, Calliphylloceras disputabile, Adabofoloceras* sp. 1 (Pl. 1. Figs 1-2), numerous *Lytoceras*, *Cadomites* (*C.*) *daubenyi, Leptosphinctes* (*L.*) sp., *Vermisphinctes* (*V.*) cf. *martiusi, V.* (*Prorsisphinctes*) aff. *meseres* (Pl. 8, Fig. 1-2) and *Bigotites tuberculatus* (Pl. 10, Fig. 7) in the Beňatina section (Text-fig. 7); and with *Phylloceras kudernatschi isomorphum, P. trifoliatum, Calliphylloceras disputabile, Holcophylloceras zignodianum, Adabofoloceras* sp., *Nannolytoceras tripartitum, Lytoceras* cf. *adelae, L.* cf. *eudesianum, Oxycerites* sp., *Cadomites* (*C.*) cf. *daubenyi, C.* (*C.*) aff. *orbignyi, C.* (*C.*) gr. *rectelobatus, C.* (*C.*) cf. *arkelli* (Pl. 6, Fig. 2), *C.* (*P.*) sp. cf. *dorni*, *Planisphinctes* (*Pl.*) *tenuissimus* and *Pl.* (*Lobosphinctes*) sp. in the Vršatec section (Text-fig. 3). In contrast, the *Parkinsoni* Zone in the Dolný Mlyn section is characterized by a great scarcity of these ammonites (Text-fig. 2). The zone was proved by taxa such as *Nannolytoceras tripartitum, Oppelia pleurifer* (Pl. 5, Fig. 3) and especially *Dimorphinites* (*D.*) *dimorphus* (Pl. 13, Fig. 2), accompanied by *Adabofoloceras* sp. 1. The thickness of the *Parkinsoni* Zone does not exceed 250 cm.

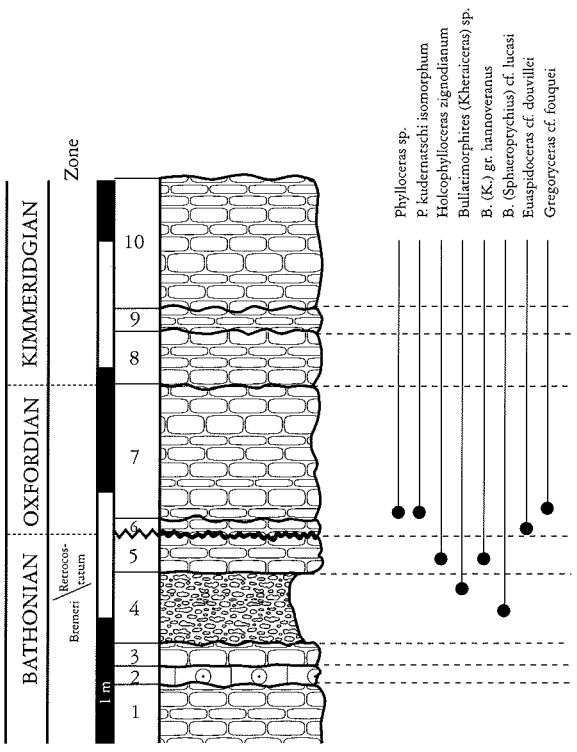

Fig. 5. Údol section

Early Bathonian

Zigzagiceras (*Z.*) *zigzag* Zone

The zone was proved by ammonite faunas in all of the localities studied except the Údol section, where the lower part of the Czorsztyn Limestone Formation is not exposed.

Zigzagiceras are generally scarce, and are present by scattered specimens only in the Dolný Mlyn, Vršatec and Beňatina sections. RAKÚS (1990) described *Zigzagiceras* (*Z.*) *zigzag* (Pl. 11, Figs 3-4) and *Z.* (*Procerozigzag*) *crassizigzag* (Pl. 11, Fig. 2) from the Beňatina section. On the other hand, the strata yielded numerous, well diversified Morphoceratidae, such as *Pseudodimorphinites pinguis* (Pl. 14, Figs 7-10), *Morphoceras* (*M.*) sp. aff. *kostelecense* (Pl. 13, Figs 7-8), *M.* (*M.*) *multiforme* (Pl. 14, Figs 4-5), *M.* (*M.*) cf. *dimorphitiformis* (Pl. 13, Figs 4-6) and *Ebrayiceras sulcatum* (Pl. 14, Fig. 12), enabling the correlation of these strata with the NE European or Sub-Mediterranean zonal scheme. These are associated with mass-occurrences of *Nannolytoceras tripartitum*(Pl. 2, Figs 5, 8), abundant *Lytoceras joniaki* sp. nov. (Pl. 2, Figs 1-4, 9), *Lissoceras psilodiscus* (Pl. 3, Figs 2-3), *Oxycerites limosus* (Pl. 5, Fig. 4), *Benatinites* (*B.*) *schlageri* (Pl. 6, Fig. 17), *B.* (*B.*) *hoki, Vermisphinctes* (?) sp. (Pl. 8, Fig. 3), *Planisphinctes* (*P.*) *planilobus, P.* (*P.*) gr. *tenuissimus* (Pl. 9, Figs 3-4), *P.* (*Lobosphinctes*) *intersertus* (Pl. 10, Fig. 1-2) and *P.* (*L.*) sp.; and rare *Nannolytoceras sturani* (Pl. 2, Figs 6-7), *Lytoceras* sp. aff. *Valentolytoceras elegans* (Pl. 3, Figs 6-7), *Micromphalites* (*M.*) aff. *pustuliferus* (Pl. 5, Fig. 8), *Oecotraustes* (*O.*) aff. *costiger* (Pl. 3, Figs 5, 9-10), *O.* (*O.*) sp. (Pl. 5, Figs 5, 7), *Cadomites* (*C.*) cf. *deslongschampsi, C.* (*C.*) cf. *rectelobatus, C.* (*C.*) cf. *exstinctus* (Pl. 6, Fig. 12), *C.* (*Polyplectites*) *rozyckii* (Pl. 6, Figs 8-9), *C.* (*P.*) cf. *rozyckii* (Pl. 6, Figs 22-23), *C.* (*P.*) aff. *zlatarskii* (Pl. 6, Fig. 13-14), *C.* (*P.*) cf. *gracilis* (Pl. 6, Fig. 11), *C.* (*P.*) *minutus* sp. nov. (Pl. 6, Fig. 5-7), *C.* (*P.*) sp. 1 aff. *dorni* (Pl. 6, Figs 15-16), *C.* (*P.*) sp. cf. *dorni* (Pl. 6, Fig. 10), *Benatinites* (*Lugariceras*) *lugarensis* (Pl. 6, Figs 18-21), *Parkinsonia* (*P.*) cf. *schloenbachi, Parkinsonia* (*Gonolkites*) cf. *subplanulata, Pseudodimorphinites* aff. *pinguis* (Pl. 14, Fig. 11), *Ps.* sp. 1 (Pl. 14, Fig. 15), *Planisphinctes* (*P.*) cf. *torrensi* (Pl. 9, Fig. 2), *Procerites* (*P.*) *tmetolobus* (Pl. 10, Fig. 6), *P.* (*Siemiradzkia*) *lenthayensis* (Pl. 10, Fig. 3), *P.* (*S.*) sp. and *Zigzagiceras* (*Z.*) cf. *torrensi* (Pl. 10, Figs 4-5). The zone is characterized by numerous phylloceratid taxa; *Adabofoloceras* is abundant in the Beňatina section (*A.* sp., *A. adabofolense azyense* (Pl. 1, Figs 7-10), *A.* cf. *abichi* (Pl. 1, Fig. 3), *A.* cf. *plicatum* (Pl. 1, Figs 4-5), whereas *Calliphylloceras disputabile* and *Holcophylloceras zigno-*

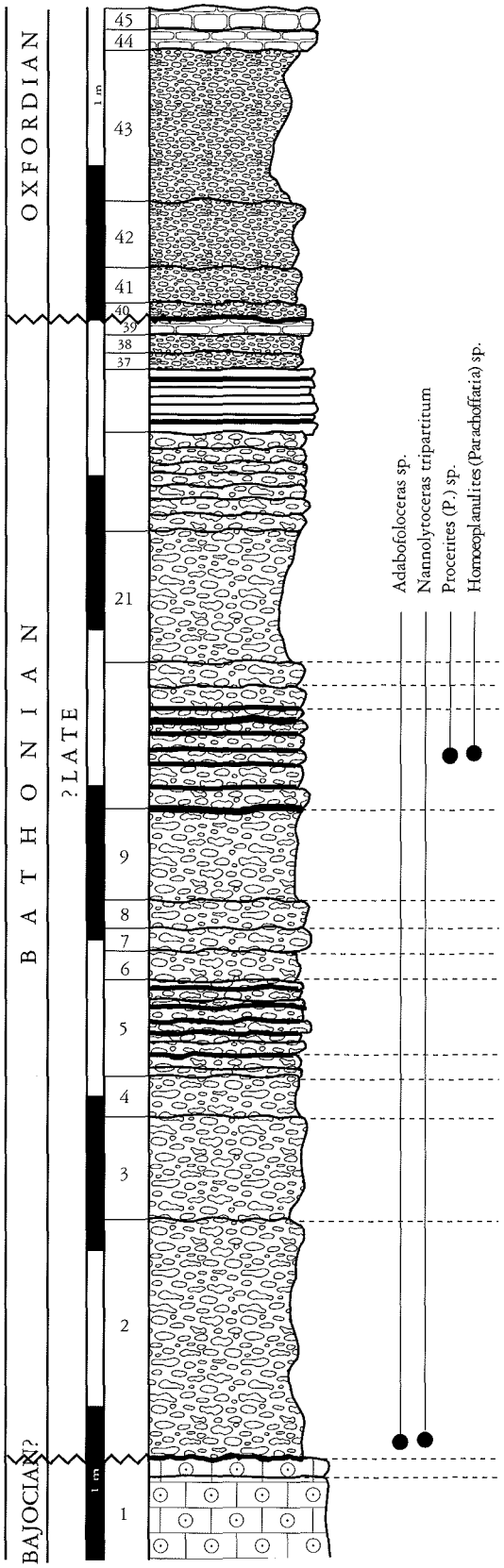

Fig. 6. Kamenica section

dianum dominate in the Vršatec and Dolný Mlyn sections. These are accompanied by *Phylloceras kudernatschi, P. kudernatschi isomorphum, P. kunthi, P. trifoliatum* and *Ptychophylloceras* (*Tatrophylloceras*) cf. *euphyllum.* The documented thickness of the *Zigzag* Zone deposits is at least 300 cm in the Vršatec section, 150 cm in the Dolný Mlyn section and 100 cm in the Beňatina section.

Procerites (Siemiradzkia) aurigerus Zone

The *Asphinctites recinctus* Subzone of the *Aurigerus* Zone was recognized in the Dolný Mlyn section on the basis of specimens of *Asphinctites* (*A.*) *recinctus* (Pl. 14, Fig. 14) and *Polysphinctites polysphinctus* (Pl. 14, Fig. 6) collected from bed 3 (Text-fig. 2). Single specimens of *Oxycerites* cf. *seebachi* (Pl. 5, Fig. 6) and *Cadomites* (*Polyplectites*) *minutus* sp. nov. (Pl. 6, Figs 3-4) were collected from the same level.

Vršatec, condensed Bed 7 (*Zigzag - Aurigerus* Zones)

The upper part of the Lower Bathonian of the Vršatec section (bed 7, see Text-fig. 3) yielded *Ebrayiceras pseudoanceps* (Pl. 14, Fig. 13) associated with numerous phylloceratids (Pl. 1, Fig. 11), *Nannolytoceras tripartitum, Lytoceras adelae* (Pl. 3, Fig. 8), *L.* aff. *adelae, L. eudesianum adeloides, L.* sp. 1 (Pl. 3, Fig. 1), *Lissoceras ventriplanum* (Pl. 5, Fig. 1-2, Pl. 6, Fig. 1, Text-fig. 9A-C), *L. compressus* sp. nov. (Pl. 4, Figs 1-2), *Oxycerites yeovilensis* (Pl. 4. Figs 3-4), *Bullatimorphites* (*B.*) sp. (Pl. 7, Fig. 5), *B.* (*Sphaeroptychius*) sp., *Parkinsonia* (*Gonolkites*) *gyrumbilica* (Pl. 14, Figs 1-2), *Zigzagiceras* (*Procerozigzag*) *postpollubrum* (Pl. 12, Fig. 1), *Procerites* (*P.*) *fowleri* (Pl. 9, Fig. 1), *P.* (*P.*) cf. *imitator, P.* (*P.*) cf. *fullonicus, Procerites* (*P*) *clausiprocerum* (Pl. 12, Fig. 2), *Choffatia* (*C.*) sp. 1 (Pl. 15, Fig. 1), *C.* (*C.*) sp. 2 (Pl. 15, Fig. 2) and *C.* (*Subgrossouvria*) sp. The presence of *Ebrayiceras, P.* (*G.*) *gyrumbilica* and *Z.* (*P.*) *postpollubrum* indicates the upper part of the *Zigzag* Zone, *Morphoceras* (*M.*) *macrescens* Subzone, although the large *Procerites* and the early *Bullatimorphites* are more typical of the overlying *Aurigerus* Zone and the Middle Bathonian *Procerites* (*P.*) *progracilis* Zone. The *Bullatimorphites* resembles *B.* (*B.*) *latecentratus* or *B.* (*B.*) *sofanus*, the former being the oldest representative of the subgenus (*Aurigerus* Zone to the lower part of the *Progracilis* Zone), the latter being restricted to the lower part of the *Progracilis* Zone. *Bullatimorphites* (*B.*) *ymir*, another similar species, has the same stratigraphical range as *B.* (*B.*) *sofanus.* The above-mentioned *Choffatia* are of particular interest because they belong to the oldest members of this taxon so far known (see the chapter on systematic descriptions).

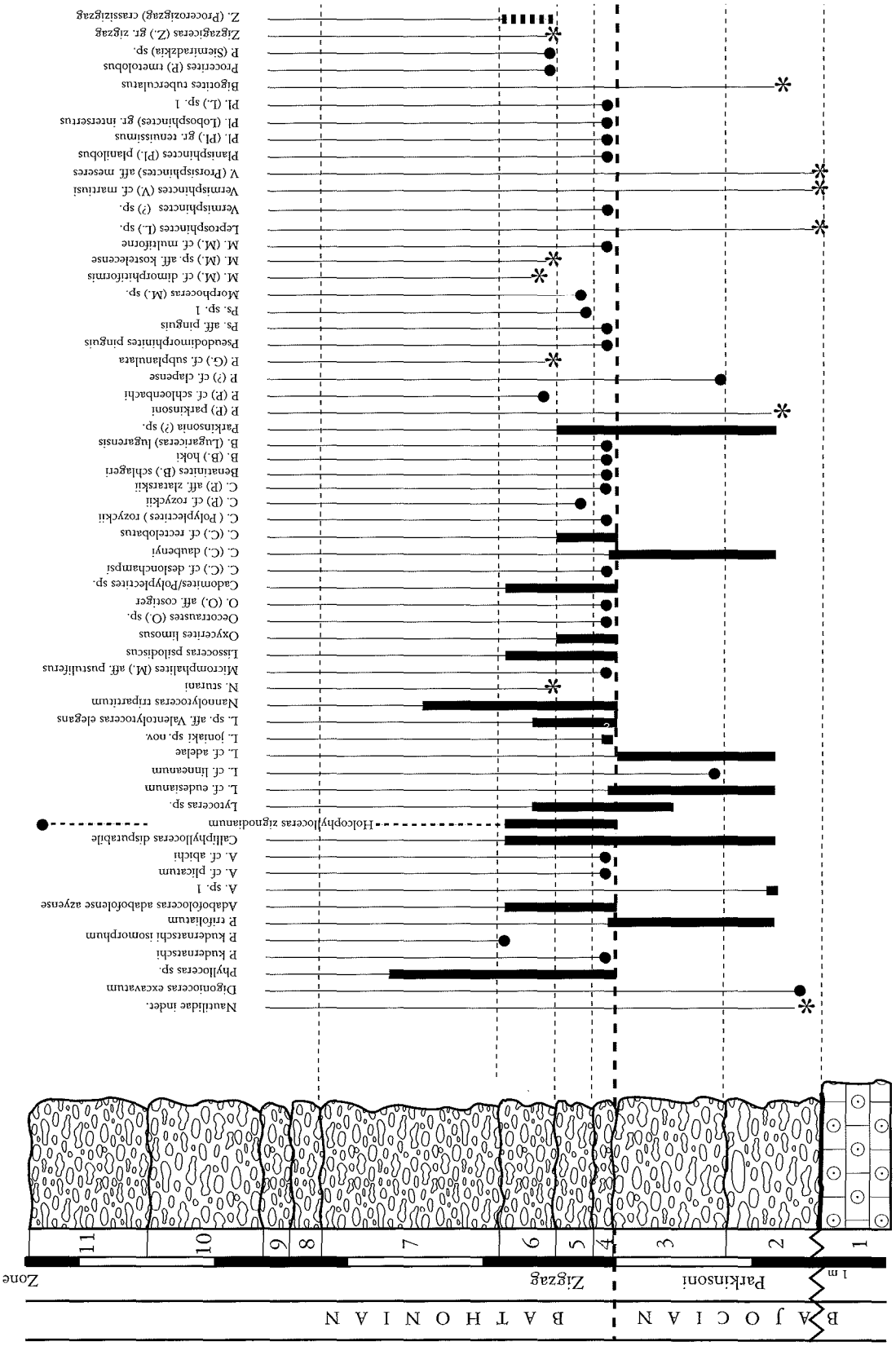

Fig. 7. Beňatina section

Middle and Late Bathonian

No ammonites indicative of the *Procerites* (*P.*) *progracilis*, *Tulites* (*T.*) *subcontractus* and *Morrisiceras* (*M.*) *morrisi* Zones have been found.

It is probable that the uppermost Middle Bathonian or lower Upper Bathonian is present in the Údol section (Text-fig. 5). Bed 4 yielded *Bullatimorphites* (*Sphaeroptychius*) cf. *lucasi* (Pl. 7, Figs 2-4), which, according to MANGOLD & GYGI (1997) ranges from the *Cadomites* (*C.*) *bremeri* Zone to the *Hecticoceras* (*Prohecticoceras*) *blanazense* Subzone of the *Hecticoceras* (*Prohecticoceras*) *retrocostatum* Zone. *Bullatimorphites* (*Kheraiceras*) cf. *hannoveranus* (Pl. 7, Fig. 1) from bed 5, lying directly below the hardground (boundary between the *Bositra* microfacies and the *Globuligerina* microfacies) indicates the *Bullatimorphites* (*Kheraiceras*) *hannoveranus* Subzone of the *Retrocostatum* Zone.

The succeeding bed 6 is already of Early Oxfordian age (Text-fig. 5).

A few large, badly preserved, evolute specimens of *Procerites* close to the morphological group of *P.* (*P.*) *quercinus*, and one very evolute, corroded specimen, belonging probably to *Homoeoplanulites* (*Parachoffatia*) sp., from the lower part of the Kamenica section could also be indicative of the early Late Bathonian (Text-fig. 6).

Early Callovian

The only locality where the Early Callovian has been identified so far is the Jarabina section (for the description see RAKÚS 1990, p. 76). The specimen of *Bullatimorphites* (*Kheraiceras*) reported by RAKÚS (1990) and refigured here belongs to the group of *B.* (*K.*) *bullatus* (Pl. 7, Fig. 6). The same author also described another *B.* (*K.*) *bullatus* from the Ukrainian part of the Pieniny Klippen Belt (RAKÚS 1990, p. 80, pl. 4, fig. 3), but its coiling, with an almost occluded umbilicus and a very large penultimate whorl, shows rather a morphology closer to that of the Late Bathonian *B.* (*K.*) *hannoveranus*.

PALAEOENVIRONMENT AND PALAEOBIOGEOGRAPHY

The quantitative data on the relative abundance of ammonite taxa suggest ecological stability of the Late Bajocian and Early Bajocian environments. Phylloceratina and Lytoceratina dominate throughout the period (Text-fig. 8). Lytoceratina constitute 37% of the whole assemblage in the *Parkinsoni* Zone and 35% in the *Zigzag* Zone. In common with the Phylloceratina they represent more than 50% of the fauna (and more than 60% in bed 7 of the Vršatec section). In general, their distribution is mainly environmentally controlled. Such a high percentage of pelagic groups indicates a moderate to deep-water open-marine environment. *Nannolytoceras,* the most abundant of all the taxa present, was probably an inhabitant of a moderate depth environment (WESTERMANN 1990). Among Phylloceratina, the genera *Phylloceras* and *Calliphylloceras* are considered as inhabitants of deeper-water oceanic environments (WESTERMANN 1990). They prevail (12:1) over the relatively shallower-water *Holcophylloceras* in both the *Parkinsoni* and the *Zigzag*

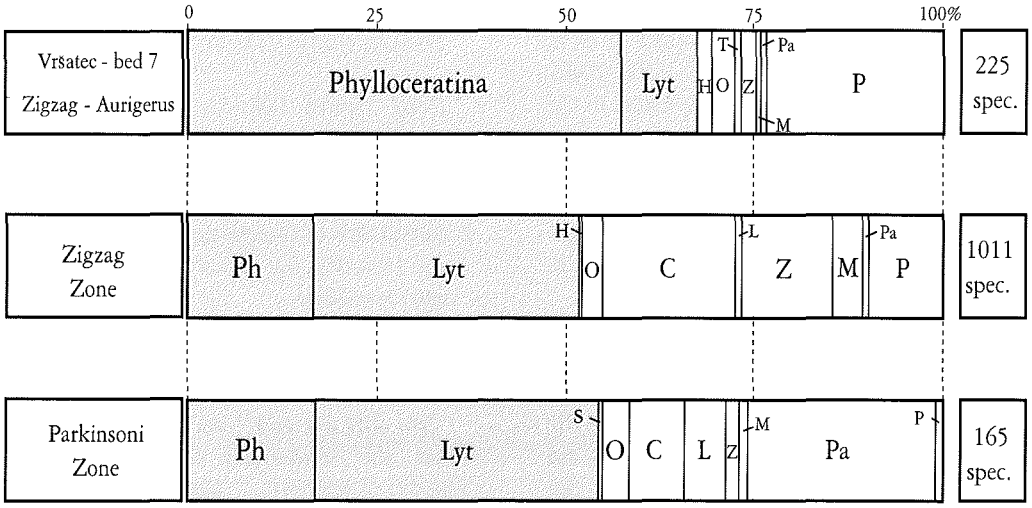

Fig. 8. Relative abundances of ammonite higher taxa from the most fossiliferous parts of the Czorsztyn Unit (cumulative data from all the localities studied). Grey colour indicates pelagic taxa. Ph – Phylloceratina, Lyt – Lytoceratina, S – Strigoceratidae, H – Haploceratidae, O – Oppeliidae, T – Tulitidae, C – Cadomitinae, L – Leptosphinctinae, Z – Zigzagiceratinae, M – Morphoceratidae, Pa – Parkinsoniinae, P – Perisphinctidae

zones. On the other hand the ratio is inverted in bed 7 of the Vršatec section (4:5); however, the reliability of these data is open to question in view of the condensation associated with the fauna.

The position of the Czorsztyn Ridge near the European continental margin during the Middle Jurassic is assumed by many authors (e.g. CSONTOS & VÖRÖS 2004). Recent palaeomagnetic data obtained from the Ukrainian part of the Pieniny Klippen Belt (LEWANDOWSKI & *al.* 2005) indicate a palaeolatitude of 41.5° ± 5°. The whole Late Bajocian to Early Bathonian fauna shows an intermediate character between the Mediterranean and Sub-Mediterranean Provinces. Among the Ammonitina, the palaeobiogeographically widespread genera *Cadomites, Parkinsonia, Planisphinctes, Procerites* and *Morphoceras* prevail. However, on closer inspection, it is seen that there are clear differences between the associations of the *Parkinsoni* Zone and the *Zigzag* Zone. The high abundance of *Parkinsonia* in the *Parkinsoni* Zone is associated with around 50% of Phylloceratina and Lytoceratina (Text-fig. 8). Here, *Parkinsonia* is the most abundant ammonite taxon, constituting around 25% of the whole fauna. In contrast, it becomes very rare (< 1%) in the *Zigzag* Zone, where the Zigzagiceratinae and Cadomitinae are the most common. Although this reduction could be locally influenced by some other factors, it certainly also reflects the natural decline of the Parkinsoniinae during the Early Bathonian.

The surprisingly high percentage of the Cadomitinae (>15%) in the *Zigzag* Zone is caused by an unusual richness of the normally very rare taxon *Benatinites* (Pl. 6, Fig. 17). It is associated with rare, extremely small sized *Lugariceras* (only four specimens, Pl. 6, Fig. 18-21), interpreted as its microconch counterpart (SCHLÖGL & *al.* in press). In this context, it is also interesting to note a relatively high diversity of the microconch *Polyplectites* in the *Zigzag* Zone, represented by numerous small to minute species (Pl. 6). Because of the generally bad state of preservation, they could only partly be described to species level. Similarly various *Polyplectites* assemblages have been reported from Iran (e.g. SEYED EMAMI & *al.* 1985).

The Early Bathonian fauna comprises ammonites of Arabian origin, namely *Micromphalites* (*M.*) aff. *pustuliferus* (Pl. 5, Fig. 8). Their palaeobiogeographical distribution follows an assumed migration corridor along the former South-European margin, linking the Arabian and Sïnai Peninsulas, NW African shelf (Morocco), the Iberian area and going as far as to the Czorsztyn Ridge (Pieniny Klippen Belt). The presence of this taxon is of considerable interest because it constitutes the northernmost Early Bathonian occurrence of the family Clydoniceratidae in the Western Tethys (ENAY & *al.* 2001; SCHLÖGL & RAKÚS 2004).

CONCLUSIONS

The Late Bajocian *Parkinsoni* Zone, the Early Bathonian *Zigzag* and *Aurigerus* Zones and the Late Bathonian *Retrocostatum* Zone could be recognized on the basis of ammonite faunas at several localities in the Czorsztyn Unit, Pieniny Klippen Belt. The Upper Bajocian biostratigraphy is based on the common occurrence of the Parkinsoniinae, whereas that of the Early Bathonian is based mainly on the occurrence of the Morphoceratidae, enabling correlation with both the NW European Province and the Sub-Mediterranean Province.

The fauna is obviously intermediate in character. The composition of the Late Bajocian and Early Bathonian ammonite faunas shows several important features. The typical Mediterranean groups, such as the Phylloceratina and Lytoceratina, predominate in both intervals. They are associated with a high percentage of Parkinsoniinae, Morphoceratidae and Zigzagiceratinae (mainly *Planisphinctes*), taxa that are normally scarce or absent in the Mediterranean Province, but abundant in the Sub-Mediterranean and NW-European Provinces. These features indicate the strong affinity of the fauna to that of the Sub-Mediterranean Province.

The ammonite fauna of the Late Bajocian *Parkinsoni* Zone of the study area shows the following characteristics:

1. Around 50% of the fauna is represented by Phylloceratina and Lytoceratina.
2. Abundance of *Parkinsonia,* common Cadomitinae and rare Oppeliidae (Text-fig. 8).

The typical features of the Early Bathonian ammonite faunal associations are as follows:

1. Around 50% of the fauna is represented by Phylloceratina and Lytoceratina.
2. Abundance of *Cadomites, Morphoceras, Planisphinctes* and *Procerites*, but scarcity of *Parkinsonia, Zigzagiceras* and Oppeliidae.
3. Presence of *Micromphalites,* an ammonite taxon of Arabian origin

The Middle and Late Bathonian ammonites are scarce; the Ammonitina consist almost exclusively of Tulitidae (*Kheraiceras, Sphaeroptychius*).

Three new species are proposed, *Lytoceras joniaki*, *Lissoceras compressus* and *Cadomites* (*Polyplectites*) *minutus*.

SYSTEMATIC DESCRIPTIONS

Because the complete list of the fauna comprises too many taxa, we decided to focus this chapter only on those which are new or rare; or possibly new, but the state of the material available is insufficient for their description. Except for the type material and the specimens already described by RAKÚS (1990), the entire material is housed in the Department of Geology and Paleontology, Comenius University in Bratislava (coll. SCHLÖGL). The holotypes, paratypes and the material of RAKÚS are housed in the Slovak National Museum in Bratislava (SNM Z).

Suborder Phylloceratina ARKELL, 1950
Family Phylloceratidae ZITTEL, 1884
Subfamily Phylloceratinae ZITTEL, 1884
Genus *Adabofoloceras* JOLY, 1977

Adabofoloceras sp. 1
(Text-fig. 12D, Pl. 1, Figs 1-2)

MATERIAL: Five more or less fragmentary internal moulds.

	D	H	E	O	O/D(%)	E/H
Pl. 1, Fig. 1-2	61.6	37	23.6	4	6.5	0.6

DESCRIPTION: Involute form with a very narrow umbilicus and a high-oval whorl section (Text-fig. 12D). The maximum whorl width is near mid-flank. The flanks are only slightly convex, almost flat. The venter is regularly rounded. Strong, prorsiradiate ribs arise on the upper half of the flanks and become more pronounced along the siphonal line. There are 22 ribs per half-whorl at 43 mm diameter and 26 at 60 mm.

REMARKS: The taxon is very close to *A. adabofolense* COLLIGNON (1958, pl. 12, fig. 63), but differs in having a more compressed whorl, slightly different whorl section, and also in ornamentation, which is largely restricted to the ventrolateral margin and venter. *A. adabofolense azyense* JOLY has a different whorl section and the maximum whorl width is closer to the ventrolateral margin. From a morphological point of view, this character places *Adabofoloceras* sp. 1 between *A. adabofolense* and *A. adabofolense azyense*, a taxon of the *Zigzag* Zone in France (Text-fig. 12A-C, see also JOLY 2000).

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Late Bajocian, *Parkinsoni* Zone, Beňatina and Dolný Mlyn, Slovakia

Suborder Lytoceratina HYATT, 1889
Superfamily Lytocerataceae NEUMAYR, 1875
Family Lytoceratidae, NEUMAYR, 1875
Subfamily Lytoceratinae NEUMAYR, 1875
Genus *Lytoceras* SUESS, 1865

Lytoceras joniaki sp.nov.
(Text-fig. 12E, Pl. 2, Figs 1-4, 9)

?1958. *Dinolytoceras zhivagoi* sp. n. (*pars*); BEZNOSOV, p. 86, pl. 23, fig. 1, 2 only.
1990. *Lytoceras adelae* (D'ORBIGNY, 1844); RAKÚS, p. 88, pl. 3, fig. 2, text-fig. 6e
?1994. *Lytoceras polyanchomenum* GEMMELLARO; GALÁCZ, p. 139, pl. 1, fig. 2

MATERIAL: Three almost complete adult specimens, nine fragments of internal moulds

HOLOTYPE: Pl. 2, Fig. 3-4, Text-fig. 12E (Slovak National Museum, SNM Z 24 166)

PARATYPE: Pl. 2, Fig. 1 (SNM Z 20 676), Pl. 2, Fig. 9 (SNM Z 24 167)

LOCUS TYPICUS: Beňatina, Pieniny Klippen Belt, East Slovakia

STRATUM TYPICUM: Czorsztyn Limestone Formation (*Zigzag* Zone)

DERIVATIO NOMINIS: After Dr. PETER JONIAK, an enthusiastic young Slovak palaeontologist

DIAGNOSIS: Relatively small lytoceratid with circular whorl section, fine ornamentation on body chamber and numerous pronounced constrictions. Suture line typically lytoceratid and very complicated. Peristome probably simple with deep peristomal constriction.

DESCRIPTION: All the material is more or less deformed and thus not measurable. The holotype and paratypes are adult or almost adult, and the final diameter can be estimated at around 85 mm. The whorl section is circular or subcircular throughout ontogeny. There are six or more relatively wide, shallow constrictions per whorl. Except for the constrictions, the internal mould of the phragmocone is smooth; the ornamentation appears at the beginning of the adult body chamber. It consists of numerous bifurcate ribs that arise on the umbilical wall. They are concave near the umbilical edge and then become stronger and prorsiradiate. The point of bifurca-

tion is situated just above the umbilical edge. The innermost whorls are not preserved. Partially preserved peristomes on the paratype specimens show a deep peristomal constriction.

REMARKS: Some of the specimens described were previously assigned to the species *L. polyanchomenum* GEMMELLARO (SCHLÖGL 2002), which is considered here to be morphologically closest to the new species. The revision of GEMMELLARO's original material (GALÁCZ 2002) enables us to verify the former determination. The two specimens which served as originals for GEMMELLARO's drawings are relatively small *Lytoceras* with a compressed oval whorl section throughout ontogeny, flat flanks on the body chamber, fine costulation and a very simple suture line. *L. joniaki* differs in its circular whorl section, more numerous and more pronounced constrictions, bifurcate ribs and complicated lytoceratid suture line.

Two specimens of *D. zhivagoi*, described and figured by BEZNOSOV (1958, pl. 23, figs 1, 2) differ from the type specimen of the species in their general morphology and ornamentation (BEZNOSOV 1958, pl. 22, fig. 1), which are reminiscent of those of *L. joniaki*. They are probably conspecific. The holotype of *D. zhivagoi*, in contrast, bears more robust ribbing and there are rib-like elevations in the middle of each constriction.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Early Bathonian, *Zigzag* Zone, Beňatina and Vršatec, Slovakia; and probably also Early Bathonian of the Mecsek Mts., Hungary, and Late Bajocian of the Caucasus.

Order Ammonitina HYATT, 1889
Family Haploceratidae ZITTEL, 1884
Genus *Lissoceras* BAYLE, 1879

Lissoceras compressus sp. nov.
(Pl. 4, Figs 1-2, Text-fig. 9D)

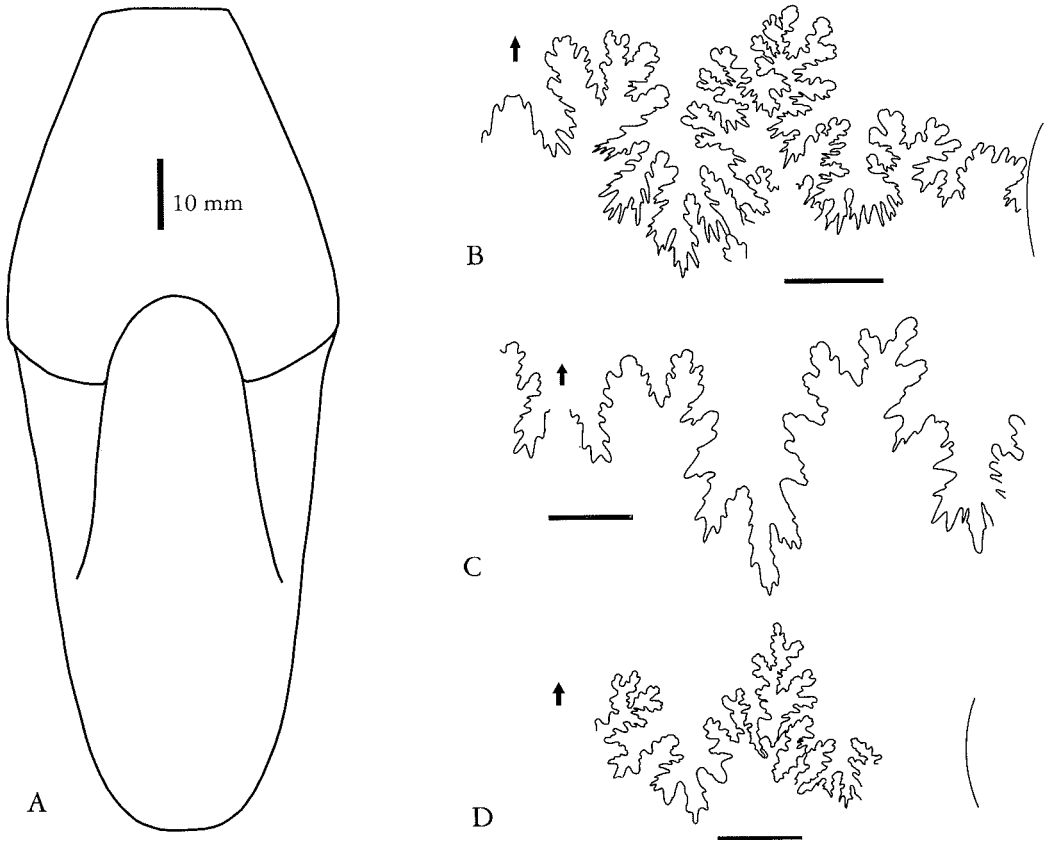

Fig. 9. A-C. *Lissoceras ventriplanum* WENDT, 1963. A. section. B. suture line, D = 83 mm. C. slightly corroded suture line at D = 91 mm. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone. D. *Lissoceras compressus* sp. nov., holotype suture line at H = 42 mm (SNM Z 24 169), Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone. Scale 10 mm

MATERIAL: An internal mould of an adult specimen, still partially covered with recrystallized shell

	D	H	E	O	O/D(%)	E/H
Pl. 4, Figs 1-2						
SNM Z 24 169	13.4	6.2	4	3.05	22.7	0.65

HOLOTYPE: Pl. 4, Figs 1-2 (Slovak National Museum, SNM Z 24 169)

LOCUS TYPICUS: Vršatec, Pieniny Klippen Belt, West Slovakia

STRATUM TYPICUM: Czorsztyn Limestone Formation (Early Bathonian, *Zigzag* Zone or *Aurigerus* Zone)

DERIVATIO NOMINIS: After the laterally compressed whorl section, *compressus* (Lat.) = laterally flattened

DIAGNOSIS: Large *Lissoceras* with compressed whorl section, narrow and highly arched venter and typical lissoceratid suture line.

DESCRIPTION: The taxon is characterized by its large size (at least 150 mm). The whorl section is high-oval, with the maximum whorl width near one-third of the whorl height. The umbilical wall is low, almost vertical or very steep with a regularly rounded edge. The flanks are only slightly convex; the venter is narrow and highly arched. The shell is totally smooth. The type of aperture is unknown, but is probably simple. The suture line is relatively well divided, similar to that of *L. psilodiscus* (SCHLOENBACH) (see e.g. GALÁCZ 1980, text-fig. 45), but only a part of S1, S2 and L1 can be seen (Text-fig. 9D).

REMARKS: There are two similarly large Early Bathonian *Lissoceras*: *L. ventriplanum* WENDT and *L. magnum* GALÁCZ. The holotype of *Lissoceras ventriplanum* (WENDT 1963, pl. 17, fig. 4) from the Bathonian of Sicily is incomplete; the adult size of this taxon can reach at least 140 mm (estimated from a deformed specimen collected from the same bed as *L. compressus* in the Vršatec section, see also SANDOVAL 1986). It differs in considerably broader whorls and in the trapezoidal whorl section of the adult body chamber. *Lissoceras magnum* (GALÁCZ 1980, pl. 12) differs mainly in the broader whorl section. The suture lines of the three above-mentioned species show the same disposition and complexity (for the suture line of *L. ventriplanum,* see Text-fig. 9B-C). The systematic position of other contemporaneous species, such as *L. monachum* (GEMMELLARO) and *L. ferrifex* (ZITTEL) has already been discussed by GALÁCZ (1980, p. 59), SANDOVAL (1986, p. 442) and more recently by PAVIA (2002). Unfortunately, the type material of these taxa is badly preserved or juvenile. This is particularly the case with *L. monachum*, the holotype of which is a poorly preserved juvenile specimen, closely comparable with the inner whorls of *L. magnum* or *L. ventriplanum.* As already noted by PAVIA (2002, p. 202), without a new topotype material the taxonomic position of these taxa is difficult to clear up.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: *Zigzag* Zone or *Aurigerus* Zone, Vršatec, bed 7, Slovakia

Family Oppeliidae DOUVILLÉ, 1890
Subfamily Oppeliinae DOUVILLÉ, 1890
Genus *Oecotraustes* WAAGEN, 1869
Subgenus *Oecotraustes* WAAGEN, 1869

Oecotraustes (*O.*) aff. *costiger* BUCKMAN, 1905
(Pl. 3, Figs 5, 9-10)

MATERIAL: Two fragmentary and partly deformed specimens

	D	H	E	O	O/D(%)	E/H
Pl. 3, Fig. 5	31	11.4		7	22.6	

DESCRIPTION: A relatively strongly ornamented *Oecotraustes* with a compressed whorl section, almost flat flanks and a fastigate venter. The umbilical wall is low and steep, with a rounded umbilical edge. The ribs are densely spaced, falcate and attenuated in the middle of the flanks. The ribs on the inner half of the whorls are weaker and prorsiradiate, but are rursiradiate and sometimes bifurcate on the upper half. On the ventrolateral margin they are sharply curved adorally, each one being surmounted by a small tubercle. The venter is keeled.

REMARKS: We agree with the opinion (STEPHANOV 1966) that *O.* (*O.*) *costiger* occupies a somewhat special place within the genus. Its type of ribbing, with a feeble spiral groove, suggests its close affinity to the subgenus *Paroecotraustes.* Apart from some small morphological details, both the type specimen and the material of STEPHANOV (1966, pl. 1, figs 5-7) differ from our material in the lower stratigraphical position, which was confirmed to be Late Bajocian (*Parkinsoni* Zone, *Bomfordi* Subzone). Our material is associated with taxa typical of the Early Bathonian *Zigzag* Zone

STRATIGRAPHICAL AND GEOGRAPHICAL DIS-

TRIBUTION: Early Bathonian, *Zigzag* Zone, Beňatina, Slovakia

Superfamily Stephanocerataceae NEUMAYR, 1875
Family Stephanoceratidae NEUMAYR, 1875
Subfamily Cadomitinae WESTERMANN, 1956
Genus *Cadomites* MUNIER-CHALMAS, 1892
Subgenus *Polyplectites* MASCKE, 1907

Cadomites (*Polyplectites*) sp. 1 aff. *dorni* (ROCHÉ 1939)
(Pl. 6, Figs 15-16, Text-fig. 12G)

MATERIAL: One fragment of an internal mould of an adult specimen with body chamber

	D	H	E	O	O/D(%)	E/H
Pl. 6, Fig. 15-16	45.2	14.6	21.6	19	42	1.48

DESCRIPTION: A medium-sized, moderately evolute *Polyplectites* with a depressed oval whorl section (Text-fig. 12G). The venter is broad and regularly arched. Numerous short, slightly prorsiradiate ribs arise near the umbilical line and branch below mid-flank into two to five fine secondary ribs. The number of secondaries per primary rib decreases towards the aperture. The peristome is not preserved. The body chamber occupies two-thirds of the last whorl.

REMARKS: It is close to *C.* (*P.*) *dorni* (ROCHÉ) but the furcation point is lower on the flanks, the venter is more arched and the secondary ribs are more numerous. Another similar taxon, *C.* (*P.*) *bajocensis* (GROSSOUVRE 1930, pl. 40, fig. 8), is smaller and more involute, with concave ribs.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Early Bathonian, *Zigzag* Zone, Vršatec, Slovakia

Cadomites (*Polyplectites*) *minutus* sp. nov.
(Pl. 6, Figs 3-7, Text-fig. 10A-B, 12H)

MATERIAL: Internal moulds of two adult specimens with peristomes

	D	H	E	O	O/D(%)	E/H
Pl. 6, Figs 3-4						
Holotype SNM Z 24 170	17.3	5.6	8	7.8	45.1	1.43
Pl. 6, Figs 5-7						
Paratype SNM Z 24 171	17.8	5.3	7.4	7.3	41	1.4

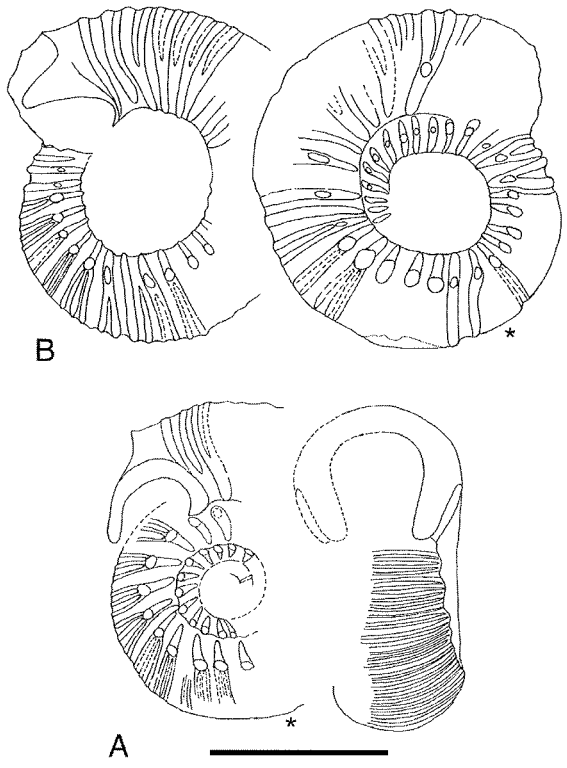

Fig. 10. *Cadomites (Polyplectites) minutus* sp. nov. A. holotype (SNM Z 24 170), Dolný Mlyn, *Aurigerus* Zone. B. paratype (SNM Z 24 171), Vršatec, bed 4, *Zigzag* Zone. Scale 10 mm

HOLOTYPE: Pl. 6, Figs 3-4, Text-fig. 10A, 12H (SNM Z 24 170)

PARATYPE: Pl. 6, Figs 5-7, Text-fig. 10B (SNM Z 24 171)

LOCUS TYPICUS: Dolný Mlyn, Pieniny Klippen Belt, West Slovakia

STRATUM TYPICUM: Czorsztyn Limestone Formation (Early Bathonian, *Zigzag* and *Aurigerus* Zones)

DERIVATIO NOMINIS: The name is derived from the diminutive size of the taxon

DIAGNOSIS: *Polyplectites* characterized by its diminutive size, broad trapezoidal whorl section, dense primary and secondary ribbing, and peristome bearing lateral lappets

DESCRIPTION: A diminutive *Polyplectites* with relatively evolute coiling, broad trapezoidal whorl section and dense, prorsiradiate, slightly irregular primary ribs. These

terminate in small tubercles and branch into four to six secondary ribs. There is one pronounced, narrow constriction on the last whorl. The body chamber occupies 270° of the last whorl. The peristome bears long and narrow lateral lappets.

REMARKS: The taxon is characterized by its very small size. The only similarly-sized taxon is *C. (P.) gracilis* WESTERMANN (1954, pl. 32, fig. 5) from Calvados in France, but this shows a different morphology, especially concerning the more involute coiling, the whorl section and the denser ornamentation. The ammonite figured by SCHAIRER (1989, pl. 1, fig. 8) from Sengenthal, Germany, is almost identical, but it is nearly twice the size and shows regular primary ribbing, in contrast to the slightly irregular primary ribbing in our specimens. Moreover the German specimen is stratigraphically older, having been collected from the Late Bajocian *Parkinsoni* Zone.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Early Bathonian, *Zigzag* Zone, Vršatec, and *Aurigerus* Zone, Dolný Mlyn, Slovakia

Genus *Benatinites* SCHLÖGL & *al.*, in press
Subgenus *Lugariceras* SCHLÖGL & *al.*, in press
Benatinites (Lugariceras) lugarensis SCHLÖGL & *al.*, in press
(Pl. 6, Figs 18-21 Text-fig. 11)

MATERIAL: Four internal casts of adult specimens, one of them complete with aperture

	D	H	E	O	O/D(%)	E/H
Pl. 6, Fig. 18-19	12.5	3.6	5	5.7	45.6	1.39
Pl. 6, Fig. 20-21	11.2	3.4	4.7	4.9	43.75	1.38

DESCRIPTION: A minute and evolutely coiled ammonite with a subquadrate whorl section. The maximum whorl width is situated at mid-flank. The primary ribs are radiate or slightly concave and almost all of the same thickness. They end in small tubercles from which one or two secondary ribs branch. These are interrupted mid-ventrally throughout ontogeny. Near the ventral line, the secondaries terminate in small tubercles. The adult body chamber occupies around 240° of the last whorl. The aperture bears small lateral lappets and a ventral visor-like collar.

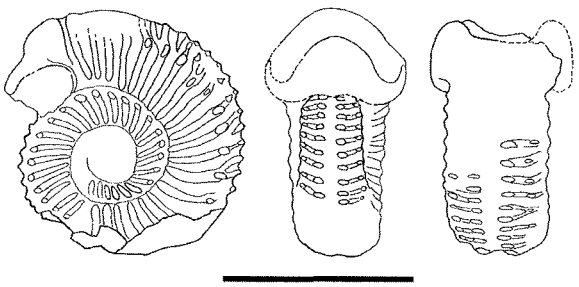

Fig. 11. *Benatinites (Lugariceras) lugarensis* (SCHLÖGL & *al.* in press), Beňatina, *Zigzag* Zone. Scale 10 mm

REMARKS: *Benatinites* (*Lugariceras*) represents probably the microconch counterpart of *Benatinites* (*Benatinites*). Both taxa are described and discussed in detail by SCHLÖGL & *al.* (in press).

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Early Bathonian, *Zigzag* Zone, Beňatina and Vršatec sections, Slovakia. *Zigzag* Zone of northeastern Morocco, *Zigzag* Zone, *Macrescens* Subzone of Subbetic (Spain).

Family Perisphinctidae STEINMAN, 1890
Subfamily Leptosphinctinae ARKELL, 1950
Genus *Vermisphinctes* BUCKMAN, 1920
Subgenus *Prorsisphinctes* BUCKMAN, 1920
Vermisphinctes (Prorsisphinctes) aff. *meseres* BUCKMAN, 1927 non 1923
(Pl. 8, Figs 1-2 Text-fig. 12K)

MATERIAL: Five more or less complete specimens with at least partially preserved body chamber, two of them still with recrystallized shell.

DESCRIPTION: A large and evolute form with a broad and shallow umbilicus. The whorl section of the phragmocone is depressed-oval with the maximum width in the middle of the whorl height, the flanks are convex. The venter is large and moderately arched. The whorl section changes at the end of the phragmocone, where it is almost circular, but becomes high-oval with slightly convex flanks and a highly arched venter on the body chamber. The umbilical wall is relatively high and steep with a rounded umbilical edge. The ornamentation consists of long radiate to slightly prorsiradiate primary ribs which bifurcate at approximately two-thirds of the whorl height. The secondary ribs are prorsiradiate and cross the venter without interruption. The number of primary ribs per whorl increases from 40 to 44 in the last four ornamented whorls. There are two prorsiradiate constrictions parallel to the ribbing per whorl. These weaken on the body chamber. The ornamentation attenuates about a half-

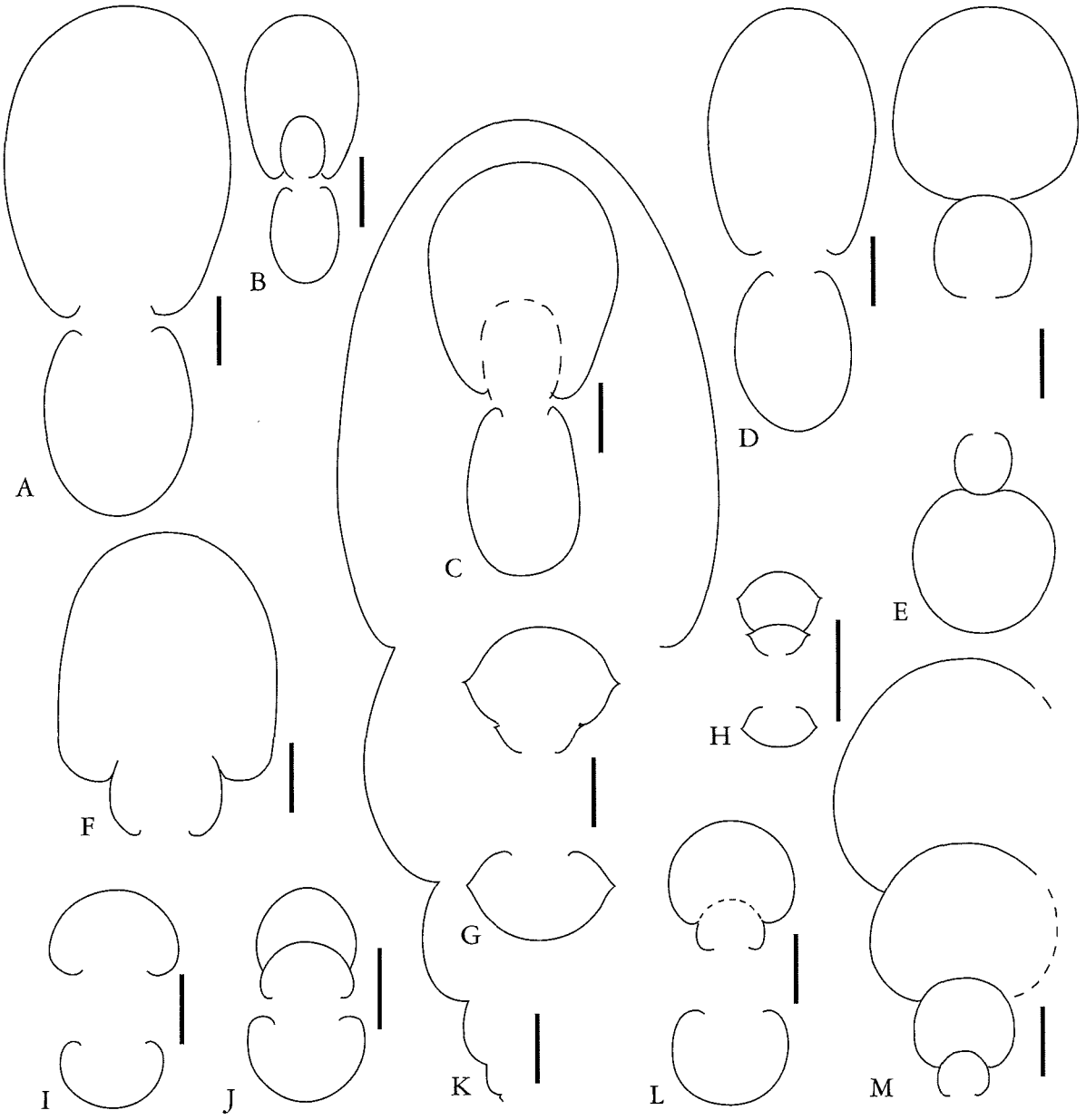

Fig. 12. A-C. *Adabofoloceras adabofolense azyense* JOLY, 2000. Beňatina, *Zigzag* Zone. D. *Adabofoloceras* sp. 1. Beňatina, *Parkinsoni* Zone. E. *Lytoceras joniaki* sp. nov. Beňatina, *Zigzag* Zone, Holotype, SNM Z 24 166. F. *Lytoceras* sp. 1. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone. G. *Cadomites* (*Polyplectites*) sp. 1 aff. *dorni* (ROCHÉ 1939). Vršatec, *Zigzag* Zone. H. *Cadomites* (*Polyplectites*) *minutus* sp. nov. Dolný Mlyn, *Aurigerus* Zone, Holotype, SNM Z 24 170. I. *Pseudodimorphinites pinguis* (DE GROSSOUVRE, 1919). Beňatina, *Zigzag* Zone. J. *Morphoceras* (*Morphoceras*) sp. aff. *kostelecense* RAKÚS, 1965, Beňatina, *Zigzag* Zone. K. *Vermisphinctes* (*Prorsisphinctes*) aff. *meseres* BUCKMAN, 1927 *non* 1923. Beňatina, *Parkinsoni* Zone. L. *Pseudodimorphinites* aff. *pinguis* (DE GROSSOUVRE, 1919). Beňatina, *Zigzag* Zone. M. *Choffatia* (*C.*) sp. 1. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone. Scale 10 mm

whorl before the end of the phragmocone. The body chamber is totally smooth. Due to the preservation of the recrystallized shell the suture-line is not visible.

REMARKS: The phragmocone morphology of this large perisphinctid ammonite is closely comparable with that of *P. meseres* (BUCKMAN 1927, non 1923), differing only in the type of ribbing, which is more prorsiradiate in BUCKMAN's specimen. The body chamber is not preserved, thus making impossible comparison of the adult whorl section of these two ammonites. As has been already stated by GALÁCZ (1980, p. 110), the second specimen figured by BUCKMAN under the name *P. meseres* (BUCKMAN 1927, fig. 446A-B) differs from the holotype

(BUCKMAN 1923, fig. 446) in having more widely spaced and sharper ribbing, greater size and more robust whorls (thus probably not conspecific).

V. (*P.*) *martiusi* (D'ORBIGNY) is more densely ribbed, the constrictions are more numerous and the whorl section is more compressed. *V.* (*P.*) *limnioticus* BUCKMAN bears stronger and more widely spaced ribs on both the phragmocone and body chamber.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Late Bajocian, probably lower part of the *Parkinsoni* Zone, Vršatec and Beňatina sections, Slovakia.

Subfamily Grossouvriinae SPATH, 1931
Genus *Choffatia* SIEMIRADZKI, 1898
Subgenus *Choffatia* SIEMIRADZKI, 1898

Choffatia (*C.*) sp. 1
(Pl. 15, Fig. 1, Text-fig. 12M)

MATERIAL: One incomplete internal cast with part of the body chamber

DESCRIPTION: An evolute ammonite with an oval, slightly depressed whorl section. The maximum whorl width is near mid-flank. The umbilical wall is steep and low, with a rounded edge. The whorls bear pronounced primary and secondary ribs with one shallow and wide constriction per half-whorl. Slightly rursiradiate primary ribs arise on the umbilical edge. They are finer and more densely spaced on the innermost preserved whorl but soon become strong and distant. They branch near two-thirds of the whorl height. Numerous intercalatory ribs are also present. All the secondary ribs on the last preserved whorl are of similar thickness.

REMARKS: According to MANGOLD (1970), the first *Subgrossouvria-Choffatia* appear in the Middle or earliest Late Bathonian (*Blanazense* Zone), and they already show a morphology resembling that of their Callovian descendants. Up to now the earliest *Choffatia* have been documented from the upper part of the *Zigzag* Zone. GALÁCZ (1980) mentions (but without illustration) *Choffatia* (*Subgrossouvria*) sp. aff. *rakotondramazavai* (COLLIGNON) from the *Zigzag* Zone of the Bakony Mts., Hungary; WARMAN & ARKELL (1954) reported *Choffatia* aff. *uriniacensis* (LISSAJOUS) among an ammonite association composed of Early Bathonian taxa from Monte Inici in Sicily. SANDOVAL (1983) described *C.* (*S.*) *uriniacensis*. from the late Early Bathonian and early Middle Bathonian deposits of the Betic Cordillera, Spain. Although our specimen generally resembles the strongly ornamented Middle Bathonian and Callovian forms such as *C.* (*S.*) *rakotondramazavai* (see SANDOVAL 1983, *non* COLLIGNON 1958), *C.* (*S.*) *gudjinsirensis* (WAAGEN), *C.* (*C.*) *transitoria* SPATH and *C.* (*C.*) *soorkaensis* SPATH, it differs from these in its very evolute coiling and in the robust and distant ribbing beginning on the innermost whorls. The specimen was collected from bed 7 of the Vršatec section. This bed yielded a condensed ammonite association comprising taxa from the upper *Zigzag* and *Aurigerus* Zones. The specimen described here thus ranks among the earliest representatives of the genus.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: *Zigzag* Zone or *Aurigerus* Zone, Vršatec section, bed 7, Slovakia.

Choffatia (*C.*) sp. 2
(Pl. 15, Fig. 2)

MATERIAL: One internal cast representing a complete phragmocone

DESCRIPTION: Similar coiling and whorl section as the previous species. The umbilical wall is low and steep. The ornamentation consists of dense radiate primary ribs that appear on the rounded umbilical edge and bifurcate between the middle and two-thirds of the whorl height. The secondaries are strong and slightly prorsiradiate. The constrictions are relatively shallow and also prorsiradiate, but their total number is not known due to the bad preservation of the specimen.

REMARKS: the specimen shows the same morphology as many other Middle and Late Bathonian species [e.g. *C.* (*C.*) *subbakeriae* (D'ORBIGNY) or *C.* (*S.*) *cerealis* ARKELL], from which it differs in its older stratigraphical position. INNOCENTI (1976, pl. 5, fig. 1; pl. 10, fig. 2) figured two medium-sized *Subgrossouvria* from the *Asphinctites tenuiplicatus* Zone of the late Early Bathonian from the vicinity of Castellane (France). The inner whorls bear dense prorsiradiate primaries, which become more widely spaced in the outer whorls. The venter is large and rounded. Based on the very similar coiling, whorl section and ornamentation, they could probably belong to the same morpho-group, possibly representing the microconch counterpart of our taxon.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: *Zigzag* Zone or *Aurigerus* Zone, Vršatec section, bed 7, Slovakia

Family Morphoceratidae HYATT, 1900
Genus *Pseudodimorphinites* SEYED-EMAMI, 1989

Pseudodimorphinites pinguis (DE GROSSOUVRE, 1919)
(Pl. 14, Figs 7-10, Text-fig. 12I)

1919. *Morphoceras pingue* n. sp.; DE GROSSOUVRE, p. 391, pl. 14, fig. 7 a, b
1955. *Morphoceras pingue* DE GROSSOUVRE; ARKELL (1951-59), p. 135, text-fig. 49
1966. *Morphoceras* (or *Asphinctites*) *pingue* DE GROSSOUVRE; STURANI, p. 37, text-fig. 37
1970. *Asphinctites pinguis* (DE GROSSOUVRE); MANGOLD, p. 111, pl. 3, fig. 13-14
*non*1972. *Asphinctites* (*Asphinctites*) *pinguis* (DE GROSSOUVRE); KRYSTYN, p. 264, pl. 8, fig. 3
1977. *Asphinctites pinguis* (DE GROSSOUVRE); LINARES & *al.*, p. 259, pl. 1, fig. 2
1983. *Asphinctites* (*Asphinctites*) *pinguis* (DE GROSSOUVRE, 1919); SANDOVAL, p. 358, pl. 28, fig. 3, 5, text-fig. 112U,V, 113I
?1985. *Morphoceras pingue* GROSSOUVRE; ROSTOVTSEV, p. 161, pl. 44, fig. 5, 6
1987. *Asphinctites pinguis* (DE GROSSOUVRE); TORRENS, pl. 2, fig. 1-4
?1991. *Pseudodimorphinites pinguis* (GROSSOUVRE); SEYED-EMAMI & *al.*, p. 73, pl. 4, fig. 11
?1994. *Asphinctites pinguis* DE GROSSOUVRE; SANDOVAL, pl. 2, fig. 10
1999. *Asphinctites pinguis* (DE GROSSOUVRE, 1919); GALÁCZ, p. 159, pl. 2, fig. 4
1999. *Asphinctites* sp. aff. *pinguis* (DE GROSSOUVRE, 1919); GALÁCZ, p. 160, pl. 2, fig. 5

MATERIAL: Internal moulds of 30 incomplete specimens

D	H	E	O	O/D(%)	E/H
31.4	11.8	18.4	9.2	29.3	1.56
35	14.4		9.6	27.4	
26.3	10.7	14.8	8.7	33.1	1.38
25.6	10.1		8,7	37.9	
29	11.2		9	31	
24.5	9.8	13.7	8.1	33.1	1.4

DESCRIPTION: The species typically lacks the morphoceratid ontogenic stage (MANGOLD, 1997). Up to 35-38 mm diameter, it is regularly involutely coiled, with a relatively narrow and deep umbilicus; the coiling then becomes evolute and the umbilicus widens rapidly. The penultimate whorl is very broad, with markedly convex flanks and a broad, regularly arched venter. The umbilical wall is rounded. The rectiradiate primary ribs arise on the upper part of the umbilical wall. Generally they bifurcate, but simple ribs are also present. The point of division is situated in the lower half of the flanks. There are numerous intercalatory ribs, appearing between one third and two-thirds of the whorl height. The secondary ribs cross the venter without interruption or attenuation. Two or three strong, prorsiradiate constrictions are already present at a diameter of 12 mm, but information regarding the presence of contrictions at smaller diameters is not available since the earlier whorls are not preserved in the material studied. The body chamber occupies at least one whorl.

REMARKS: Although the more evolute coiling, as well as the uninterrupted secondary ribs, suggest its close affinity to the genus *Asphinctites,* we agree with MANGOLD (1970), who considered *Pseudodimorphinites pinguis* to be the oldest representative of the *Pseudodimorphinites – Asphinctites* evolutionary lineage.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: It already appears in the *Morphoceras* (*M.*) *parvum* Subzone, although similar (?homeomorphic) forms were described from the *Oxycerites yeovilensis* Zone. It is known from the *Parkinsonia* (*Gonolkites*) *convergens* Zone of Cap Mondego in Portugal (MANGOLD 1970) and from the lower part of the *Macrescens* Subzone of the Betic in Spain (SANDOVAL 1983). STURANI (1966) and TORRENS (1987) figured similar forms from the *Yeovilensis* Subzone of the Bas Auran section, France. In the Western Carpathians, it occurs in the Early Bathonian, *Zigzag* Zone of the Beňatina section, Slovakia

Pseudodimorphinites aff. *pinguis* (DE GROSSOUVRE, 1919)
(Pl. 14, Fig. 11, Text-fig. 12L)

MATERIAL: One internal mould, probably representing a complete phragmocone

	D	H	E	O	O/D(%)	E/H
Pl. 14, Fig. 11	41.1	14.1	21.6	9.4	22.9	

DESCRIPTION AND REMARKS: Except some small differences in ornamentation, this specimen is identical with the preceding taxon. The main difference is in the type of the ribbing, which is much finer and more densely spaced. The primary ribs are simple or bifurcated. The point of bifurcation is situated in mid-flank. Intercalatory ribs are rare.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Early Bathonian, *Zigzag* Zone, Beňatina section, Slovakia.

Pseudodimorphinites sp. 1
(Pl. 14, Fig. 15)

MATERIAL: An internal mould of an adult specimen

	D	H	E	O	O/D(%)	E/H
Pl. 11, Fig. 15	44.3	10.4		24	54.2	

DESCRIPTION: A relatively small *Pseudodimorphinites* with a subcircular whorl section, low and vertical umbilical wall and slightly convex flanks. The ornamentation consists of short radiate primary ribs, bifurcating on the inner half of the flanks. Some intercalatory ribs are also present. The ribs pass over the venter without interruption. There is a pair of constrictions at the end of the phragmocone, the first of which is deeper and slightly wider. The body chamber is more than one whorl long.

REMARKS: *Pseudodimorphinites pinguis* differs from the described specimen in the markedly stouter whorls, the whorl section, unpaired constrictions and larger size. Other morphologically close specimens, but belonging to *Asphinctites*, were figured by STURANI (1966, pl. 10, fig. 2) and TORRENS (1987, pl. 2, figs. 10-12) from the Bas Auran, France. However, there is a significant difference is in the type of ribbing, which is only bifurcate in our specimen, whereas the ribs branch more than twice in the French specimens. Moreover, these are stratigraphically younger, having been collected from the topmost *Yeovilensis* Subzone and *Tenuiplicatus* Zone. *A. patrulii* HAHN from the *Recinctus* Subzone is another similarly large taxon but with much finer ornamentation.

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Early Bathonian, *Zigzag* Zone, Beňatina section, Slovakia

Genus *Morphoceras* DOUVILLÉ, 1881
Subgenus *Morphoceras* DOUVILLÉ, 1881

Morphoceras (*M.*) sp. aff. *kostelecense* RAKÚS, 1965
(Pl. 13, Figs 7-8, Text-fig. 12J)

MATERIAL: Two internal moulds of phragmocones with a part of the body chamber preserved

	D	H	E	O	O/D(%)	E/H
Pl. 13, Fig. 7	26	10	12.2	5.5	21.2	1.22

DESCRIPTION: Small sphaerocone ammonite with an extremely narrow umbilicus. Up to approximately 23 mm diameter, it is involute with an occluded umbilicus; the coiling then rapidly becomes evolute. The venter is broad and regularly rounded. The ornamentation consists of dense primary ribs, bifurcating at one-third of the whorl-height. Both the primary and secondary ribs are slightly prorsiradiate. They are interrupted in the middle of the venter, forming a thin smooth band. The secondary ribs alternate along the ventral line. There are three to four strong constrictions per whorl. These are only slightly prorsiradiate in the lower half of the flanks, but become much more curved adorally in the middle of the flanks. The body chamber is badly preserved. The suture line seems to be simpler than that of *M.* (*M.*) *kostelecense* (see RAKÚS 1965).

REMARKS: The described form possesses several aspects in common with *M.* (*M.*) *kostelecense* and *M.* (*M.*) *ellipticum* SANDOVAL. The principal difference lies in the point of rib bifurcation, which is lowest in our specimens. The primary ribs of *M.* (*M.*) *kostelecense* bifurcate between the middle and upper third of the flank, simple ribs are very rare. In contrast, *M.* (*M.*) *ellipticum* is typified by a high number of simple ribs; bifurcate ribs being rare. The division point is situated near the middle of the flank. The inner whorls of both this and our taxon are fairly broad (depressed), but more slender than in *M.* (*M.*) *kostelecense.* An elliptical shape is, according to SANDOVAL (1983), a typical feature of *M.* (*M.*) *ellipticum.* Due to the incomplete preservation of the Carpathian material, the final shell shape cannot be examined. The taxon described here belongs to the early *Morphoceras* group, which are characterized by sphaerocone coiling and with an extremely narrow to almost completely occluded umbilicus (like in *D. dimorphus* (D'ORBIGNY)). The exact stratigraphic position of *M. kostelecense* is unknown (stated to be Early Bathonian). The Spanish taxon *M. ellipticum* is associated with ammonites proving the *Morphoceras* (*M.*) *dimorphitiformis* Subzone of the Early Bathonian (equivalent of the *Parvum* Subzone) (SANDOVAL 1983).

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION: Early Bathonian, *Zigzag* Zone, Beňatina section, Slovakia.

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PLATE 1

1-2 – *Adabofoloceras* sp. 1. Beňatina, *Parkinsoni* Zone.
3 – *Adabofoloceras* cf. *abichi* (UHLIG, 1892). Beňatina, *Zigzag* Zone.
4-5 – *Adabofoloceras* cf. *plicatum* (BEZNOSOV, 1958). Beňatina, *Zigzag* Zone.
6 – *Digonioceras excavatum* (SOWERBY, 1826). Beňatina, *Parkinsoni* Zone.
7-10 – *Adabofoloceras adabofolense azyense* JOLY, 2000. Beňatina, *Zigzag* Zone.
11 – *Calliphylloceras disputabile* (ZITTEL, 1869). Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.

All figures are natural size

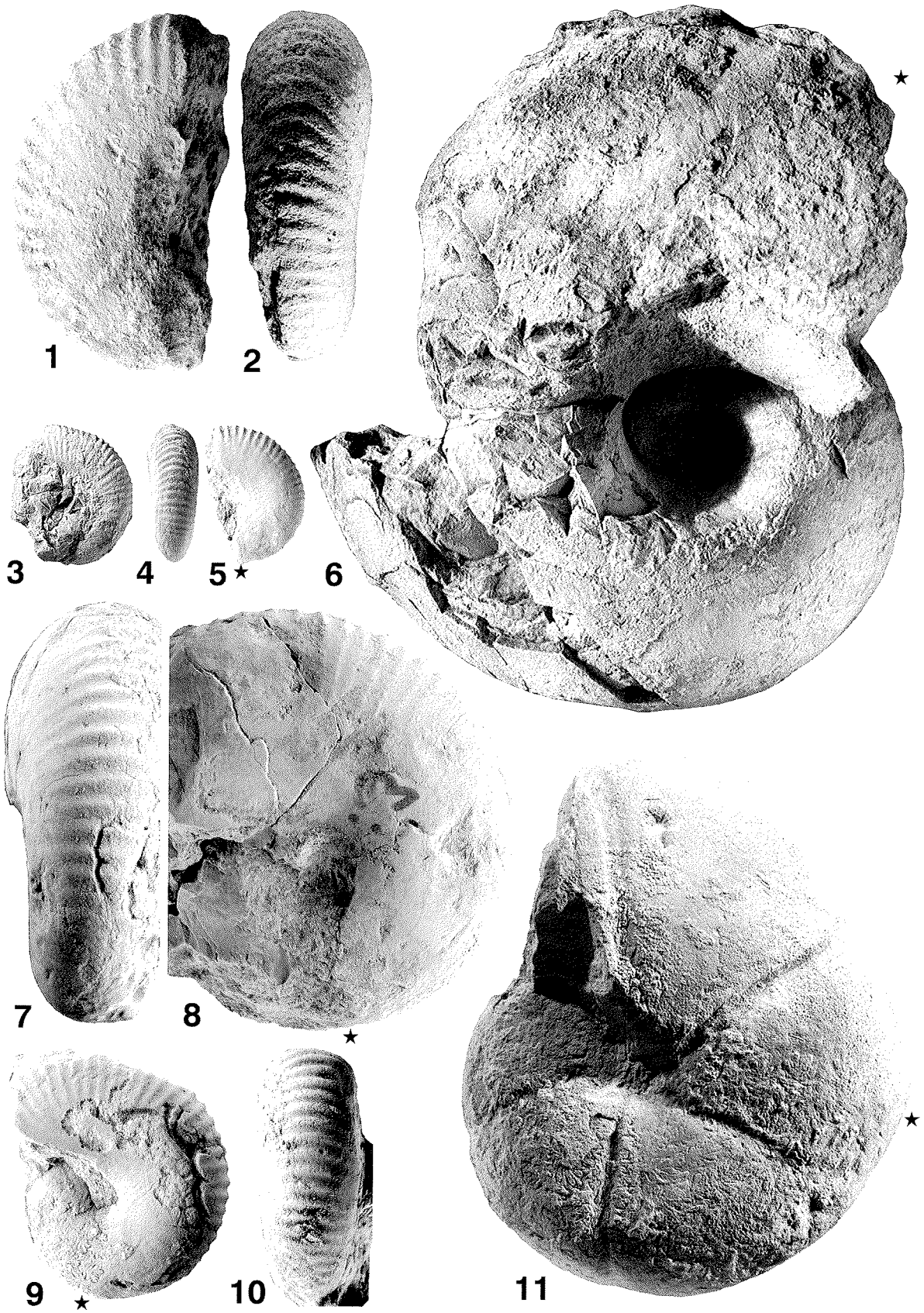
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PLATE 2

1-4, 9 – *Lytoceras joniaki* sp. nov., Beňatina, *Zigzag* Zone. 1 – Paratype (SNM Z 20 676), specimen described and figured by RAKÚS (1990, Pl. 3, Fig. 2). 2 – body chamber, SNM Z 24 168. 3 – Holotype, SNM Z 24 166. 4 – detail of suture line of the holotype. 9 – Paratype, SNM Z 24 167.

5 – *Nannolytoceras tripartitum* (RASPAIL, 1831). Štepnická skala, *Zigzag* Zone.

6-7 – *Nannolytoceras sturanii* PATRULIUS, 1969. Beňatina, *Zigzag* Zone.

8 – *Nannolytoceras tripartitum* (RASPAIL, 1831). Beňatina, *Zigzag* Zone.

All figures are natural size

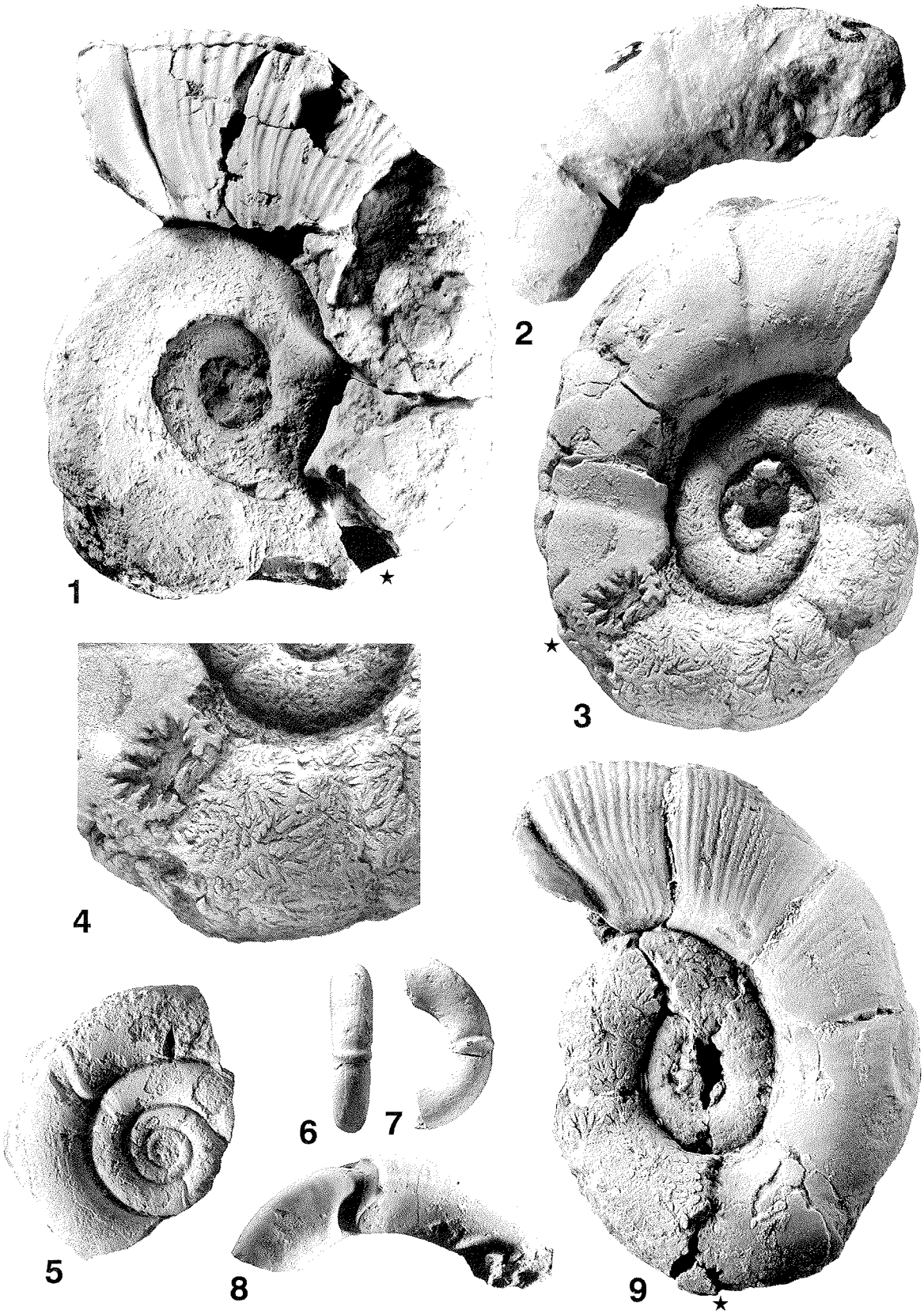
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PLATE 3

1 – *Lytoceras* sp. 1. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.
2-3 – *Lissoceras psilodiscus* (SCHLOENBACH, 1865). Beňatina, *Zigzag* Zone.
4 – *Strigoceras truellei* (D'ORBIGNY, 1845). Vršatec, *Parkinsoni* Zone.
5, 9-10 – *Oecotraustes* (*Oecotraustes*) aff. *costiger* BUCKMAN, 1905. Beňatina, *Zigzag* Zone.
6-7 – *Lytoceras* sp. aff. *Valentolytoceras elegans* BEZNOSOV, 1958. Beňatina, *Zigzag* Zone.
8 – *Lytoceras adelae* (D'ORBIGNY, 1844). Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.

All figures are natural size

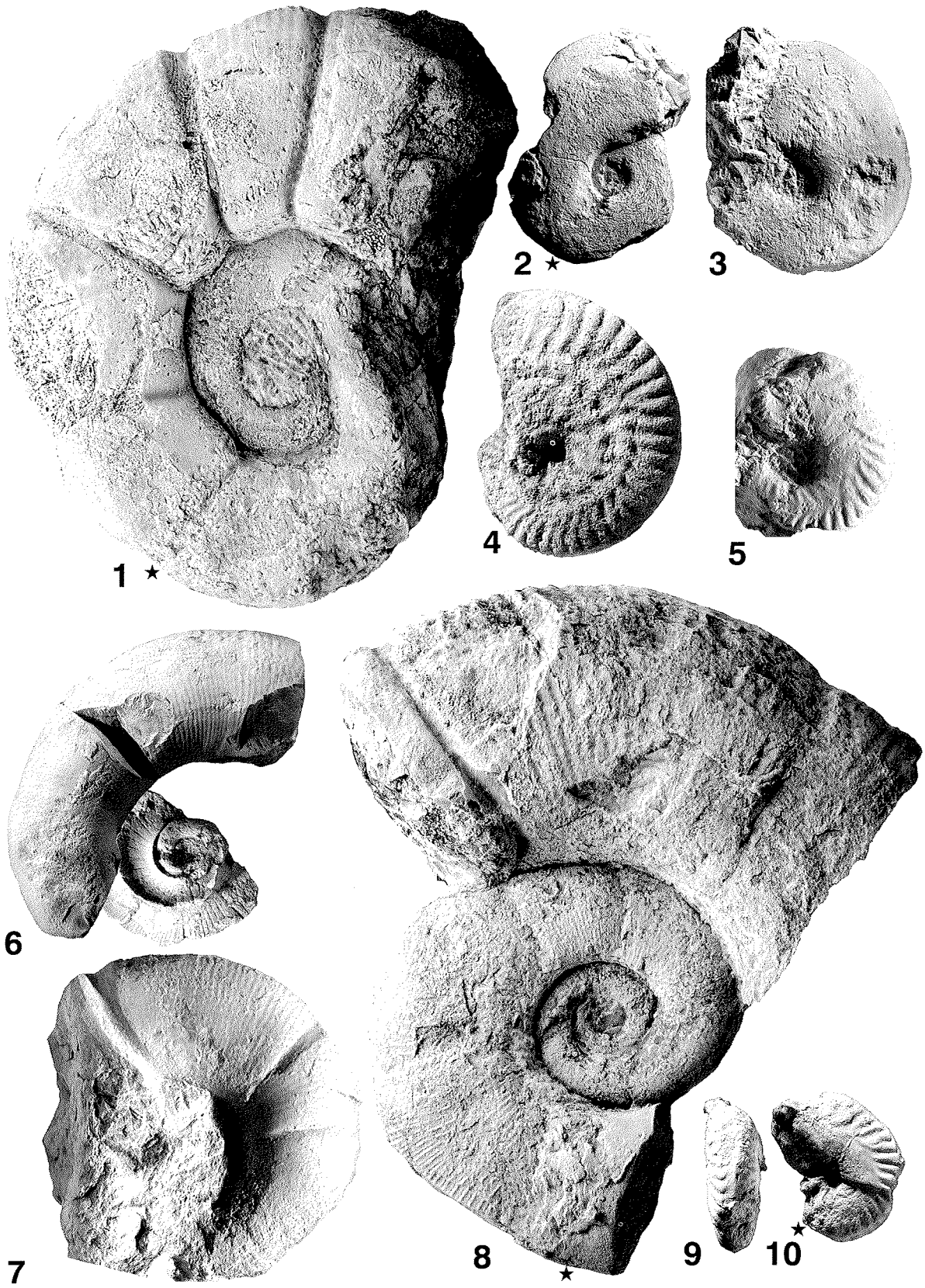
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PLATE 4

1-2 – *Lissoceras compressus* sp. nov. Holotype, SNM Z 24 169, Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.

3-4 – *Oxycerites yeovilensis* ROLLIER, 1911. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.

All figures are natural size

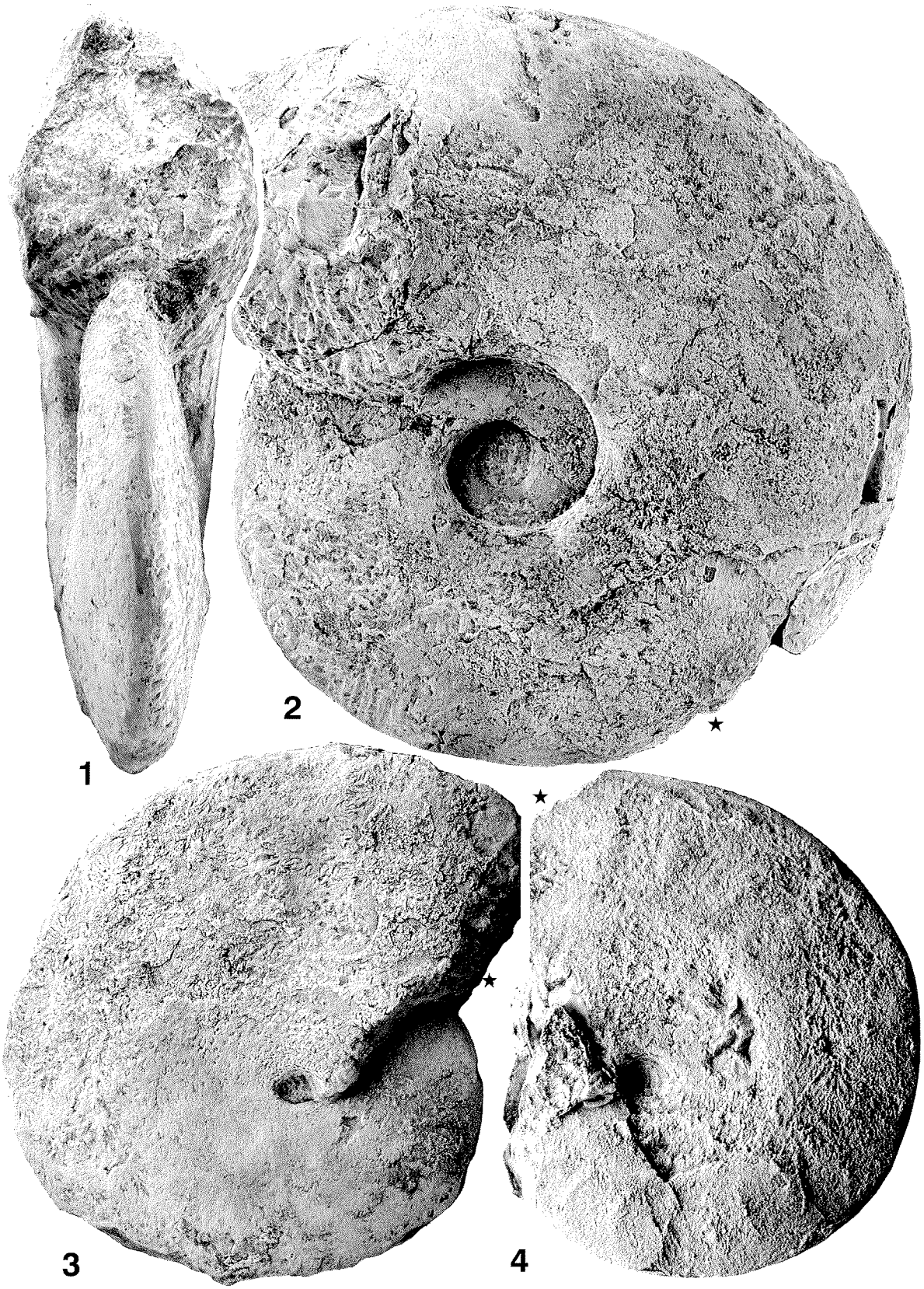
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PLATE 5

1-2 – *Lissoceras ventriplanum* WENDT, 1963. Adult specimen with the one quarter of the last whorl removed, Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.
3 – *Oppelia pleurifer* (BUCKMAN, 1924). Dolný Mlyn, *Parkinsoni* Zone.
4 – *Oxycerites limosus* (BUCKMAN, 1925), Beňatina, *Zigzag* Zone.
5, 7 – *Oecotraustes (Oecotraustes)* sp. Beňatina, *Zigzag* Zone.
6 – *Oxycerites seebachi* (WETZEL, 1950). Dolný Mlyn, *Aurigerus* Zone.
8 – *Micromphalites* (*M.*) aff. *pustuliferus* (DOUVILLÉ, 1916). Beňatina, *Zigzag* Zone (specimen figured by SCHLÖGL & RAKÚS, 2004, fig. 4); × 1.5

Except fig. 8, all figures are natural size

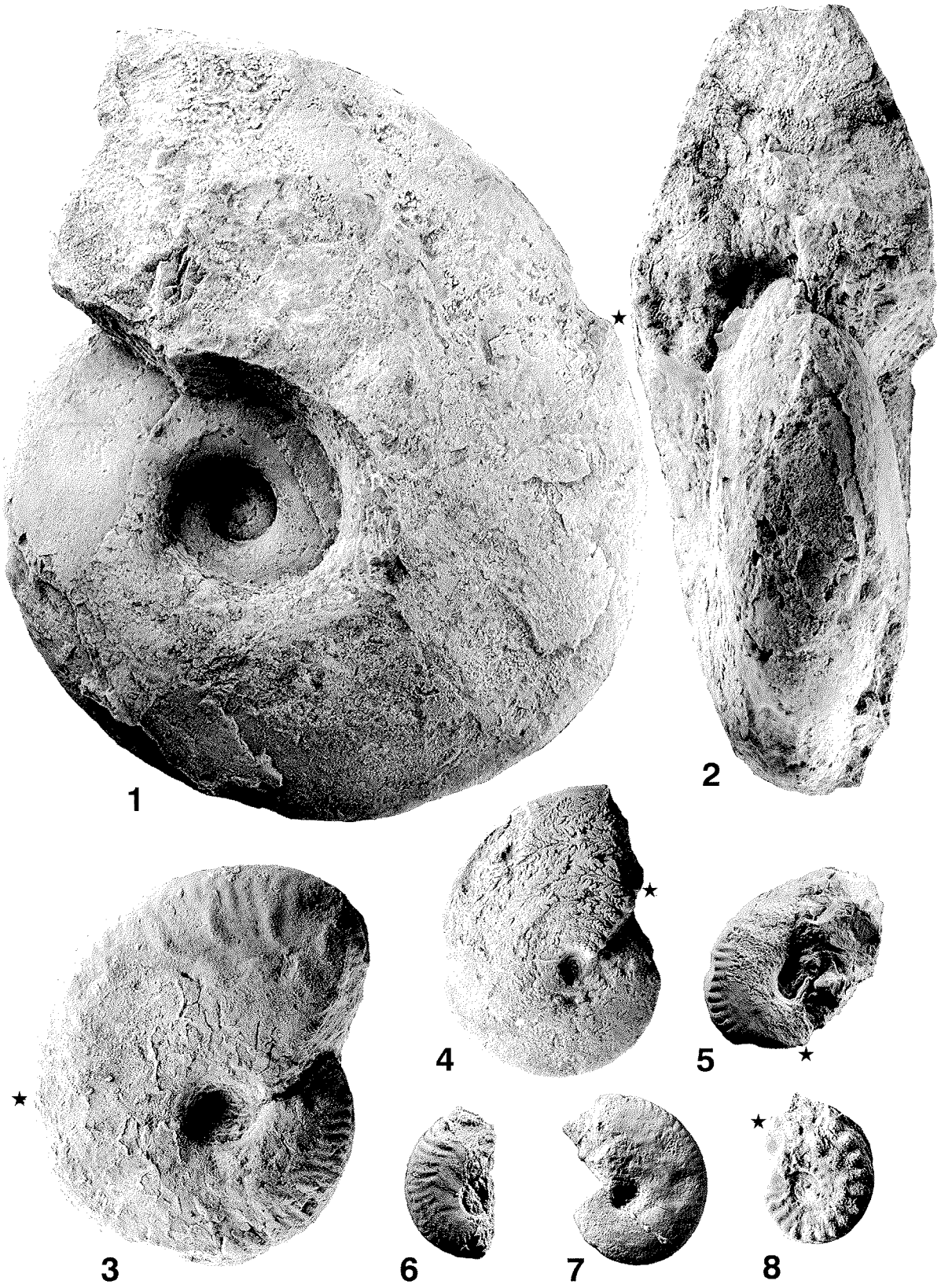
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PLATE 6

1 – *Lissoceras ventriplanum* WENDT, 1963. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.
2 – *Cadomites* (*C.*) cf. *arkelli* (STURANI, 1964). Vršatec, *Parkinsoni* Zone.
3-4 – *Cadomites* (*Polyplectites*) *minutus* sp. nov. Holotype, SNM Z 24 170, Dolný Mlyn, *Aurigerus* Zone. × 1.5
5-7 – *Cadomites* (*Polyplectites*) *minutus* sp. nov. Paratype, SNM Z 24 171, Vršatec, *Zigzag* Zone. × 1.5
8-9 – *Cadomites* (*Polyplectites*) *rozyckii* KOPIK, 1974. Beňatina, *Zigzag* Zone.
10 – *Cadomites* (*Polyplectites*) sp. cf. *dorni* (ROCHÉ, 1939). Dolný Mlyn, *Zigzag* Zone.
11 – *Cadomites* (*Polyplectites*) cf. *gracilis* WESTERMANN, 1954. Vršatec, *Zigzag* Zone. × 1.25
12 – *Cadomites* (*Cadomites*) cf. *exstinctus* (QUENSTEDT, 1887). Vršatec, *Zigzag* Zone.
13-14 – *Cadomites* (*Polyplectites*) aff. *zlatarskii* STEPHANOV, 1963. Beňatina, *Zigzag* Zone.
15-16 – *Cadomites* (*Polyplectites*) sp. 1 aff. *dorni* (ROCHÉ, 1939). Vršatec, *Zigzag* Zone.
17 – *Benatinites* (*B.*) *schlageri* (KRYSTYN, 1972). Beňatina, *Zigzag* Zone.
18-19 – *Benatinites* (*Lugariceras*) *lugarensis* SCHLÖGL & *al.*, in press. Beňatina, *Zigzag* Zone. × 1.5
20-21 – *Benatinites* (*Lugariceras*) *lugarensis* SCHLÖGL & *al.*, in press. Vršatec, *Zigzag* Zone. × 1.5
22-23 – *Cadomites* (*Polyplectites*) cf. *rozyckii* KOPIK, 1974. Beňatina, *Zigzag* Zone.

Except for figs 3-7, 11, 18-21, all are natural size

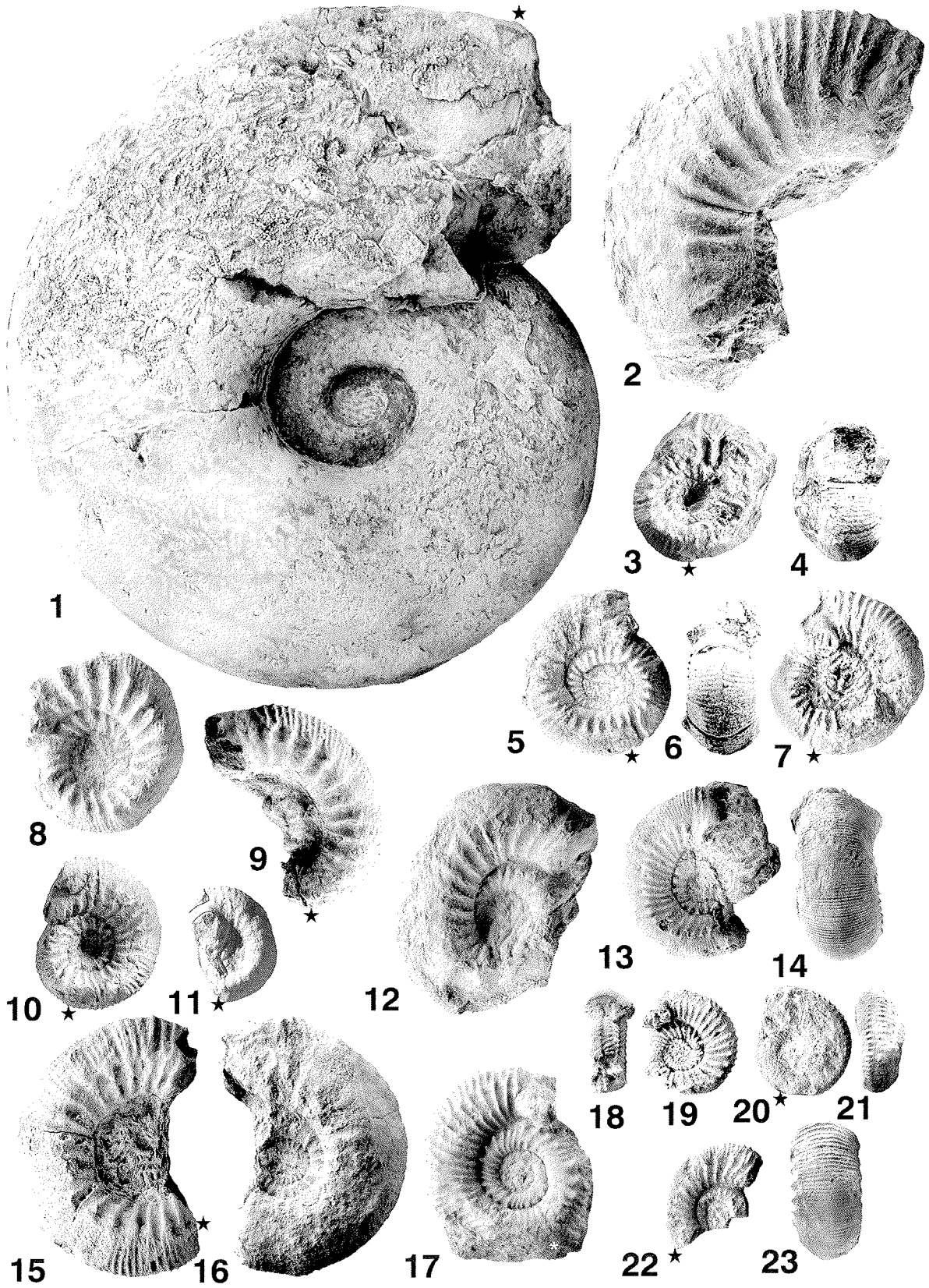
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PLATE 7

1 – *Bullatimorphites* (*Kheraiceras*) cf. *hannoveranus* (ROEMER, 1911). Adult specimen with peristomal constriction. Údol, *Retrocostatum* Zone.

2-4 – *Bullatimorphites* (*Sphaeroptychius*) cf. *lucasi* (DE GROSSOUVRE, 1888). Adult specimen with ventral flare. Údol, *Bremeri* or *Retrocostatum* Zone (specimen figured by RAKÚS, 1990, pl. 2, fig. 6, SNM Z 20 668).

5 – *Bullatimorphites* (*Bullatimorphites*) sp. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.

6 – *Bullatimorphites* (*Kheraiceras*) ex gr. *bullatus* (D'ORBIGNY). Adult specimen with the terminal part of the body chamber missing. Jarabina quarry, Early Callovian (specimen figured by RAKÚS, 1990, pl. 2, fig. 1, SNM Z 20 690).

All figures are natural size

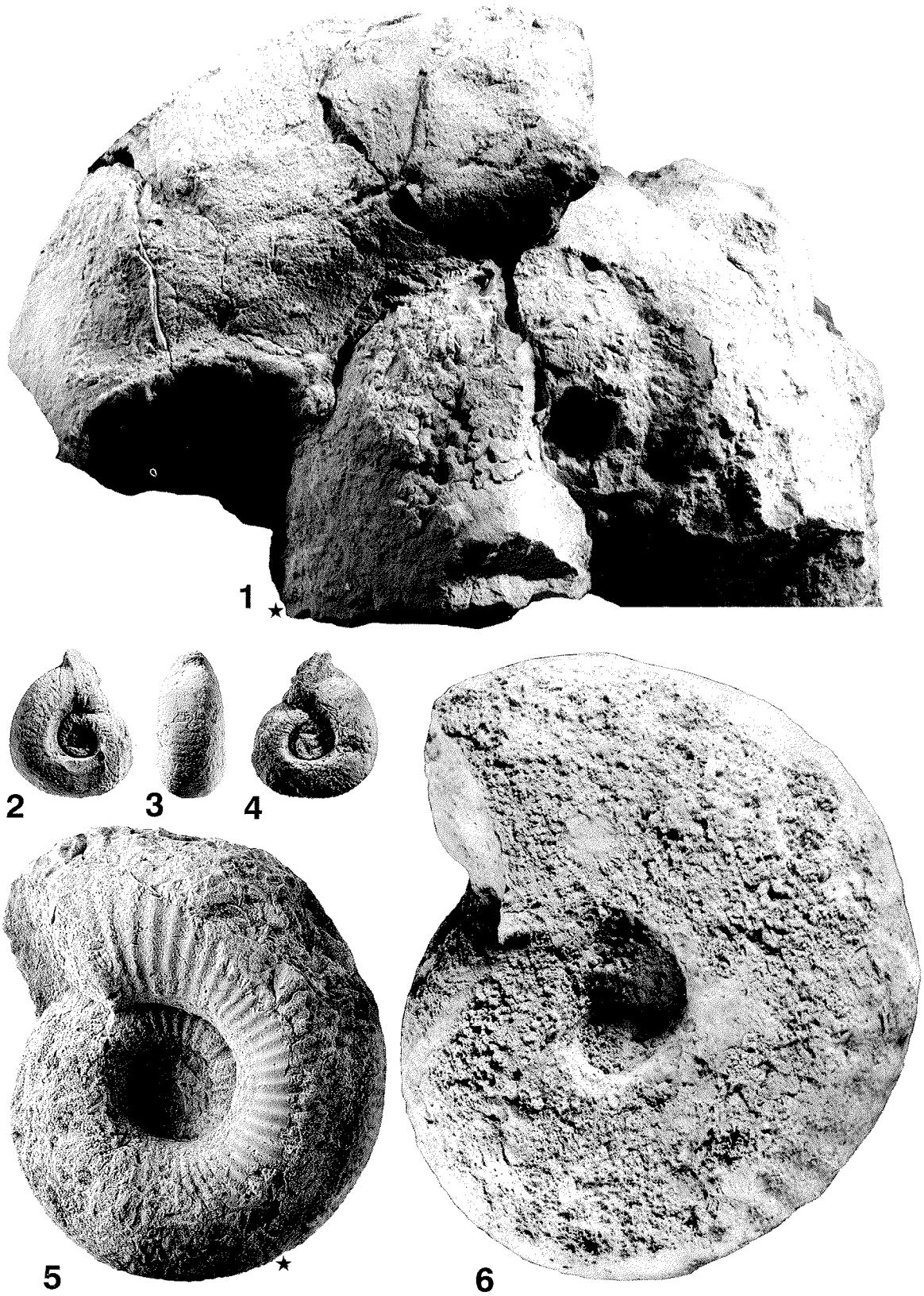
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PLATE 8

1-2 – *Vermisphinctes* (*Prorsisphinctes*) aff. *meseres* BUCKMAN, 1927 *non* 1923. Beňatina, *Parkinsoni* Zone.

3 – *Vermisphinctes* (?) sp. Beňatina, *Zigzag* Zone.

Figures 2, 3 are natural size, figure 1 is × 0.5

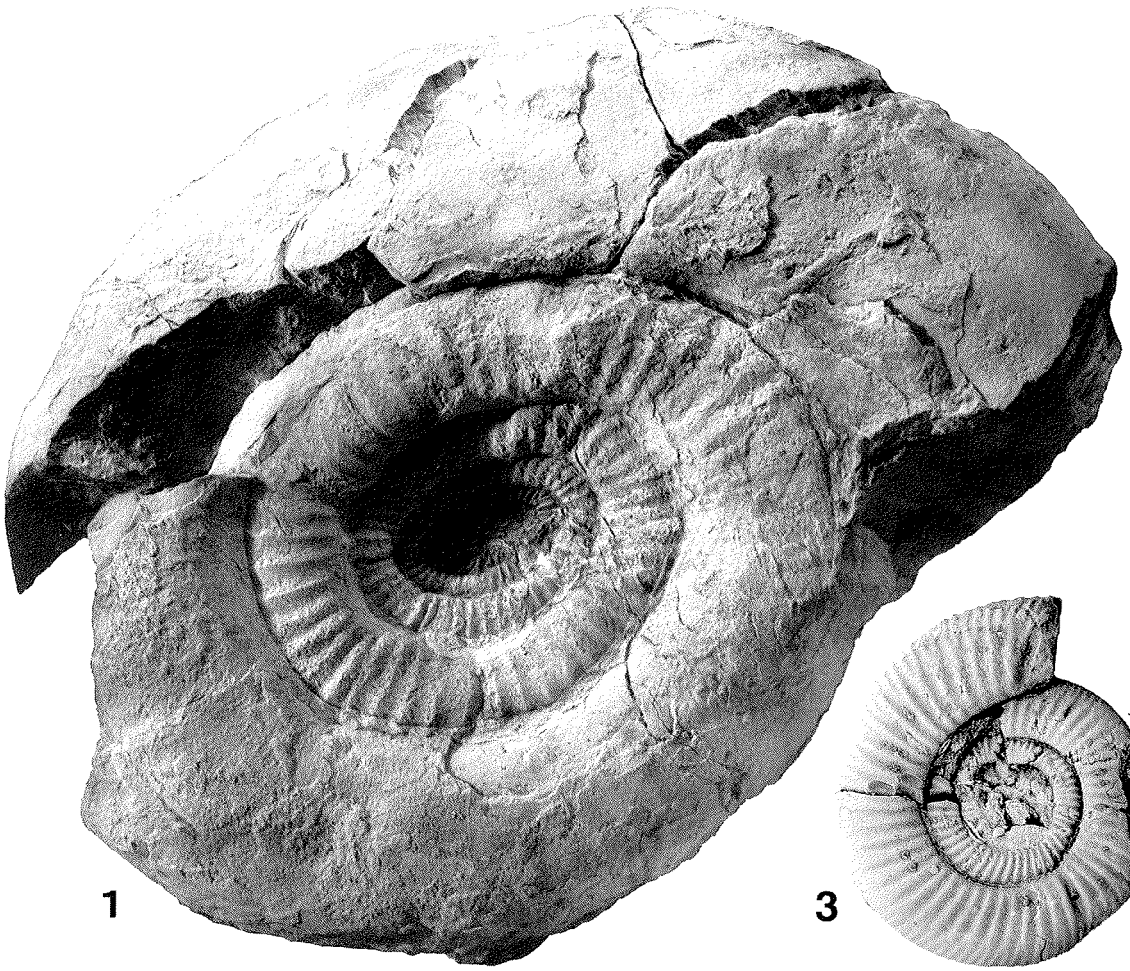

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PLATE 9

1 – *Procerites* (*Procerites*) *fowleri* ARKELL, 1958. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.

2 – *Planisphinctes* (*Planisphinctes*) cf. *torrensi* (STEPHANOV, 1972). Vršatec, bed 4, *Zigzag* Zone.

3-4 – *Planisphinctes* (*Planisphinctes*) ex gr. *tenuissimus* (SIEMIRADZKI, 1898). Beňatina, *Zigzag* Zone.

Figures 2-4 are natural size, figure 1 is × 0.66

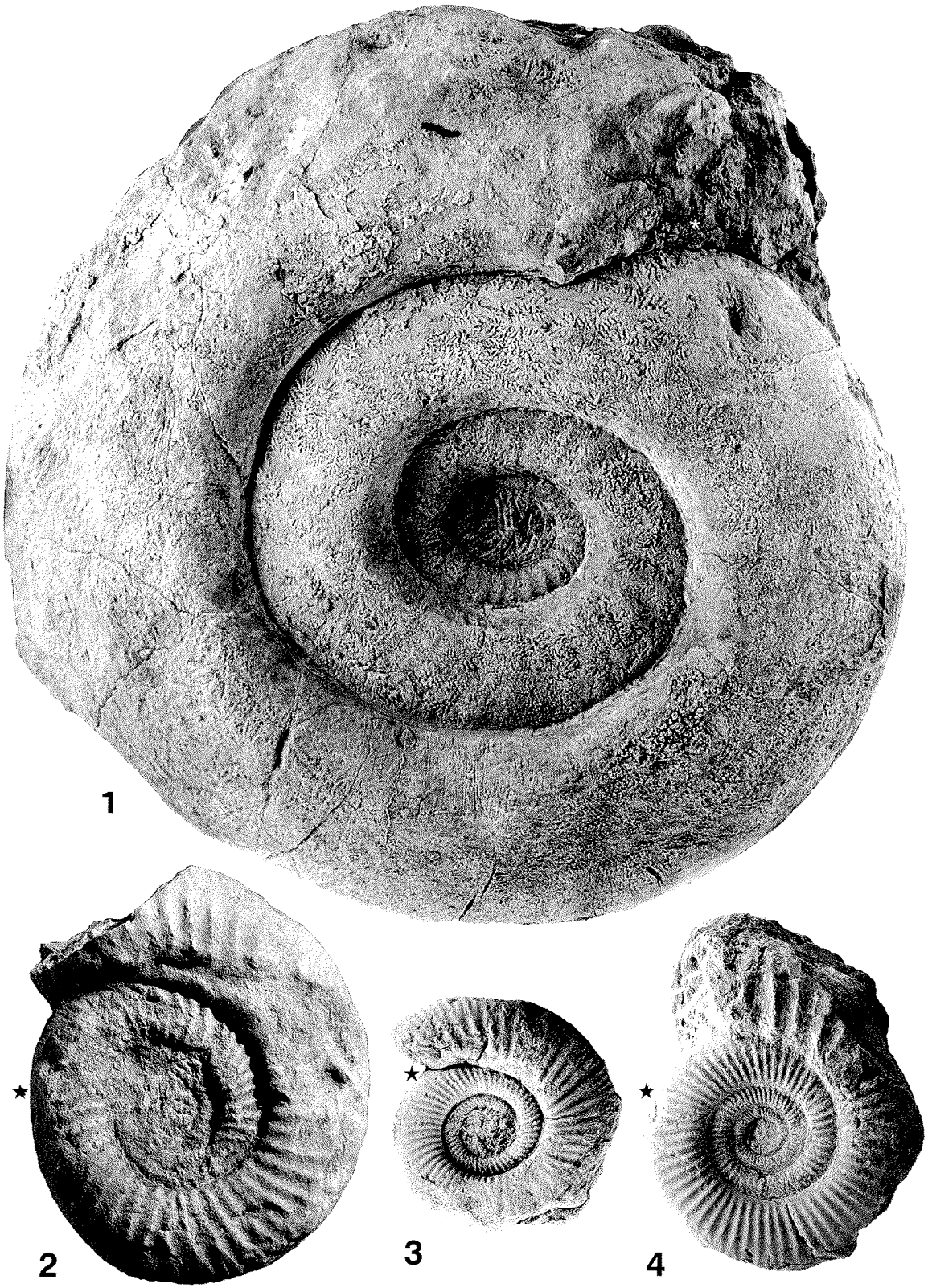
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PLATE 10

1-2 – *Planisphinctes* (*Lobosphinctes*) ex gr. *intersertus* BUCKMAN, 1923. Beňatina, *Zigzag* Zone.
3 – *Procerites* (*Siemiradzkia*) *lenthayensis* (ARKELL, 1958). Dolný Mlyn, *Zigzag* Zone.
4-5 – *Zigzagiceras* (*Zigzagiceras*) cf. *torrensi* STURANI, 1966. Dolný Mlyn, *Zigzag* Zone.
6 – *Procerites* (*Procerites*) *tmetolobus* BUCKMAN, 1923. Beňatina, *Zigzag* Zone.
7 – *Bigotites tuberculatus* (NICOLESCO, 1916). Beňatina, *Parkinsoni* Zone.

All figures are natural size

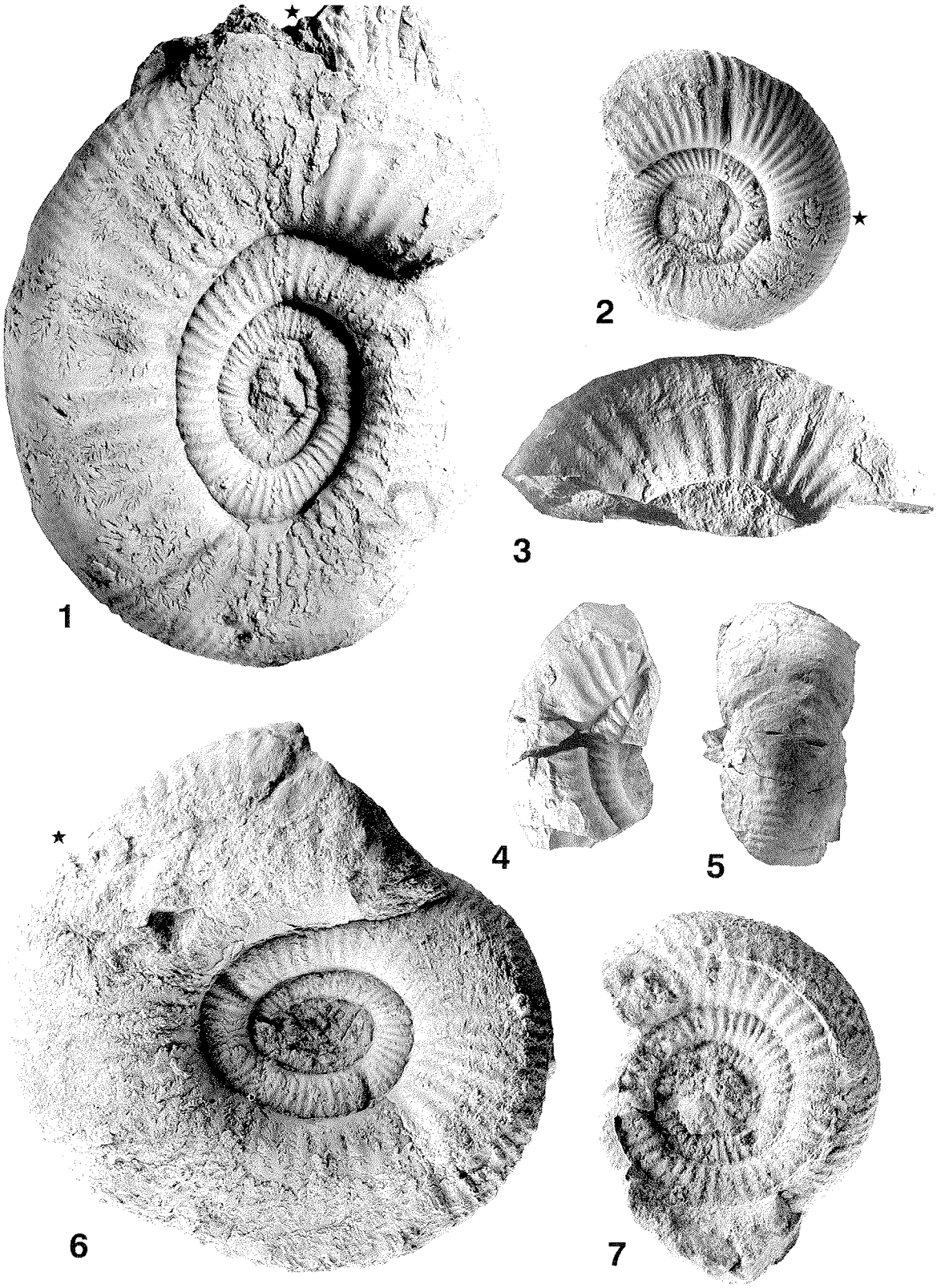
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PLATE 11

1, 5 – *Parkinsonia* (*Parkinsonia*) *parkinsoni* (SOWERBY, 1821). Beňatina, *Parkinsoni* Zone.

2 – *Zigzagiceras* (*Procerozigzag*) *crassizigzag* (BUCKMAN, 1892). Beňatina, *Zigzag* Zone (specimen already figured by RAKÚS, 1990, pl. 1, fig. 1, SNM Z 20 682).

3-4 – *Zigzagiceras* (*Zigzagiceras*) ex gr. *zigzag* (D'ORBIGNY, 1845). Beňatina, *Zigzag* Zone (specimen already figured by RAKÚS, 1990, pl. 1, fig. 2, SNM Z 20 677).

All figures are natural size

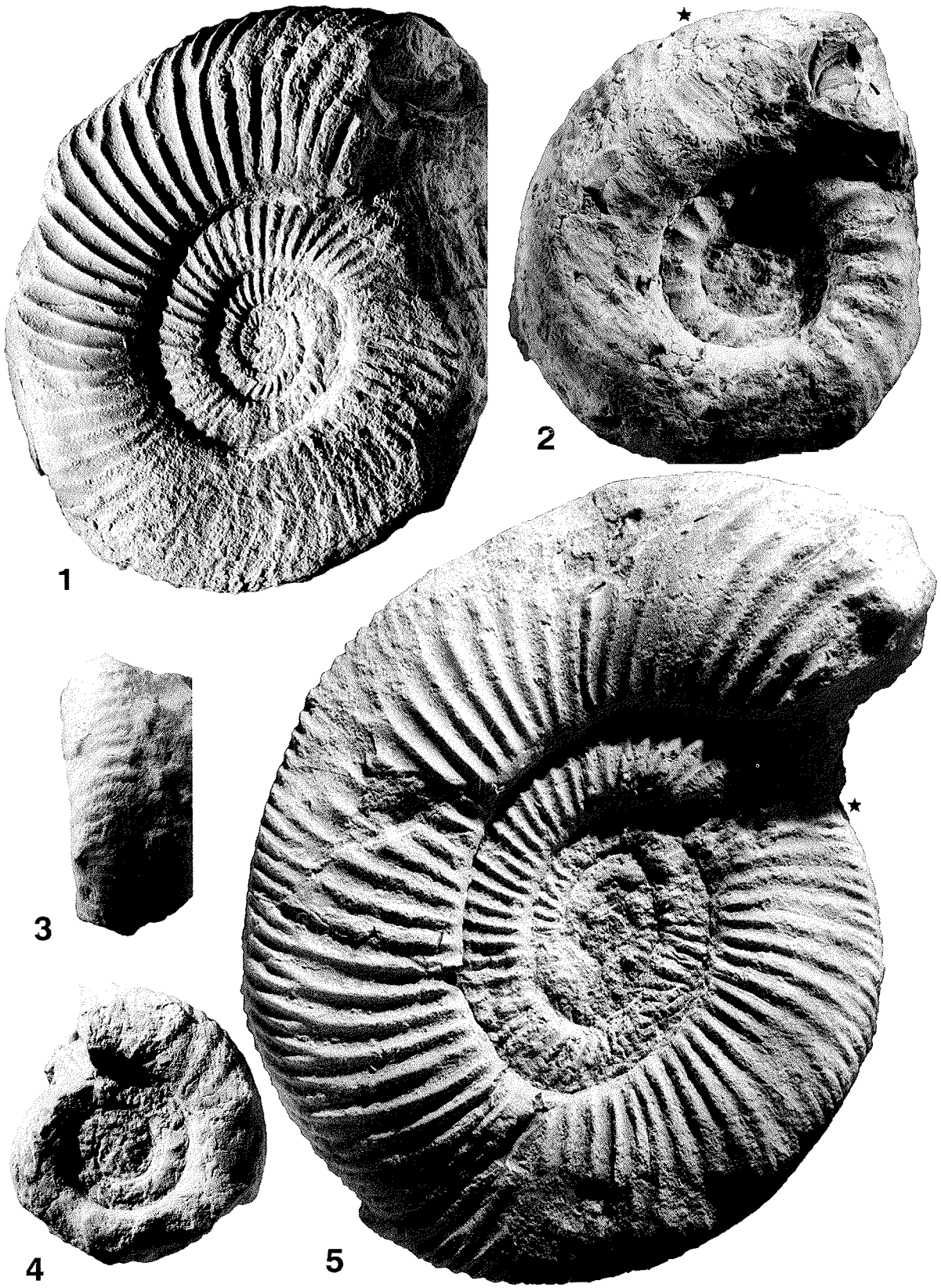
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PLATE 12

1 – *Zigzagiceras* (*Procerozigzag*) *postpollubrum* WETZEL, 1937. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.

2 – *Procerites* (*Procerites*) *clausiprocerum* BUCKMAN, 1892. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.

All figures are natural size

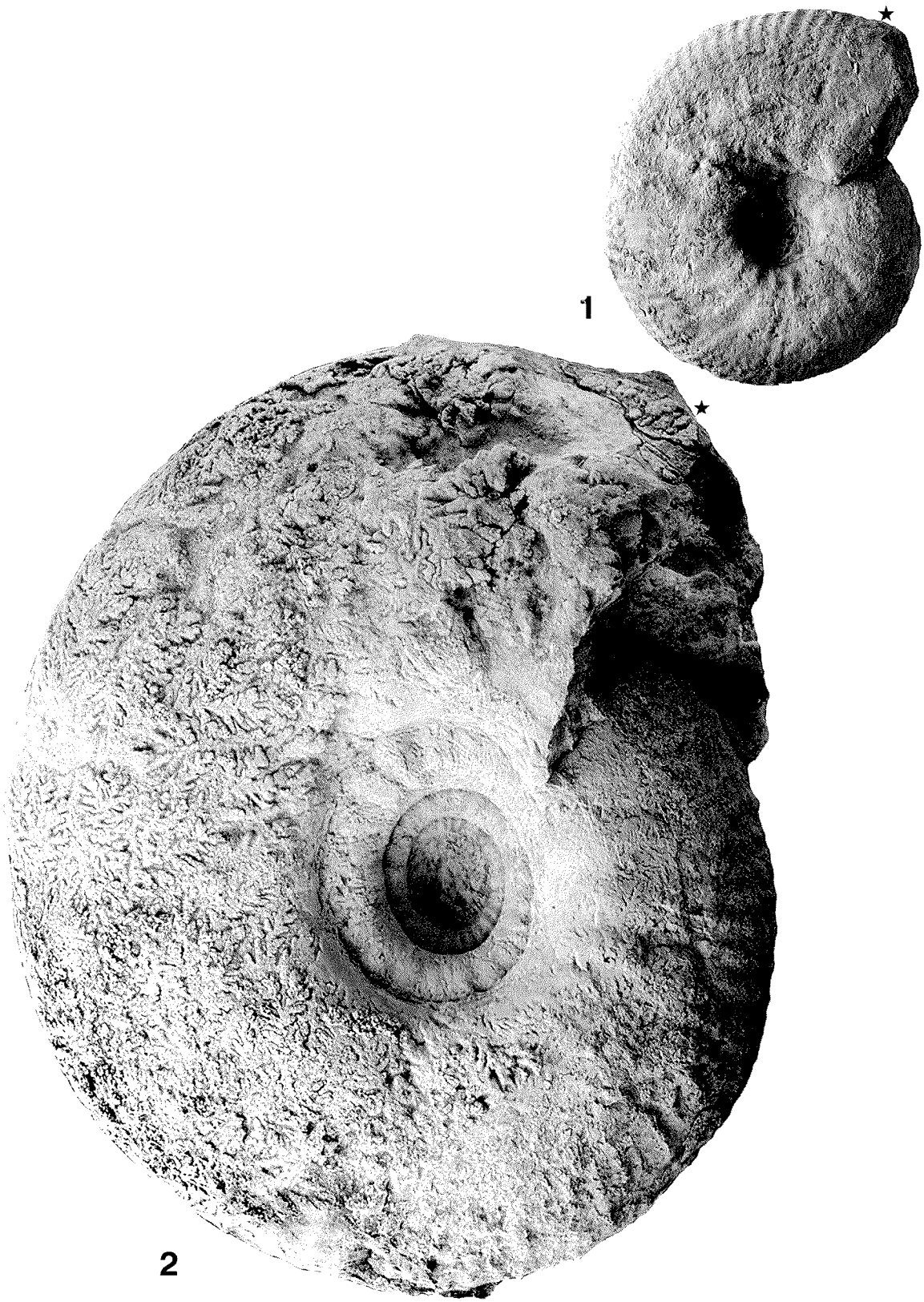
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PLATE 13

1 – *Parkinsonia* (*Durotrigensia*) ex gr. *dorsetensis* (WRIGHT, 1856). Vršatec, *Parkinsoni* Zone.
2 – *Dimorphinites* (*Dimorphinites*) *dimorphus* (D'ORBIGNY, 1846). Dolný Mlyn, *Parkinsoni* Zone.
3 – *Morphoceras* (*Morphoceras*) sp. Vršatec, *Zigzag* Zone.
4 – *Morphoceras* (*Morphoceras*) cf. *dimorphitiformis* SANDOVAL, 1983. Dolný Mlyn, *Zigzag* Zone.
5-6 – *Morphoceras* (*Morphoceras*) cf. *dimorphitiformis* SANDOVAL, 1983. Beňatina, *Zigzag* Zone.
7-8 – *Morphoceras* (*Morphoceras*) sp. aff. *kostelecense* RAKÚS, 1965, Beňatina, *Zigzag* Zone.
9 – *Parkinsonia* (*Parkinsonia*) *parkinsoni* (SOWERBY, 1821). Vršatec, *Parkinsoni* Zone.

All figures are natural size

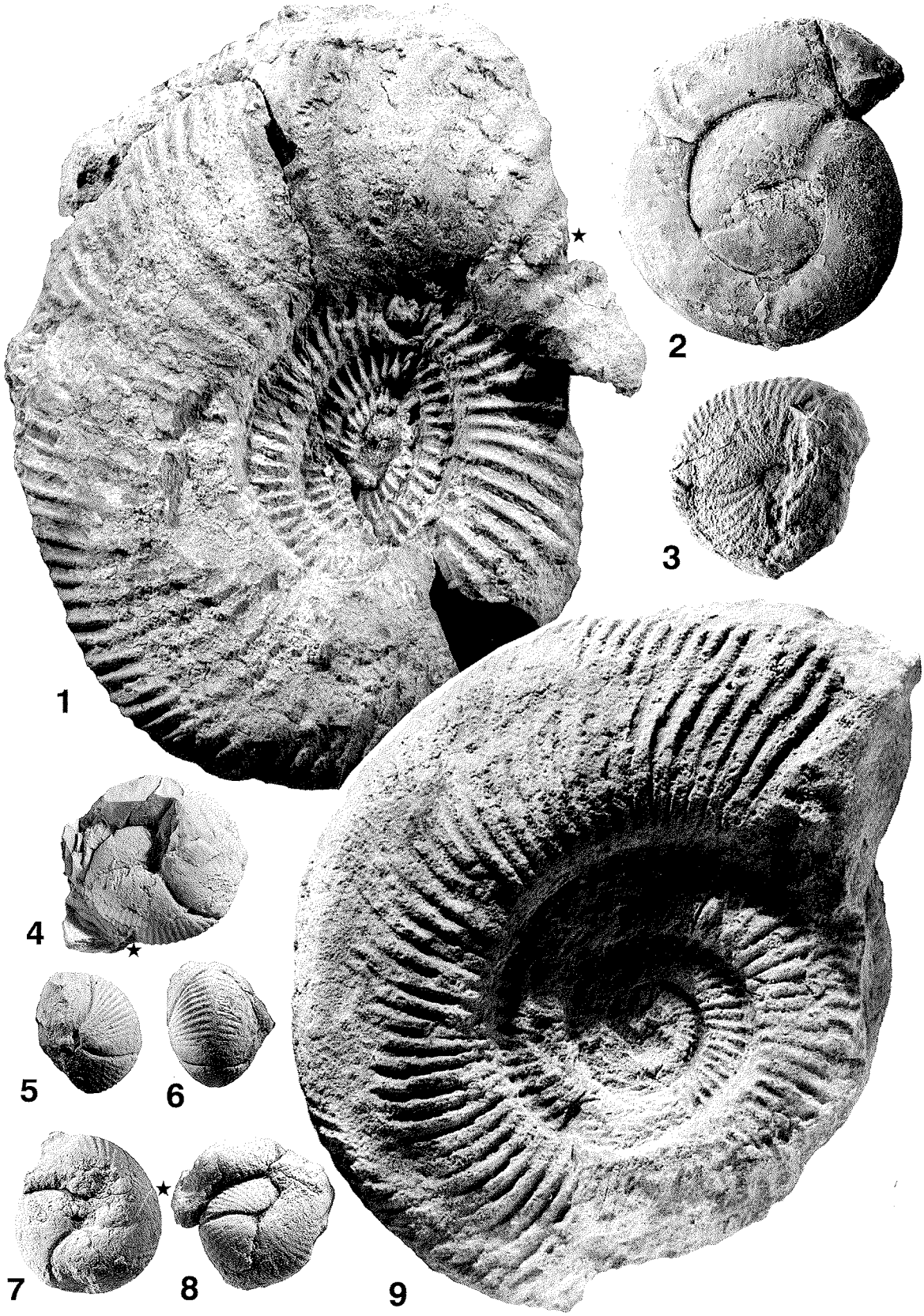
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PLATE 14

1-2 – *Parkinsonia* (*Gonolkites*) *gyrumbilica* (QUENSTEDT, 1887). Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.
3 – *Morphoceras* (*Morphoceras*) sp. Beňatina, *Zigzag* Zone.
4-5 – *Morphoceras* (*Morphoceras*) *multiforme* ARKELL, 1951. Dolný Mlyn, *Zigzag* Zone (specimen figured by RAKÚS, 1990, pl. 2, fig. 4-5).
6 – *Polysphinctites polysphinctus* BUCKMAN, 1922. Dolný Mlyn, *Aurigerus* Zone.
7-10 – *Pseudodimorphinites pinguis* (DE GROSSOUVRE, 1918). Beňatina, *Zigzag* Zone.
11 – *Pseudodimorphinites* aff. *pinguis* (DE GROSSOUVRE, 1918). Beňatina, *Zigzag* Zone.
12 – *Ebrayiceras sulcatum* (ZIETEN, 1830). Dolný Mlyn, *Zigzag* Zone (specimen collected by M. HLÔŠKA, described and figured by RAKÚS, 1990, pl. 2, fig. 2).
13 – *Ebrayiceras pseudoanceps* (EBRAY, 1864). Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.
14 – *Asphinctites* (*Asphinctites*) *recinctus* BUCKMAN, 1924. Dolný Mlyn, *Aurigerus* Zone.
15 – *Pseudodimorphinites* sp. 1. Beňatina, *Zigzag* Zone.

All specimens are natural size

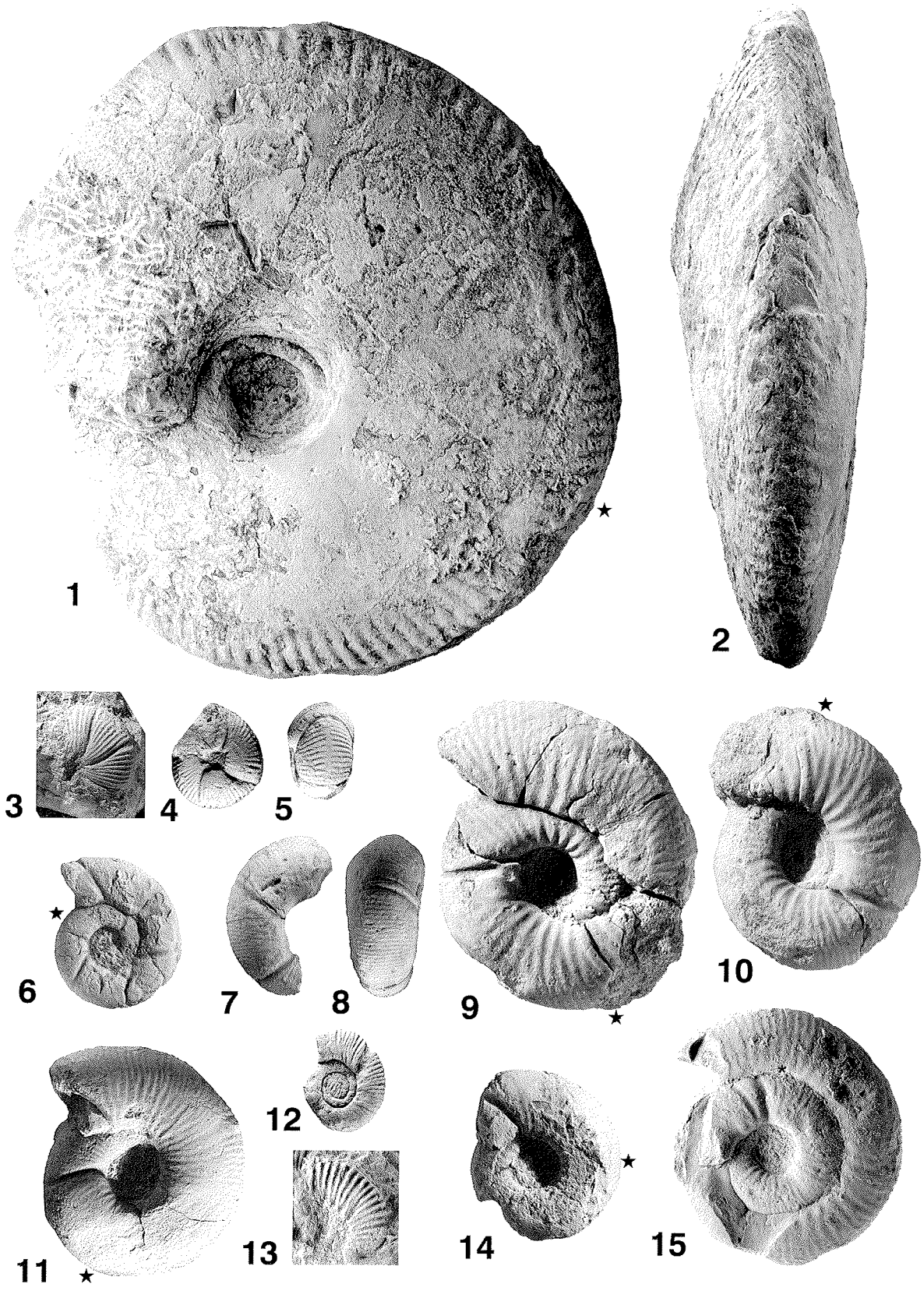
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PLATE 15

1 – *Choffatia* (*C.*) sp. 1. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.
2 – *Choffatia* (*C.*) sp. 2. Vršatec, bed 7, *Zigzag* Zone or *Aurigerus* Zone.

All specimens are natural size


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