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Ammonoids (Desmoceratoidea and Silesitoidea) from the Late Barremian of Boljetin, eastern Serbia

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ABSTRACT

The subject of the study was the taxonomy of the ammonite fauna from the Upper Barremian marls and marly limestones of the Donji Milanovac Formation outcropped at the Boljetin Hill (Danubicum Unit). These sediments yielded a rich ammonite fauna which included also representatives of two superfamilies, Desmoceratoidea and Silesitoidea. The Desmoceratoidea include the family Barremitidae to which belong *Plesiospitidiscus boljetinensis* n. sp., *Barremites balkanicus*, *Montanesiceras breskovskii* n. sp., *Barremitites strettostoma strettostoma* and *B. panae*, *Torcapella serbiensis* n. sp., *Pseudohaploceras tachthaliae*, *P. portaeferreae*, *Melchiorites haugi* and *Patruliusiceras* cf. *crenelatum*. The Silesitoidea are represented by the family Silesitidae with *Silesites trajani* and *S. seranonis.* With the exception of the new, possibly endemic species, *Plesiospitidiscus boljetinensis* n. sp., *Montanesiceras breskovskii* n. sp., and *Torcapella serbiensis* n. sp., these taxa are common in the Tethyan regions. The studied deposits with ammonites belong to the lower part of the Late Barremian, in particular to the upper part of the *Toxancyloceras vandenheckii* ammonite Zone up to the lower part of the *Imerites giraudi* Zone.

1. Introduction

The Early Cretaceous pelagic deposits of the Danubic Unit of Carpatho-Balkanides, which extend as an elongated arch from southern Romania, eastern Serbia and further in western Bulgaria (the Salash Synclinal), are rich in ammonites and widely distributed. The Late Barremian rocks have the greatest distribution and are much more abundant and diverse in ammonite fauna compared with the other Early Cretaceous sediments.

Tietze (1872) was the first worker to monograph the Early Cretaceous cephalopods from Greben in eastern Serbia and Sviniţa, on the opposite side of the Danube River, in southern Romania and described 27 species. He noted that the layers on Greben are almost identical with those discovered around Sviniţa and assigned them to the Aptian.

Later on, studying Tietze's collection, Uhlig (1883) concluded that the layers with ammonites are much closer to the Barremian stage than to the Aptian.

Žujović (1921), based on two ammonite species, *Lytoceras phestum* Matheron and *Silesites seranonis* d'Orbigny, "in the upper marlstones level" proved the presence of the Barremian stage on Greben.

Petković (1921), from Greben (the Boljetin Hill), described 29 taxa of the Barremian ammonite species. He divided the Barremian stage into two levels, the lower and the upper, and noted that the Barremian stage outsized all other Cretaceous stages in terms of thickness.

Modern processing of the western Bulgarian localities (the Salash Synclinal) was performed by Dimitrova (1967), Manolov (1975) and by Breskovski (1966, 1977a, b, 1980); the southern Romanian localities (above all the Sviniţa region) later by Avram (e.g., 1976, 1978, 1988, 1995a, b, 2002).

Rabrenović (1989) from the Barremian sediments from Greben, near Donji Milanovac (eastern Serbia) introduced the new genus *Lepeniceras* with a new species *L. lepensis*. Later, the same author (1991) from the Lower Cretaceous deposits described a new collection of ammonite fauna of the Boljetin Hill in his unpublished dissertation.

The aim of the present paper is to give a detailed study on the ammonite representatives of superfamilies Desmoceratoidea and Silesitoidea from the Late Barremian of the Boljetin Hill in eastern Serbia. Eight genera with 11 species are described, including three new species.

The material under study was collected in the 80's of the last century by Rabrenović and further new material was collected in 2010 by the present authors.

The first part of the submitted results is followed by a second part devoted to representatives of other ammonite suborders

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(Phylloceratina, Lytoceratina, and of the sporadic Ancyloceratina), and by a final evaluation of the section.

2. Geological setting

The ammonite fauna was discovered from the Boljetin Hill, in a cutting by a new road from Donji Milanovac to Dobra, near the right bank of the Danube River (Fig. 1).

According to Grubić (1974), the deposits in the study belong to the Danube Trough, i.e., the Danubic Unit of the Carpatho-Balkanides, located between the Gethicum and the Moesian Platform (the marginal part of the European craton). It is also known as the "Milanovac–Novo Korito Zone", which forms a part of the Balkan autochthon (Andjelković and Nikolić, 1974, 1980).

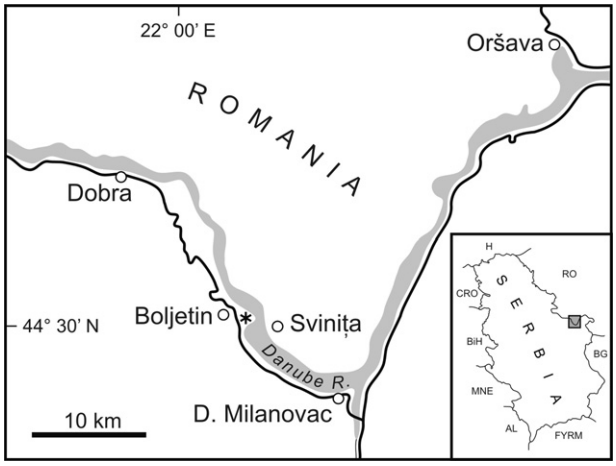


Fig. 1. Location map of the fossiliferous locality (star), eastern Serbia.

Lower Cretaceous succession was described by Vasić et al. (1998) as the Donji Milanovac Formation. This formation consists of two members: (1) deep water limestones and marly limestones with black cherts of Berriasian-Early Hauterivian age (*Berriasella privasensis, Subthurmannia boissieri, Busnardoites campylotoxus* and *Acanthodiscus radiatus* ammonite Zones; Rabrenović, 1991), and (2) shelf marls and marly limestones without cherts, Late Hauterivian-Albian in age. According to Rabrenović (1991) this marls and marly limestones on the base of the second member represent the Late Hauterivian (*Subsaynella sayni* Zone), while the Early Barremian sediments consist of an ammonite association, which documented the *Kotetishvilia compressissima* Zone.

In the next 34 m, belonging to the Late Barremian, marlstones dominate, while less abundant marly limestones occur as thinner, but more compact interlayers, which dismembered the already crumbled and schistose marlstones (Fig. 2).

These layers contain a very rich and diverse ammonite fauna of the Late Barremian. From the point of view of the systematic composition, representatives of the suborder Phylloceratina, the suborder Lytoceratina and of the superfamily Desmoceratoidea of the suborder Ammonitina predominate in the locality. Only very sporadically the heteromorphic ammonites occur.

The assemblage of ammonites here described is: *Plesiospitidiscus boljetinensis* n. sp., *Barremites balkanicus* Manolov, *Montanesiceras breskovskii* n. sp., *Barremitites strettostoma strettostoma* (Uhlig), *B. panae* Avram, *Torcapella serbiensis* n. sp., *Pseudohaploceras tachthaliae* (Tietze), *P. portaeferreae* (Tietze), *Melchiorites haugi* (Kilian), *Patruliusiceras* cf. *cranelatum* Avram, *Silesites trajani* (Tietze), and *S. seranonis* (d'Orbigny). The stratigraphic distribution of the determined ammonites of the Boljetin Hill is given in Fig. 3.

3. Studied collections

Within the framework of the systematic processing of our ammonite collection, we also made efforts to acquaint ourselves with some historical collections related to our theme. One of us (Z. V.) visited the collections of the Geological Survey of Austria in Vienna, where he made himself acquainted with the deposited originals of the ammonites of Tietze's collection (1872). It can be stated that with some exceptions, the collection of Tietze is still almost complete. D. Rabrenović attempted to find the collection of Petković (1921), which had been deposited in the National History Museum in Belgrade. As it turned out, the ammonites of Petković had fallen to pieces due to pyritisation; hence, only several insignificant fragments were preserved.

The manner of preservation of our material and Tietze's collection is similar to that of Coquand's collection (1880), the shells of which were illustrated by Heinz (1886). For a long time, Coquand's collection was considered to be lost. However, we were informed by O. Szives in the year 2009 that this collection was deposited in the collections of the National Museum in Budapest. At present, Coquand's collection is being revised by O. Szives together with M. Company and W.J. Kennedy.

To the seminar on the Jurassic/Cretaceous Boundary, which was held in Smolenice in April 2010 and at which Z. V. participated, O. Szives brought two originals from the Coquand collection

Fig. 2. General view of the Late Barremian (Donji Milanovac Formation) section of the Boljetin Hill, eastern Serbia, showing alternation of marls and marly limestones.

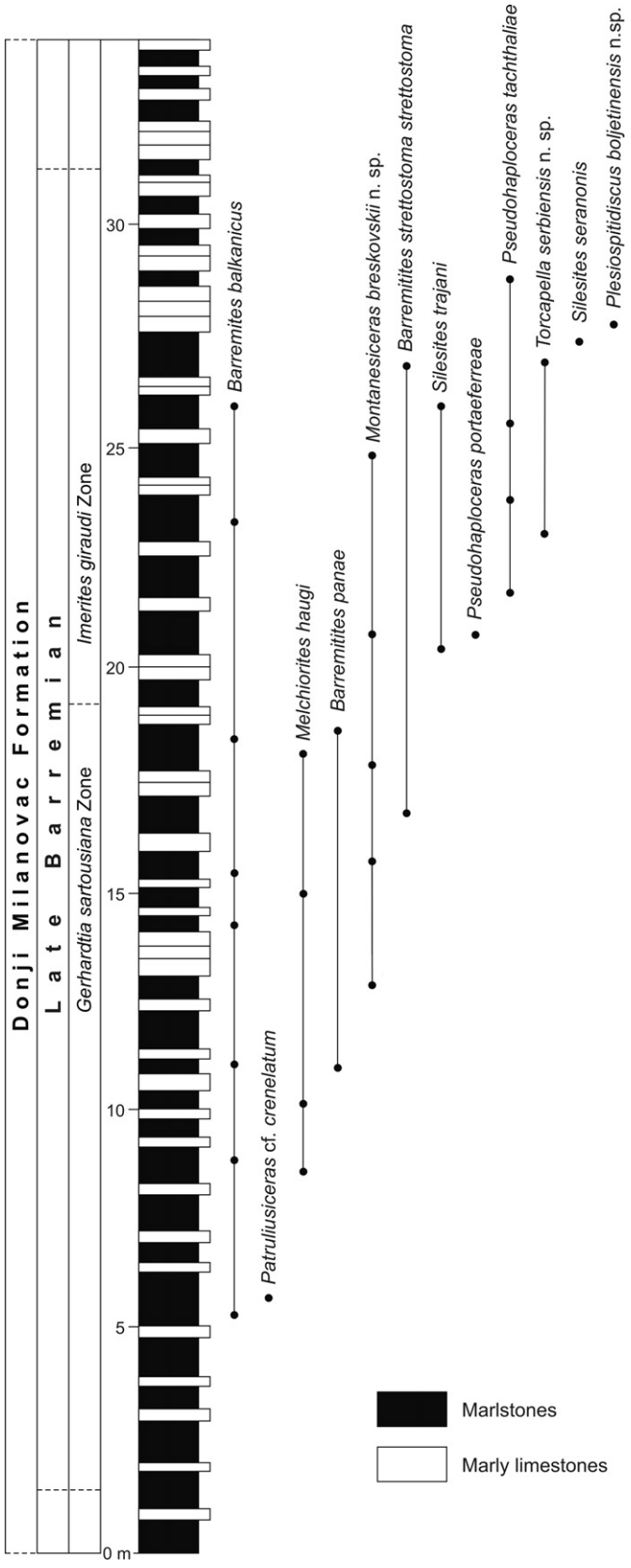


Fig 3. Stratigraphic column and range chart of ammonites of the Boljetin Hill section, eastern Serbia.

designated as *Ammonites nabdalsa*. This enabled a comparison of a part of Coquand's species with related specimens in our Serbian collection.

4. Preservation of fossils

As a rule, ammonites are found in two basic types of sediments: in relatively soft and crumbling marly deposits and in scabby clayey limestones. In the marly deposits, mainly non-deformed pyritic, but usually limonitic moulds of the initial whorls are usually found. The diameter of their shell usually reaches about 10–30 mm; sporadically they are even larger. As evidenced by the more or less perfectly preserved suture-lines, they are always phragmocones. Sometimes, the pyritisation and later limonitization of original shells also occurred. In isolated cases, still pyritised original shells are found that could be designated as *Goldschnecken* by German collectors. With reference to the fact that pyritised and also limonitized shells contain the remains of pyrite, it is necessary to conserve these shells.

In diagenetically consolidated deposits, the living chambers often occur together with usually pyritised inner whorls. These were usually filled with the surrounding sediment. In the course of rock diagenesis, they were compressed and deformed. Sometimes the pyritisation of juvenile whorls did not occur at all and the whole shells are deformed onto the bedding plane. Such deformed shells with living chambers have sporadically the diameters of about 150 mm.

Together with abundant ammonites, sculpture moulds of valves of bivalves and also original shells of brachiopods are found only sporadically.

The fossils described herein are housed in the second author's collection at the Department of Geology and Palaeontology, the Faculty of Mining and Geology, the University of Belgrade (RGF DR). For the Ammonitina, we refer to the new Treatise (Wright et al. 1996) and above all to Klein and Vašíček (2011). For the superfamilies we use here the suffix–oidea (according to the International Code of Zoological Nomenclature, 2000, p. 117).

The dimensions of the ammonite shell are measured in millimetres. The following abbreviations are used: D, shell diameter; H, whorl height; U, umbilical diameter; B, maximum thickness. The measured values are followed by the ratios of the parameters relative to shell diameter given in parentheses (H/D, U/D, B/D) and ratio B/H.

The basic elements of the suture-lines are designated herein by the usual symbols: E, external lobe (with arrow oriented to aperture); L, lateral lobe; U, umbilical lobes.

5. Systematic palaeontology

Superfamily: Desmoceratoidea Zittel, 1895
Family: Barremitidae Breskovski, 1977

It was Breskovski (1977a, b) who paid the greatest attention to Barremian representatives of the family Desmoceratidae in the last decades. He proposed to divide the family Desmoceratidae into nine subfamilies. To the five subfamilies previously stated in a classical work by Wright in Arkell et al. (1957), he added four new subfamilies: namely Torcapellinae, Melchioritinae, Barremitinae and Abrytusitinae.

Breskovski (1977a) further subdivided the subfamily Barremitinae into lower taxa (tribes – Barremitini and Cassidoiceratini). He supplemented the subfamily Barremitinae, in addition to the genera *Barremites* Kilian, 1913, *Cassidoiceras* Dimitrova, 1967 and *Reboulites* Dimitrova, 1967, by the new genera *Kostovites* (type

species *Barremites difficilis dimboviciorensis* Breskovski, 1966) and *Nikolovites* (type species *Barremites* (*Cassidoiceras*) *fegirensis* Dimitrova, 1967). In the conception of Breskovski, the subfamily Torcapellinae contains, besides the genus *Torcapella* Busnardo, 1970 and others, also the genus *Raspailiceras* Wright, 1956 and furthermore, the new genera *Montanesiceras* (type species *Barremites* (*Cassidoiceras*) *chaputi tshuprenensis* Dimitrova, 1967) and *Trimontioniceras* (type species *Barremites charrierianus* Druščic, 1960). Similarly, he extended the subfamily Melchioritinae by new genera *Nabdalsiceras* (type species *Ammonites nabdalsa* Coquand, 1880) and *Falloticeras* (type species *Desmoceras falloti* Kilian, 1910). Later, Breskovski (1980) added the genus *Bistrilitzeras* (type species *Barremites* (*Barremites*) *balkanicus* Manolov, 1975) to them.

The conception of Breskovski (1977a) is based primarily on such detailed features as whorl cross-section, shape of ventral side, presence or absence of periumbilical depression, shape and arrangement of constrictions, size of shells, and others. However, the first three mentioned features are not usually unambiguously distinguishable on deformed shells. Moreover, the formation of juvenile whorls and constrictions is not always known in genera defined only based on large shells and vice versa, the formation of the above-mentioned features on adult whorls in genera and species defined on juvenile shells is not known. It is a pity that although Breskovski promised in his contributions that the description of a number of potential species would be the subject of a special publication, he has never written it.

Breskovski's (1977a) detailed classification of family Desmoceratidae, as follows from the following text, has never been widely used for the reasons given above.

The issue of the new Treatise on Invertebrate Paleontology, part L, vol. 4, Cretaceous Ammonoidea (Wright et al., 1996), family Desmoceratidae, divided into several subfamilies, also contains the subfamily Barremitinae Breskovski (1977a, p. 893). Into the synonymy of this subfamily, the subfamily Torcapellinae Breskovski, 1977a and the tribe Cassidoiceratini are included. The genera *Miodesmoceras* Wright, 1955, *Raspailiceras, Nabdalsiceras, Falloticeras* and *Cassidoiceras* are treated as synonyms of *Barremites*.

Cecca et al. (1998) considered *Raspailiceras, Montanesiceras, Trimontioniceras* and *Kostovites* to be synonyms of the genus *Barremites*.

Vermeulen (1996, 2003, 2005) raised the subfamily Barremitinae to the family Barremitidae, following Hoedemaeker (1995). Vermeulen (2005) included in this family the genus *Montanesiceras* with *Kostovites, Trimontioniceras* and *Nikolovites* as synonyms. He regarded *Cassidoiceras* as a subjective junior synonym of *Melchiorites.*

Klein and Vašíček (2011) submitted for the superfamily Desmoceratoidea a simpler division; it ends with families. We respect their concept in this paper.

All the taxonomically processed genera of the superfamily Desmoceratoidea are characterised by similarly formed adult suture-lines with a relatively low outer lobe and trifid, more and less asymmetric first lateral lobe (Figs 5–8, and 10). The mentioned type of suture-line is also characteristic of all representatives of the genus *Patruliusiceras* Avram, 1990. Avram (1990) classified this genus into the family Silesitidae Hyatt, 1900. Suture-lines of true Barremian silesitids are, however, formed much simply (see Fig. 11). Vermeulen (2005, p. 156) also expressed his doubts about the classification of some representatives of *Patruliusiceras* into silesitids; he noted that the type species of *P. crenelatum* had affinity to *Melchiorites* Spath, 1923.

In accordance with Vermeulen (2007), we consider the genus *Silesites* to be a constituent part of the superfamily Silesitoidea Hyatt, 1900 and not to be a representative of the superfamily Desmoceratoidea. The main reason is the simpler character of the suture-line in *Silesites* than that in desmoceratids of a similar age.

Genus *Plesiospitidiscus* Breistroffer, 1947

Type species. Ammonites ligatus d'Orbigny, 1841. Lectotype, considered to be lost for a long time, was found and illustrated again not long ago (Vermeulen et al., 1999).

The genus *Plesiospitidiscus*, designated by Breistroffer (1947), differs from the related genera *Barremites* Kilian, 1913 and *Montanesiceras* Breskovski, 1977, which have relatively smooth, involute shells with high whorls, and which usually bear ribs on the shells and on internal moulds constrictions corresponding to them, and above all by the formation of constrictions. In the genus *Plesiospitidiscus,* constrictions reach, in contrast to the above-mentioned genera (if they have developed constrictions in at least later growth stages), as far as the umbilical wall and form characteristic notches on it. With reference to the above-mentioned feature, Wright et al. (1996) and Cecca et al. (1998) consider by right the genus *Reboulites* Dimitrova, 1967 (type species *Puzosia issarpayensis* Kilian et Reboul, 1915) as a synonym of *Plesiospitidiscus.* For the same reasons, and moreover with regards to the cross-sections of whorls that narrow towards the venter, we regard the genus *Raspailiceras* Wright, 1956 (type species *Ammonites cassida* Raspail, 1831) to be also a synonym of *Plesiospitidiscus*.

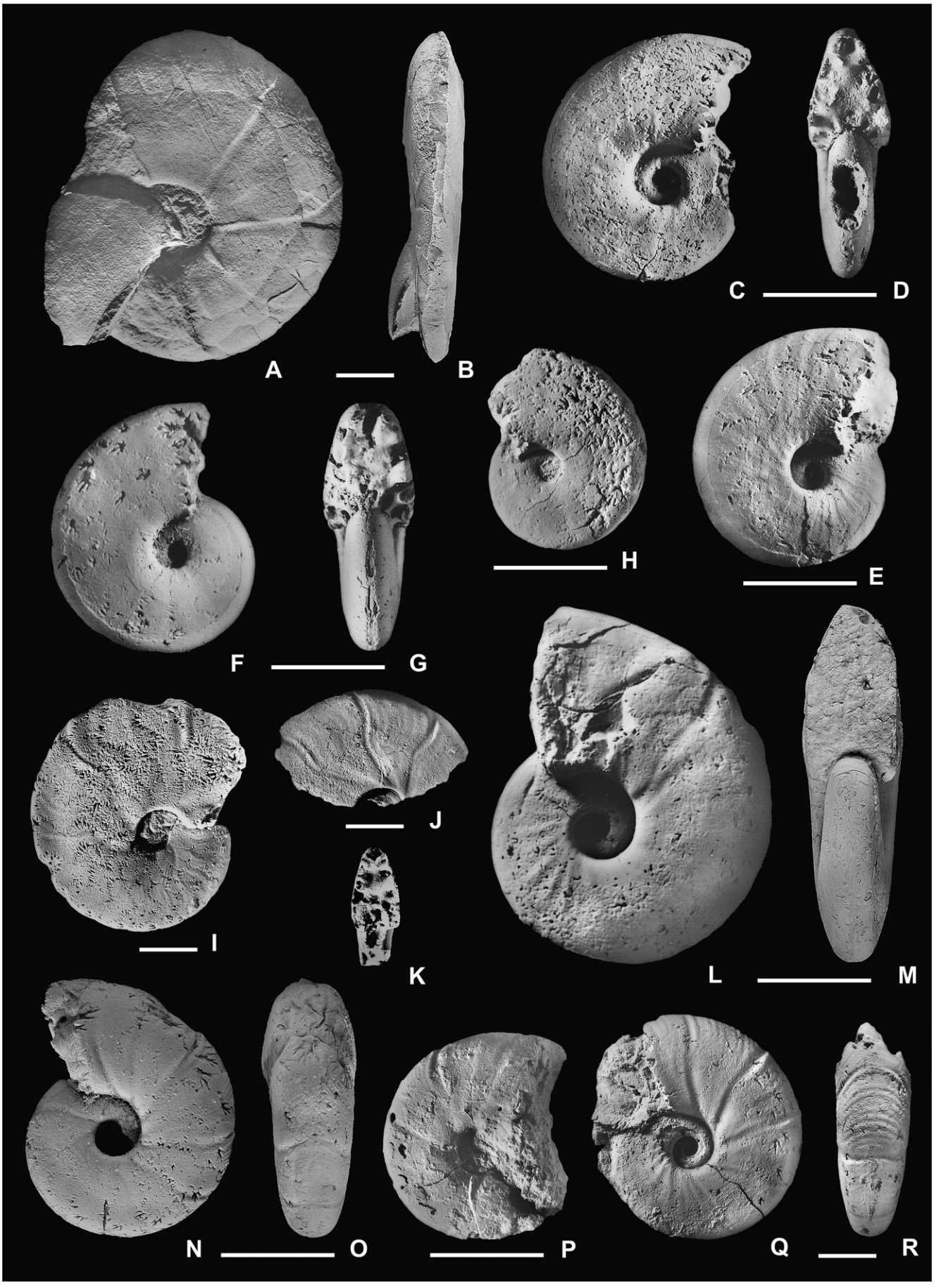
Plesiospitidiscus boljetinensis n. sp.
Fig. 4A, B

1991 *Trimonitioniceras boletinense* sp.; Rabrenović, p. 230, pl. 7, figs 4, 5 (nom. nud.).

Etymology. After the name of municipality of Boljetin, in the vicinity of which the type locality is situated.

Diagnosis. Shell involute, with convex whorls and a periumbilical depression, bears straight, distinct, proverse constrictions. These bend towards the aperture in the vicinity of the venter and continue in an arch-like manner on the venter. On the base of the whorl, the constrictions form notches.

Fig 4. The Late Barremian ammonites of the Gornji Milanovac Formation from the Boljetin Hill section, eastern Serbia (except Tietze's specimen). A, B. *Plesiospitidiscus boljetinensis* n. sp., holotype, specimen RGF DR 5/17; A: the end of phragmocone and the living chamber; B: ventral view; *Imerites giraudi* Zone. C–E. *Barremites balkanicus* Manolov; C, D. Specimen RGF DR 3/122, preserved as an internal mould; C: lateral view, D: apertural view; *Gerhardtia sartousiana* Zone. E. Specimen RGF DR 4/18, in the juvenile part and on the circumference with the limonitized original shell, the remaining part preserved as internal mould; lateral view; *Immerites giraudi* Zone. F–H. *Montanesiceras breskovskii* n. sp. F–G. Holotype, specimen RGF DR 3/59, on the circumference there are the remains of the original shell, prevailing part preserved as internal mould; F: lateral view, G: apertural view; *Immerites giraudi* Zone. H. Paratype, specimen RGF DR 3/10, juvenile part with the remains of the original shell, continuation preserved as internal mould; lateral view; *Gerhardtia sartousiana* Zone. I. *Barremitites strettostoma strettostoma* (Uhlig), specimen RGF DR 3/130, preserved as an internal mould; lateral view; *Immerites giraudi* Zone. J–K. *Barremitites panae* Avram, specimen RGF DR 3/129, preserved with the original shell; J: lateral view, K: apertural view; *Gerhardtia sartousiana* Zone. L, M. *Torcapella serbiensis* n. sp., holotype, specimen RGF DR 4/17, phragmocone and the beginning part of living chamber preserved as an internal mould; L: lateral view; M: apertural view; *Imerites giraudi* Zone. N–R. *Pseudohaploceras tachthaliae* (Tietze). N, O. Specimen GBA 1872/002/0077, the original of Tietze, 1872, pl. 9, fig. 3, from the ?Aptian of Sviniţa, Romania; N: lateral view, O: ventral view. P. Specimen RGF DR 4/14, in the vicinity of the aperture, thin ribs on the venter are still indistinct; lateral view; *Imerites giraudi* Zone. Q, R. Specimen RGF DR 3/101; Q: lateral view, R: ventral view; *Imerites giraudi* Zone. White scale bars represent 1 cm. Before taking the photos, the shells were whitened with ammonium chloride. Photos K. Mezihoráková, Ostrava and A. Schumacher, Vienna (Fig. 4N, O).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Holotype. Specimen RGF DR 5/17, illustrated in Fig. 4A, B. A single shell, deformed onto the bedding plane of marly limestone, of medium size, incomplete, preserved as an internal mould (RGF DR 5/17). The terminal half-whorl is occupied by the body chamber.

Type locality and horizon. Boljetin Hill, eastern Serbia, the Late Barremian (the *Imerites giraudi* Zone), Donji Milanovac Formation.

Description. Shell involute, with rather high whorls and a quite narrow umbilicus. With regards to deformation, the cross-section of the whorl and the shape of the venter are not known. However, it is clear that the flanks of the whorl were convex. The whorl has the greatest width at about the lower third of the flanks. Between it and the coiling line, a periumbilical depression exists. The flanks of the whorl are probably separated from the umbilicus by an edge. An umbilical wall is not evident, owing to the deformation of the shell and the filling of the umbilicus with sediment.

On the surface of the shell, only constrictions are in principle apparent. They are prevailingly almost straight, proverse. In the vicinity of the venter, they are markedly proverse. Across the venter, they run without interruption in an arch-like manner. The constrictions are relatively wide and deep. From the venter to the umbilicus, they are evenly strong. The constrictions reach as far as the line of coiling, where they form conspicuous notches. On the anterior side, the constrictions are more distinctly delimited than on the posterior side, where a thin rib is present in front of the constrictions. Merely in places, growth lines are indistinct between the constrictions. On the terminal half-whorl, there are five constrictions.

Measurements (in mm) *and ratios.*

Specimen No. RGF DR	D	H	U
5/17, holotype (Fig. 4A, B)	56.8 (max. 57.5)	26.7 (0.47)	12.8 (0.22)

Remarks. As the element decisive for the generic classification, we take notches on the line of coiling. As we have not yet succeeded in revealing any equivalent species, it is assume that it is a case of a new species. From the point of view of the arrangement of the constrictions, *Plesiospitidiscus subdifficilis* (Karakaš, 1907), *P. rebouli* (Kilian, 1910) and *P. issarpayensis* (Kilian et Reboul, 1915) can be considered as close species. However, in all cases, the specimens have more constrictions than *P. boljetinensis.*

Genus *Barremites* Kilian, 1913

Type species. Ammonites difficilis d'Orbigny, 1841.

Barremites balkanicus Manolov, 1975
Figs 4C–E, 5

?1960 *Barremites subdifficilis* Karak. Druščic in Druščic and Kudrjavcev, p. 299, pl. 42, fig. 2a, b.
1975 *Barremites* (*Barremites*) *balkanicus* Manolov, p. 315, pl. 1, figs 1–10.
1980 *Bistrilitzeras balkanicus* Manolov; Breskovski, p. 247.
1991 *Bistrilitzeras breskovski* n. sp.; Rabrenović, p. 232, pl. 7, figs 8, 10 (only).
2011 *Montanesiceras balkanicum* (Manolov); Klein and Vašíček, p. 18.

Material. Eight internal moulds (phragmocones), partly with remains of the original shell (specimens RGF DR 3/17, 3/121, 3/122, 3/123, 3/124, 3/125, 4/18, 4/31), preserved as non-deformed limonitic moulds.

Description. Shells involute, with medium-high, slim, slightly convex whorls and a relatively narrow umbilicus. The whorl is most convex near the umbilicus. From the widest point, the whorls converge to the venter. This is smooth, narrow, and only slightly convex. The venter is separated from the whorl flanks distinctly although bluntly. From the most convex point towards the umbilicus, the flanks of the whorl decline over a short distance. They are separated bluntly from the low, steep umbilical wall.

On the flanks of specimens with the remains of the original shell, on the terminal whorl, weak, sometimes merely indistinct, blunt ribs are usually visible. Ribs are proverse and slightly S-shaped. Usually they are accompanied by numerous weak constrictions that are delimited with an indistinct rib on the anterior side. Their number is variable, most frequently eight per half-whorl; no continuation on the venter is apparent.

Measurements (in mm) *and ratios.*

Specimen No. RGF DR	D	H	U	B	B/H
4/18 (Fig. 4E)	21.9	10.4 (0.47)	5.8 (0.26)	7.0 (0.32)	0.67
3/122 (Fig. 4C, D)	22.1	10.2 (0.46)	5.4 (0.24)	6.8 (0.31)	0.67
4/31	30.5	15.0 (0.49)	6.3 (0.21)	9.7 (0.32)	0.65
3/125	31.7	15.1 (0.48)	7.3 (0.23)	10.0 (0.31)	0.66

Suture-line. On the majority of phragmocones, strongly articulated, outer parts of suture-lines are preserved (Fig. 5). The most complete suture-line has specimen RGF DR 3/122; it is preserved almost as far as the umbilical wall. On it, six lobes are distinct. A not too deep external lobe bears a low secondary saddle. The first lateral lobe is the deepest, asymmetrically trifid. Its external lateral secondary lobe is more robust than the equivalent internal lobe. Saddles are asymmetric, bifid. The first partial lateral saddle adjacent to the external lobe is more robust than the opposite partial saddle.

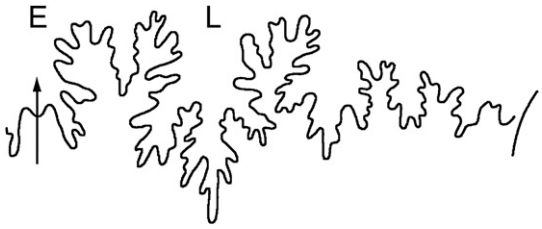

Fig. 5. Almost complete outer suture-line of *Barremites balkanicus* Manolov, specimen RGF DR 3/122 at D = 21 mm (H = 10 mm).

Remarks. The type material of Manolov (1975, specimen C_r 225, holotype figured on pl. 1, fig. 2 and all other specimens) from the Late Barremian (*Silesites seranonis* Zone) of the Salash Synclinale (village of Bistrilitza, north-eastern Bulgaria) is deformed. Most importantly, the cross-section of the whorls and the shape of the venter are not clear. Some specimens are almost smooth. His specimen in pl. 1, fig. 6 shows, on the other hand, a well-preserved sculpture. The Serbian collection (see Material), represented by non-deformed specimens, is preserved non-uniformly mainly from the point of view of the sculpture. Specimen RGF DR 3/17 documents the style of preservation of the sculpture in segments with remains of the original shell and on an internal mould. In some cases (specimen RGF DR 4/31), the sculpture has not been preserved almost at all. The size parameters of Manolov's collection, although slightly affected by deformation, correspond well with the Serbian material (U/D of about 0.20, H/D of 0.48–0.50).

Based on the narrow umbilicus (U/D of about 0.20) and quite high and slim whorls (B/D of about 0.31), we do not consider Manolov's specimens (1975, p. 315, pl. 1, figs 1–10) to be a member of melchiorites group; rather, we consider it be included into the genus

Barremites (in accordance with the original conception of Manolov, 1975). It is a fact that the sculpture of *B. balkanicus* is reminiscent somewhat type species of the Late Hauterivian *Plesiospitidiscus subdifficilis* (Karakaš) from Crimea. However, the indistinct constrictions of *B. balkanicus* do not indicate to the genus *Plesiospitiscus*. This is also especially evident in a specimen designated as *Barremites subdifficilis,* illustrated by Druščic (1960, pl. 42, fig. 2), which should come from the Late Barremian. According to Druščic, it has size parameters similar to those of *B. balkanicus*. According to the illustration, its venter seems to be somewhat wider.

Occurrence. B. balkanicus is known only from the Late Barremian of Bulgaria so far. Its occurrence in the Crimea cannot be excluded. In the Boljetin Hill section, it is found in the Late Barremian (the *Gerhardtia sartousiana* and *Immerites giraudi* Zones), Donji Milanovac Formation.

Genus *Montanesiceras* Breskovski, 1977

Type species. Barremites (Cassidoiceras) chaputi tshuprenensis Dimitrova, 1967.

Montanesiceras breskovskii n. sp.
Figs 4F–H, 6

1991 *Bistrilitzeras breskovski* n. sp.; Rabrenović, p. 230, pl. 7, only figs 7, 9 (nom. nud).

Etymology. Dedicated to Stanislav Breskovski, a significant Bulgarian palaeontologist, who was also extensively concerned with desmoceratids within the framework of the study of Lower Cretaceous ammonites in Bulgaria.

Diagnosis. Involute, suboxycone shells with high whorls and a narrow umbilicus. Shells are smooth.

Holotype. Specimen RGF DR 3/59, illustrated in Fig. 6F–G, the *Imerites giraudi* Zone.

Paratypes. Four non-deformed shells (phragmocones), usually with a partially to entirely preserved outer part of the suture-line (RGF DR 3/10, 3/26, 3/58, 3/126).

Type locality and horizon. Boljetin Hill, eastern Serbia, the upper part of the Late Barremian section. In the Boljetin Hill, Late Barremian (the *Gerhardtia sartousiana* and *Imerites giraudi* Zones), Gornji Milanovac Formation.

Description. Shells small, involute, with high and not too wide whorls and a narrow umbilicus. The width of whorls is the greatest near the umbilicus. The flanks of the whorl decline to the venter over a short distance. The venter is rather narrow and convex. It is not sharply separated from the whorl flanks. From the most convex point of the whorl, the flanks decline to the umbilicus over a short distance. The mentioned part has the character of a narrow periumbilical depression. The not sharply, but distinctly delimited flanks of the whorl pass to a low and steep umbilical wall. The shells are smooth; merely in two specimens; thin, flat, not too dense ribs are indistinct.

Measurements (in mm) *and ratios.*

Specimen No. RGF DR	D	H	U	B	B/H
3/10 (Fig. 4H)	18.0	9.9 (0.55)	2.8 (0.15)	6.5 (0.36)	0.66
3/58	19.0	9.9 (0.52)	3.7 (0.19)	6.6 (0.35)	0.67
3/59, holotype (Fig. 4F, G)	22.8	11.6 (0.51)	4.1 (0.18)	7.8 (0.34)	0.67

Suture-line. The most complete outer part of the suture-line is preserved in specimen RGF DR 3/58 (Fig. 6). On the venter and on the whorl flanks, five lobes are preserved; probably even a sixth lobe (non-preserved) existed as well. The not deep external lobe is quite articulated, bears a low secondary saddle extending as far as about 1/3 of the lobe depth. The first lateral lobe is the deepest and, likewise the following lobes, asymmetrically trifid; the partial lobe closer to the external lobe being always more robust than the partial inner lobe. Saddles are asymmetric, bifid.

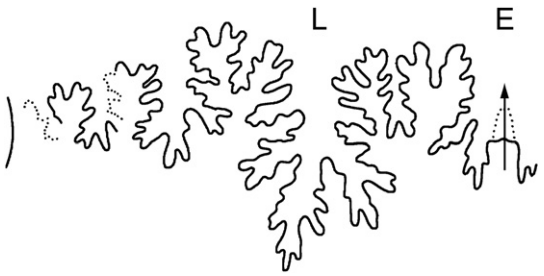

Fig 6. Outer suture-line of *Montanesiceras breskovskii* n. sp., specimen RGF DR 3/58 at D = 18 mm (H = 10 mm).

Remarks. The species defined newly is represented merely by juvenile shells (phragmocones). No constrictions and almost now sculpture are visible on them. This makes generic classification difficult. With regards to the narrow periumbilical depression and the shape of the shells (suboxycone, with a narrow umbilicus, high and somewhat wider whorls), we rank them within a relatively cumulative genus *Montanesiceras* Breskovski, which is defined on large-sized shells with ribs distinct, especially on the outer half of the whorls. The described juvenile shells are relatively close to size-equivalent shells of *Barremites balkanicus.* However, they differ in all size parameters and by having at least faint ribbing. Their suture-lines are similar, only the secondary saddle of the outer lobe of *B. balkanicus* is somewhat less high and articulated.

Genus *Barremitites* Avram, 1997

Type species. Haploceras strettostoma Uhlig, 1883.

Barremitites strettostoma strettostoma (Uhlig, 1883)
Fig. 4I

1883 *Haploceras strettostoma* Uhlig, p. 225, pl. 27, fig. 3a, b, ?figs 8, ?15, non fig. 4a, b (= *Ammonites bicurvatus* Michelin, specimen in Tietze, 1872, pl. 9, fig. 5a, b, = *Barremitites strettostoma tietzei* Avram, 1997).
1921 *Desmoceras strettostoma* Uhl. sp.; Žujović, p. 29.
1978 *? Barremites strettostoma* (Uhlig); Avram, p. 19, pl. 3, figs 1, 3a–d, 5, non figs 2a, b, 4a–d, 6a, b (= *Barremitites strettostoma tietzei* Avram, 1997).
1991 *Barremitites strettostoma* (Uhlig); Rabrenović, p. 226, pl. 7, figs 1, 2.
1997 *Barremitites strettostoma* (Uhlig); Avram, p. 176, pl. 24.II, figs 1a, b, 3, 4a–c.
2011 *Barremitites strettostoma strettostoma* (Uhlig); Klein and Vašíček, p. 20 (cum syn.).

Material. Two specimens (RGF DR 3/127, 3/130). The first is a juvenile specimen preserved as an outer mould; the second specimen is a well-preserved adult phragmocone with suture-lines.

Description. Shells involute, lenticular, with slender, high whorls, which are slightly convergent-depressed in their outer

halves, and with a narrow umbilicus. The umbilical wall is separated from the flanks with an edge. The venter is narrow, strongly convex.

On the ventral half of the flanks on the final half-whorl, weak ribs concavely bent towards the aperture are evident. In front of some of them, weak, indistinct constrictions are present. Between the mentioned ribs, lines of behaviour similar to those of ribs appear here and there.

Measurements (in mm) *and ratios*.

Specimen No. RGF DR	D	H	U	B	B/H
3/130 (Fig. 4I)	41.7	22.1 (0.53)	6.7 (0.16)	11.5 (0.27)	0.52

Remarks. Based on the species *Barremites strettostoma* (Uhlig), Avram (1997) justifiably defined the genus *Barremitites*. This is, however, in addition to a spiral depression situated on the outer side of the whorl, also characterised by suture-lines with a shallow outer lobe and a robust, high secondary saddle in the lateral lobe (see e.g., Avram, 1997, pl. 24II, figs 2c, 4c, 5c). Avram (1997) divided the hitherto species *B. strettostoma* into two subspecies, namely the typical subspecies and *B. s. tietzei* Avram, 1997. *B. s. tietzei* differs from the typical subspecies and our material by having markedly developed constrictions. In addition to the mentioned subspecies, *B. strettostoma eichwaldi* (Dimitrova, 1967), differing from both the mentioned ones by having another whorl cross-section with a wider and more rounded venter, is defined as well.

Occurrence. The type material comes from the area of Sviniţa in Rumania. Avram (1997, p. 177) states its distribution in all the Late Barremian and also the Early Aptian. *B. strettostoma* is distributed over a considerable area in the Mediterranean regions of Europe and adjacent areas. Andjelković (1956, pl. 4, fig. 1) described and illustrated *B. s. strettostoma* from central Serbia under the name *Barremites strettostoma* nov. var. His poor-quality illustration, however, does not indicate that it is *B. strettostoma.* In the Boljetin Hill, the specimens come from the Late Barremian (the *Gerhardtia sartousiana* and *Imerites giraudi* Zones), Donji Milanovac Formation.

Barremitites panae Avram, 1997
Figs 4J, K, 7

?1978 ?*Barremites strettostoma* (Uhlig); Avram, pl. 2, fig. 2a, b.
1997 *Barremitites panae* Avram, p. 177, pl. 24.III, figs 1a–d, 2a–d.
2011 *Barremitites panae* Avram; Klein and Vašíček, p. 20.

Material. Two fragments. A fragment (RGF DR 3/129) of about a quarter of an adult whorl (phragmocone) preserved on one side as an inner mould with well-visible suture-lines on the outer half-whorl, on the other side with the remains of the limonitized original shell; and an additional fragment (RGF DR 3/132).

Description. Shells involute, with relatively slender whorls converging to the venter. The venter is narrow and convex. Near the ventral area, a shallow depression is indistinct on the flanks. The umbilical wall is low, slightly concave. It is separated from the flanks by an angular edge. On the phragmocone, three constrictions of the falcoid type are well-developed. In the umbilical region, the constrictions are relatively straight, considerably inclined towards the aperture. After a rather sharp bend in the centre of the whorl flanks, they are concave in relation to the aperture. They are wider in comparison with the previous part. Across the venter, the constrictions form a relatively sharp bend towards the aperture. On the back side of the constrictions, a rather strong rib is there near the venter. On the opposite side of the whorl, the sculpture is similar, but more conspicuous. The mentioned rib on the back side of the constrictions almost reaches the umbilicus. On the front side of the constrictions, a short rib is developed in the vicinity of the venter. In addition to these ribs, weak, blunt ribs also occur on the outer side of the whorls.

Measurements (in mm) *and ratios*.

Specimen No. RGF DR	D	H	U	B	B/H
3/129 (Fig. 4J, K)	–	20.4 (max.)	–	11.5 (0.27)	0.56

Suture-line. An incomplete outer part of an adult suture-line (Fig. 7) with a poorly preserved area of umbilical saddles and lobes is characterised by a shallow external lobe with a low secondary saddle. The lateral lobe is deep and very wide. It is asymmetric, with a strikingly high and robust secondary saddle. The saddles on both sides of the lateral lobe are asymmetrical.

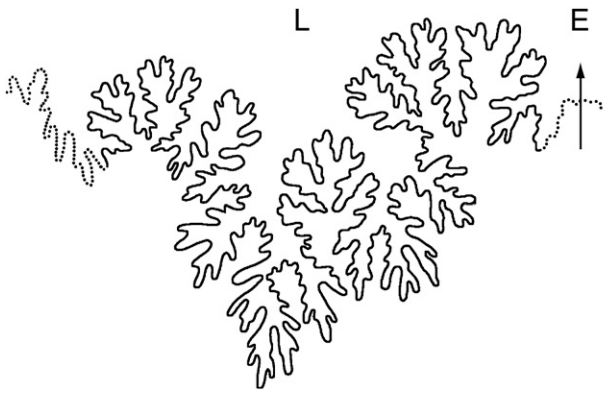

Fig. 7. A part of the outer suture-line of *Barremitites panae* Avram, specimen RGF DR 3/129 at H = 20.2 mm.

Remarks. In contrast to the type material of Avram (1997, p. 177, pl. 24.III, fig. 1 – holotype and fig. 2) from the Late Barremian (below the beds with *Imerites*), Sviniţa locality, Romania, preserved as internal mould, our adult specimen enables his diagnosis to be supplemented with the description of sculpture of an original shell. Typical features of *B. panae* are proversal constrictions in comparison with relatively straight constrictions of *B. strettostoma tietzei* and relatively wider whorls (B/H = 0.56–0.58) of *B. panae* than those of both the subspecies of the typical species *B. strettostoma* (B/H about 0.50).

Occurrence. Hitherto, *B. panae* was merely known from the Romania territory, from the vicinity of the known locality of Sviniţa. Avram (1997) stated that the mentioned species occurs in the Late Barremian, in the layers underlying deposits with *Imerites.* The fragments of our adult specimens comes from the Late Barremian (the *Gerhardtia sartousiana* Zone) in the described section.

Genus *Torcapella* Busnardo, 1970

Type species. *Ammonites Fabrei* Torcapel, 1884.

Torcapella serbiensis n. sp.
Figs 4L, M, 8

1921 *Desmoceras portae ferrae* Tietze sp.; Petković, p. 74, pl. 1, fig. 29, ?fig. 28.

1991 *Melchiorites melchioris* (Tietze); Rabrenović, p. 228, pl. 8, figs 2, 4 (only).

Etymology. After Serbia, the country from which the findings come.

Diagnosis. Shell involute, suboxycone. On the juvenile half of the terminal whorl, there are proverse ribs. The terminal half bears merely very indistinct ribs. The phragmocone ends with an indistinct, S-shaped constriction.

Holotype. Specimen RGF DR 4/17, illustrated in Fig. 4L, M.

Paratype: In addition to the holotype that belongs, with the exception of a short last part, to the phragmocone preserved partly as a sculpture mould and partly as an internal mould, another juvenile specimen (RGF DR 4/53).

Type locality and horizon. Boljetin Hill, eastern Serbia, the Late Barremian (the *Imerites giraudi* Zone), Donji Milanovac Formation.

Description. Shell involute, with high and narrow whorls and a relatively narrow umbilicus. The flanks of the terminal whorl are slightly convex. The width is the greatest at about the lower quarter of the flank. The continuously convex whorl flanks incline towards the venter. They are separated, although not sharply, from the rather narrow and convex venter. The flanks also incline continuously towards the umbilicus. The umbilicus is markedly bordered, but merely by a not quite sharp edge, from the vertical and low umbilical wall.

On the juvenile half of the terminal whorl, there are not too distinct, rather blunt and sparse, almost straight, simple ribs. They are proverse. On the inner (juvenile) half of the terminal whorl, about 14 ribs are present. Near the venter, the ribs fade away. The mentioned ribs are barely preserved in the continuation of the terminal whorl. At the terminal half-whorl, three constrictions bend across the venter that is smooth. Only the last of them is evident also on a flank of the whorl, namely as a weak, S-shaped constriction.

Measurements (in mm) *and ratios*.

Specimen No. RGF DR	D	H	U	B	B/H
4/17, holotype (Fig. 4L, M)	30.4 (max. 32.0)	14.0 (0.46)	7.2 (0.24)	9.4 (0.31)	0.67
Same shell 4/53	24.4 15.8	11.6 (0.47) 8.6 (0.54)	5.2 (0.21) 3.5 (0.22)	7.6 (0.31) 5.4 (0.34)	0.66 0.63

Suture-line. One of the last suture-lines on the phragmocone has only an imperfectly preserved external lobe, and on the preceding suture-line also another, incomplete lateral lobe (Fig. 8). The external lobe bears a low secondary saddle; the first lateral lobe, which is asymmetrically trifid, is the deepest. The following lobe has a shape quite similar to that of the first lateral lobe. The preserved saddles are bifid. On the whole, the shape of the incomplete adult suture-line is very similar to that in the genus *Barremites.*

Fig. 8. A part of an imperfectly preserved outer suture-line of *Torcapella serbiensis* n. sp. together with an incomplete second lateral lobe preserved on the previous suture-line; holotype, specimen RGF DR 4/17 at D = 30 mm (H = 14 mm).

Remarks. From the point of view of shape and size parameters, the holotype is reminiscent of shells of *Barremites balkanicus.* Similarly shaped is also the suture-line. But *T. serbiensis* differs clearly in sculpture. Its ribbing, reaching as far as the vicinity of the venter, is reminiscent of ribs of the genus *Torcapella* Busnardo. The majority of the representatives of the mentioned genus, the species of which are represented especially by large-sized shells, bear rather thin and dense falcoid ribs. These are in the lower half-whorl almost straight, proverse. For these reasons, we believe that the Serbian specimens, which are, however, represented only by juvenile shells and terminal development stage, belong to the genus concerned. A certain similarity in the form of the ribbing in the lower half-whorl can be found in the Late Barremian species *Torcapella falcatiformae* Kotetishvili, 1978 (documented only by adult large-sized shells as well). For the sake of completeness, we would like to add that the illustrations of all ammonite shells in the table in Petković (1921) are not in actual size, because the photographs were reduced. The majority of species of the genus *Torcapella* occur in the Early Barremian. *T. falcatiformae* (*Colchidites securiformis* Zone) from Georgia, similarly to *T. serbiensis,* occurs in the Late Barremian (the *Imerites giraudi* Zone).

Genus *Pseudohaploceras* Hyatt, 1900

Type species. Ammonites Liptoviensis Zeuschner, 1856.

Pseudohaploceras tachthaliae (Tietze, 1872)
Fig. 4N–R

1872 *Ammonites Tachthaliae* Tietze, p. 136, pl. 9, fig. 3a, b.
1883 *Haploceras Tachthaliae* Tietze; Uhlig, p. 155.
1921 *Desmoceras Tachthaliae* Tietze sp.; Petković, p. 72, pl. 1, figs 26, 27.
1978 *Pseudohaploceras tahchthaliae* (Tietze); Avram, p. 13, pl. 2, fig. 1a–d (= Tietze's specimen, 1872, pl. 9, fig. 3a, b), figs 2, 3, 4a, b, 5a, b, 6a, b, text-fig. 3 (= Tietze's specimen, 1872, pl. 9, fig. 3a, b).
1978 *Pseudohaploceras portaeferreae* (Tietze); Avram, p. 15, pl. 2, fig. 8.
2011 *Pseudohaploceras tahchthaliae* (Tietze); Klein and Vašíček, p. 44 (cum syn.).

Material. Two incomplete juvenile sculpture mould (specimens RGF DR 4/14, 4/16), one fragment of a whorl of an adult shell (specimen RGF DR 3/102) and a relatively well-preserved complete phragmocone with incomplete suture-lines of an adult shell (specimen RGF DR 3/101).

Description. Shells semi-involute, of medium size, with a rather wide umbilicus. The not high whorls are slightly convex. The most convex point is at about the lower third of flank. From there, the whorl flanks gradually incline towards the venter, into which they pass without interruption. The venter is slightly convex, of medium width. The umbilicus has a low and steep umbilical wall, which is distinctly, although roundly, separated from the whorl flanks.

The whorls bear numerous proverse constrictions. On the whole, they are moderately S-shaped, on the venter bounded by

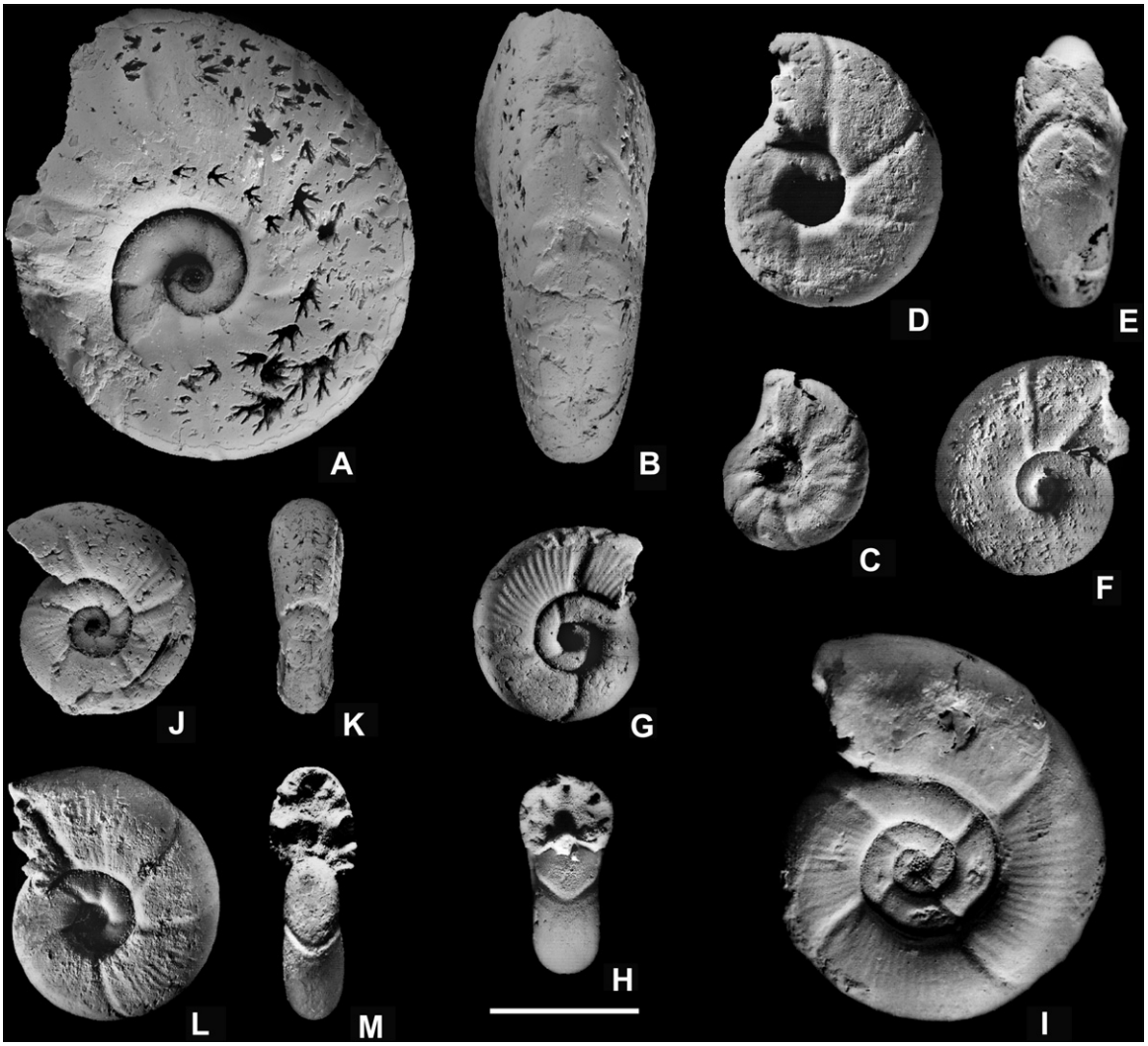

Fig. 9. The Late Barremian ammonites of the Gornji Milanovac Formation from the Boljetin Hill section, eastern Serbia (except Tietze's specimen). A–C. *Pseudohaploceras portaeferreae* (Tietze). A, B. Specimen GBA 1872/002/0078, the original of Tietze, 1872, pl. 8, fig. 10, from the ?Aptian of Sviniţa, Romania; A: lateral view, B: ventral view. C. Juvenile specimen RGF DR 3/11; lateral view; *Imerites giraudi* Zone. D, E. *Melchiorites haugi* (Kilian), specimen RGF DR 4/52, preserved as an internal mould; D: lateral view, E: ventral view; *Gerhardtia sartousiana* Zone. F. *Patruliusiceras* cf. *crenelatum* Avram, specimen RGF DR 3/128, preserved as an internal mould; *Gerhardtia sartousiana* Zone. G–I. *Silesites trajani* (Tietze). G, H. Specimen RGF DR 4/34, preserved as an internal mould; G: lateral view, H: apertural view; *Imerites giraudi* Zone. I. Specimen RGF DR 3/46; lateral view; *Imerites giraudi* Zone. J–M, *Silesites seranonis* (d'Orbigny). J, K. Specimen GBA 1872/002/0086, the original of Tietze, 1872, pl. 9, fig. 2, from the ?Aptian of Sviniţa, Romania; J: lateral view, K: ventral view. L, M. Specimen RGF DR 4/7; L: lateral view, M: apertural view; *Imerites giraudi* Zone. White scale bar represent 1 cm. Before taking the photos, the shells were whitened with ammonium chloride. Photos by K. Mezihoráková, Ostrava and A. Schumacher, Vienna (Fig. 9A, B, J, K).

a weak, blunt rib. They appear closely above the umbilical wall. There they are wide and markedly proverse. At about the whorl mid-flank, the constrictions bend to the opposite side. At three quarters of the flank, they are proverse again. In contrast to this arrangement, the constrictions narrow and deepen, because on their posterior sides a relatively narrow and distinct rib appears. Across the venter they curve convexly forward. There are about 5–6 constrictions per half-whorl.

Between the constrictions on the terminal whorl, simple thin ribs are there on the outer side. They fade away at around whorl mid-flank. However, a small portion of them reach as far as the umbilicus. The number of them ranges from 7–9. The arrangement of the ribs follows that of the constrictions. The last ribs are incomplete, because they end as close as the preceding constriction on the venter.

The juvenile shells of diameters less than 20 mm are, with the exception of constrictions, smooth. Only later, dense, thin ribs appear between the constrictions in the vicinity of the venter. At the terminal half-whorl, there are six constrictions.

Measurements (in mm) *and ratios*.

Specimen No. RGF DR	D	H	U	B	B/H
3/101 (Fig. 4Q, R)	37.5 (max. 41.3)	16.7 (0.44)	8.5 (0.23)	12.7 (0.34)	0.76
3/102	–	17.3	11.4	13.8	0.80
4/16	20.5	10.5 (0.51)	5.5 (0.27)	6.8 (0.33)	0.65

Remarks. The morphology of the shells, especially the constrictions and the suture-lines, are typical features of *Pseudohaploceras.* Avram (1978) described in detail the holotype of *Ps. tachthaliae*

(including thin ribs between constrictions) and also illustrated the suture-line of it, not known at that time. Avram (1978) also figured an incomplete large shell under the name *Pseudohaploceras portaeferreae* in pl. 2, fig. 8. However, the sculpture of it corresponds fully to that of *P. tachthaliae*.

An allegedly close species *P. portaeferreae* is so far an imperfectly known species. Constrictions on Tietze's holotype (1872, pl. 8, fig. 10a, b) are more numerous (14–15 on the terminal whorl) and are little conspicuous, especially on the venter. At a maximum diameter of somewhat more than 30 mm, the shell, with the exception of the constrictions, remains smooth.

Occurrence. In addition to Tietze's holotype of *P. tachthaliae*, Avram's specimens (1978) come from the same area of Romania (from the Banat Mts.). Avram incorporated them into the upper part of the Late Barremian. Into the Barremian, Petković (1921) also included his findings from Serbia. The Serbian specimens were found in the Late Barremian (the *Imerites giraudi* Zone), Donji Milanovac Formation.

Pseudohaploceras portaeferreae (Tietze, 1872)
Fig. 9A–C

1872 *Ammonites portae ferrae* Tietze, p. 136, pl. 8, fig. 10a, b.
? 1921 *Desmoceras portae ferrae* Tietze sp.; Petković, p. 74, pl. 1, fig. 28, non fig. 29 (= *Torcapella serbiensis* n. sp.).
1978 *Pseudohaploceras portaeferreae* (Tietze); Avram, p. 15, text-fig. 4, pl. 2, fig. 7a–d, non fig. 8a, b (= *Pseudohaploceras* tachthaliae).
1991 *Melchiorites melchioris* (Tietze); Rabrenović, p. 228, pl. 8, fig. 3 (only).
2011 *Pseudohaploceras portaeferreae* (Tietze); Klein and Vašíček, p. 43.

Material. A single small limonitized sculpture mould (specimen RGF DR 3/11).

Description. Mould of juvenile specimen, semi-involute, with a flat, not too high terminal whorl. Whorl flanks pass relatively continuously to the rather narrow, strongly convex venter. On the base, the flanks are bounded by an indistinct edge, followed by a low umbilical wall inclined obliquely to the umbilicus. On the shell flanks, there are numerous constrictions, straight at the beginning. In the vicinity of the venter, the constrictions incline markedly towards the aperture. Across the venter, they run forming a relatively closed, sharp bend. At the umbilical edge, the constrictions are the deepest; on the flanks and along the venter, they are less distinct. The last constrictions in the vicinity of the aperture are S-shaped. On both sides, they are accompanied by indistinct ribs. Otherwise, the shell is smooth. On the last whorl, there are about 11 constrictions. Near the aperture, the constrictions are more abundant than in the juvenile part of the whorl.

Measurements (in mm) *and ratios.*

Specimen No. RGF DR	D	H	U	B	B/H
3/11 (Fig. 9C)	11.7 (max. 11.8)	5.2 (0.44)	3.3 (0.28)	4.3 (0.37)	0.83

Remarks. The juvenile mould is reminiscent of the holotype of *P. portaeferreae* (Tietze, 1872, p. 136, pl. 8, fig. 10a, b) from the Late Barremian (the Sviniţa Formation) of Sviniţa, Romania, which is deposited in Tietze's collection in the Geologische Bundesanstalt (GBA) in Vienna. This holotype, studied and illustrated later by Avram (1978, pl. 2, fig. 7a–d), differs from the Serbian specimen by a relatively wide and slightly convex venter. Numerous constrictions on the holotype are documented best by Tietze's lithographic illustration. The constrictions are difficult to photograph as can be seen in Avram's illustration (1978, pl. 2, fig. 8), as well as a new photograph in a submitted work that was taken by Alice Schumacher from GBA in Vienna.

On the terminal whorl of the holotype, 14–15 constrictions are there. The maximum diameter of the holotype is about 30 mm. On it we measured the following dimensions: at D = 29.7 mm, H = 13.8 (0.46), U = 7.3 (0.245), B = 10.7 (0.36), B/H = 0.775. These values are close to those of the Serbian specimen being described. Even at the maximum diameter of the holotype, no ribs occur between constrictions, as is usual in representatives of the genus *Pseudohaploceras*. Thus the generic classification of *Ps. portaeferreae* is rather uncertain.

Occurrence. Hitherto, *Pseudohaploceras portaeferreae* has been reported certainly only from the Late Barremian deposits of Romania. In the Boljetin Hill section, it is known from the Late Barremian (the *Imerites giraudi* Zone), Donji Milanovac Formation.

Genus *Melchiorites* Spath, 1923

Type species. *Ammonites Melchioris* Tietze, 1872.

Melchiorites haugi (Kilian, 1910)
Fig. 9D, E

1898 *Puzosia Melchioris* Tietze; Simionescu, p. 129, pl. 4, fig. 2a, b.
?1907 *Puzosia Melchioris* Tietze; Karakaš, p. 75, pl. 7, figs 4a, b, 8a, b.
1910 *Desmoceras Haugi* Kil.; Kilian, p. 259.
1969 *Melchiorites haugi* (Kilian); Patrulius, pl. 5, fig. 4a, b.
1991 *Melchiorites melchioris* (Tietze); Rabrenović, p. 228, pl. 8, only fig. 1.
2011 *Melchiorites haugi* (Kilian); Klein and Vašíček, p. 51.

Material. Four corroded limonitic sculpture moulds (phragmocones), in places with imperfectly preserved remains of suture-lines (specimens RGF DR 3/75, 3/76, 4/52, 4/160).

Description. Shells semi-involute, with not high whorls and a quite wide umbilicus. The whorl flanks are flat. They are convex mostly somewhere below the whorl mid-flank. From the zone of greatest width, the whorl dips gradually to the venter. The venter is of medium width, roundly convex. Similarly, the flanks dip gradually to the line of coiling. The umbilical wall is missing or is perhaps very low so that the whorls terminate on the line of coiling.

Except for constrictions, the shells are smooth. On the terminal half-whorl, the constrictions are quite deep, distinct. They fade away towards the juvenile end. The constrictions are oblique, on the shell flanks prevailingly almost straight or slightly concave in relation to the aperture. As far as to the vicinity of the venter, they bend evidently towards the aperture. They cross the venter markedly bent to a V-shape. On the terminal whorl, 6–7 constrictions are usually visible but, as already mentioned above, the total number of them is uncertain owing to their dwindling.

Measurements (in mm) *and ratios*.

Specimen No. RGF DR	D	H	U	B	B/H
4/52 (Fig. 9D, E)	18.4	7.4 (0.40)	5.7 (0.31)	5.6 (0.30)	0.76
3/75	20.5 (max.)	8.3 (0.40)	6.2 (0.30)	6.4 (0.31)	0.77
Same shell	18.4	8.0 (0.43)	5.8 (0.31)	6.2 (0.34)	0.78

Remarks. The size parameters are one of the basic generic features for differentiation of *Melchiorites* from others barremitids. *Melchiorites* is characterised by medium-high whorls, a medium-

wide umbilicus and usually medium-wide whorls. The umbilical wall is missing or is very low. On moulds, there are constrictions reaching as far as the line of coiling, where they form notches.

The described material represented merely by shells of small diameter is characterised by medium-height, slightly vaulted whorls with subparallel flanks, a rather wide umbilicus and not too wide, i.e., rather slender, whorls. The constrictions on the flanks are in principle straight; on the venter they incline markedly towards the aperture. Crossing the venter, they sharply bend into a V-shape. Between the constrictions, no sculpture is visible.

From the above-mentioned characteristics, it follows that the described shells differ from those of *M. melchioris* (Tietze) from the Sviniţa locality in their dimensional parameters, i.e., by having a somewhat larger whorl height, a wider umbilicus and a smaller whorl width, and also by the fact that on the shells of *M. melchioris*, the first constrictions appear as far as the diameter of about 25 mm; this means at a diameter larger than that of the shell described here.

A certain similarity can be seen between the Serbian material and *M. nabdalsa* (Coquand, 1880) from Algeria. Breskovski (1966), Dimitrova (1967) and Lillo Bevia (1975) regarded the specimen of Sayn (1890, pl. 2, fig. 11) as the type specimen of the mentioned species, because they believed that the type specimen of Coquand no longer existed. However, it transpired recently that the type material of Coquand (1880) is deposited in Coquand's collection in the National Museum in Budapest.

According to O. Szives, Coquand's collection includes two specimens designated as *Ammonites nabdalsa.* The larger of them, which has a diameter of 18.1 mm, should be selected as lectotype. According to O. Szives, the final half-shell is crushed. Between the straight constrictions on the subparallel flanks (five on the last whorl), the ribs are indistinct. On a single measurable non-deformed specimen of Coquand with a diameter of 13.8 mm, H = 6.0 (0.43), U = 3.4 (0.25), B = 5.1 (0.37), B/H= 0.85. From the mentioned data, marked differences from *M. haugi* follow, especially the narrower umbilicus, the wider whorls and the absence of ribs between the constrictions. A completely different, i.e., rounded whorl cross-section and wider whorls can be found in another related species *M. ouachensis* (Joleuad, 1912). The dimensional quantities and the overall character of the formation of the shells of *M. haugi* do not exclude any link with the genus *Patruliusiceras* Avram, 1978.

Occurrence. On the stratigraphical position of *M. haugi*, no reasonably accurate data are available at present. It can be assumed that this is a Late Barremian species. The unambiguous occurrence is known merely from Romania. The studied specimens come from the Late Barremian (the *Gerhardtia sartousiana* Zone), Donji Milanovac Formation.

Genus *Patruliusiceras* Avram, 1978

Type species. *Patruliusiceras crenelatum* Avram, 1978.

Patruliusiceras cf. *crenelatum* Avram, 1978
Figs 9F, 10

1921 *Desmoceras* (*Uhligella*) *Seguenzae* Coquand; Petković, p. 70, pl. 1, figs 22–24, text-fig. 14.
1978 *Patruliusiceras crenelatum crenelatum* Avram, p. 71, text-fig. 2/1–4, pl. 1, figs 7–10, pl. 2, figs 1–6.

Material. A single juvenile internal mould (phragmocone) with well-preserved suture-lines on one side (specimen RGF DR 3/128).

Description. Shell small, semi-involute, of lenticular shape, with not too high, slim whorls. The umbilicus is of medium width. The whorl flanks are slightly convex. The whorl has its greatest width in the vicinity of the umbilicus. The venter is quite narrow, convex, separated, although not sharply, from the whorl flanks. The whorl flanks dip, over a very short, obliquely inclined part, directly to the line of coiling; a narrow periumbilical depression being thus formed. An umbilical wall is missing.

One side of the shell is almost smooth; on the opposite side, two constrictions are however evident near the aperture. Other constrictions are indistinct on the continuation of the whorl. The constrictions are proverse; on the flanks they are S-shaped. They start at the line of coiling. The last mentioned two constrictions near by the end of shell are quite deep, equally strong from the umbilicus to the venter. Near the venter, the constrictions are markedly proverse. On the venter they are steeply convex, forming a V-shape. On the terminal whorl of the more favourably preserved side, six constrictions are visible.

Measurements (in mm) *and ratios*.

Specimen No. RGF DR	D	H	U	B	B/H
3/128 (Fig. 9F)	14.3 (max. 15)	5.8 (0.40)	4.2 (0.29)	4.5 (0.31)	0.77
Same shell	12.4	5.4 (0.43)	3.4 (0.27)	3.9 (0.31)	0.72

Suture-line. The almost complete outer part of the suture-line (Fig. 10) is characterised by a relatively narrow and not deep outer lobe with a secondary saddle reaching approximately as far as the lower third of the lobe height. The lateral lobe is deep, slightly asymmetrically trifid, and a little wide. The other two lobes located towards the umbilicus are of similar character; however, they are less deep and rather complicated. The first lateral saddle is somewhat asymmetric, two-branched; the following saddles, the shapes of which are increasingly simpler, are similar.

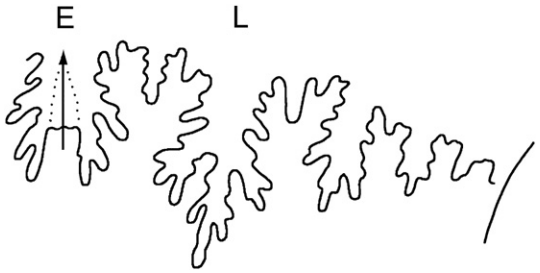

Fig. 10. Almost complete outer suture-line of *Patruliusiceras* cf. *crenelatum* Avram, specimen RGF DR 3/128 at D = 14.5 mm (H = 6 mm).

Remarks. The juvenile Serbian shell is characterised by slightly convex whorl flanks that incline continuously to a relatively narrow venter, and especially by the greatest whorl width in the vicinity of the umbilicus. The umbilical wall is missing; around the umbilicus a narrow periumbilical depression is there. Constrictions extend to the line of coiling on which they form a crenulation. The suture-line is characterised by the almost symmetrical first lateral lobe.

The mentioned features are similar to those of *M. nabdalsa* (Coquand, 1880) and to not clearly defined *M. seguenzae* (Coquand, 1880) from Algeria. The main difference between *P.* cf. *crenelatum* and *M. nabdalsa* lie in different whorl cross-sections.

In the conception of the type specimen of *M. seguenzae*, two trends exist, i.e., the specimen of Coquand (1880), illustrated by Heinz (1886), and the specimen of Sayn (1890, pl. 2, fig. 10). The

first specimen is smaller (according to Coquand, it has a diameter of 22 mm) and is perfectly smooth; the other specimen is larger (D = 31 mm) and bears constrictions. According to the illustration, Sayn's shell has somewhat wider whorls than the Coquand's specimen. It is not sure whether Coquand's type specimen has been preserved because Sayn (1890) illustrated another specimen. Thus, the direct comparison of Sayn's measured width (B/D = 0.35) with the width of the whorl of Coquand's specimen is not possible. The cross-section of the whorl of Coquand's specimen (in Heinz, 1886) is more similar to the Serbian specimen than the specimen that was illustrated by Sayn (1890). An essential piece of information stating that specimens having shell diameters of less than about 25 mm remain smooth, and only at greater diameters, do the first constrictions appear, is provided by Sayn (1890, p. 40).

With regards to the above-mentioned facts, the juvenile Serbian specimen with constrictions does not correspond to the description of *Melchiorites seguenzae* either. On the other hand, the whorl cross-section, size parameters, shape of constrictions on the flanks and also on the venter, their early appearance, and also the structure of the suture-line of the Serbian specimen toile within the range of those of representatives of *Patruliusiceras crenelatum* Avram, 1990 (above all *Patruliusiceras crenelatum crenelatum*).

Nevertheless, what is remarkable is the fact that the suture-lines of representatives of the genus *Patruliusiceras* (see Avram, 1990, pl. 1) are, in principle, similar to the suture-lines of the genus *Melchiorites*. Thus, it is not clear without detailed revision whether *Patruliusiceras* is or is not a synonym of the genus *Melchiorites*.

Avram (1990) considers the genus *Patruliusiceras* as part of the family of Silesitidae. However, it is evident that the suture-lines of silesitids on the specimens of similar diameter are differently and especially more simply formed. For this reason, we regard *Patruliusiceras* as a representative of the family Barremitidae Breskovski, 1977.

Occurrence. Avram (1978) reports *P. crenelatum* from the uppermost part of the Early Barremian and from the Late Barremian in the area of Sviniţa in Romania. The Boljetin Hill specimen comes from the Late Barremian (the *Gerhardtia sartousiana* Zone), Donji Milanovac Formation.

Superfamily: Silesitoidea Hyatt, 1900 (nom. transl. in Vermeulen, 2007)
Family: Silesitidae Hyatt, 1900
Genus *Silesites* Uhlig, 1883

Type species. *Ammonites Seranonis* d'Orbigny, 1841.

Silesites trajani (Tietze, 1872)
Figs 9G–I, 11

1872 *Ammonites Trajani* Tietze, p. 140, pl. 9, fig. 1, non fig. 2 (= *Silesites seranonis* d'Orbigny).
1883 *Silesites Trajani* Tietze; Uhlig, pl. 18, fig. 15, non pl. 18, figs 4, 7, 10, 11 (= *S. seranonis* d'Orbigny).
?1921 *Silesites Seranonis* d'Orb sp.; Petković, p. 60, pl. 1, fig. 13, text-fig. 8.
non 1921 *Silesites Trajani* Tietze sp.; Petković, p. 61, pl. 1, fig. 14 (= *Silesites seranonis* d'Orbigny).
non 1953 *Silesites traiani* (Tietze); Roth and Matějka, p. 37, pl. 1, fig. 3 (= ?*Silesites seranonis* d'Orbigny).
1978 *Silesites seranonis trajani* (Tietze); Avram, p. 18, pl. 4, figs 6, 7.
1995a *Silesites seranonis trajani* (Tietze); Avram, pl. 17, figs 5, 6.
1991 *Silesites seranonis* (d'Orbigny); Rabrenović, p. 235, pl. 8, only figs 8, 9, non fig. 10 (= *Silesites seranonis* (d'Orbigny, 1841).
2011 *Silesites trajani* (Tietze); Klein and Vašíček, p. 162.

Material. Two non-deformed limonitic internal moulds with suture-lines (specimens RGF DR 3/46, 4/34).

Description. Shells semi-involute, with a circular whorl cross-section. Whorls are not high, are convex mostly at about the whorl mid-flank. The whorl flanks pass into the venter that is quite wide and rounded. Towards the umbilicus, the whorl flanks are less rounded. The flanks end on the line of coiling because the umbilical wall is missing. The whorl width exceeds slightly the whorl height.

On the shell, constrictions are evident. On the whorl flanks they are moderately concave towards the aperture. In the vicinity of the venter, they are proverse. The constrictions cross the venter and form there a narrow sinusoidal bend (of a V-type). There are 4 constrictions per whorl, at approximately 90 degrees one after another. Between the constrictions, simple, slightly concave ribs are present. In the interval between two constrictions, usually 14–18 ribs occur. The first ribs located closely before and after the constrictions can bifurcate on the line of coiling. The ribs are distinct merely on the flanks of the whorl. In the vicinity of the venter, they fade away. The venter is smooth. Juvenile whorls at a shell diameter of less than about 4 mm are smooth. Only at larger shell diameters does the first constriction and very thin interim ribs appear.

Measurements (in mm) *and ratios*.

Silesites trajani (Tietze)

Specimen No. RGF DR	D	H	U	B	B/H
4/34 (Fig. 9G, H)	12.6 (max.)	4.4 (0.35)	5.4 (0.43)	5.2 (0.41)	1.18
3/46 (Fig. 9I)	22.0 (max. 26.5)	7.3 (0.33)	9.5 (0.43)	7.7 (0.35)	1.06

Silesites seranonis (d'Orbigny)

Specimen No. RGF DR	D	H	U	B	B/H
4/7 (Fig. 9L, M)	17.4	7.0 (0.40)	6.0 (0.34)	5.7 (0.33)	0.81
3/131	18.8	7.2 (0.38)	6.9 (0.37)	6.5 (0.34)	0.90

For comparison, we present measurements of a shell designated as *Ammonites Trajani* and illustrated by Tietze (1872, pl. 9, fig. 2; here refigured as Fig. 9J, K), which in reality belongs to *Silesites seranonis* (d'Orbigny). Its maximum diameter is 15 mm. At D = 13.0 mm, H = 5.4 (0. 415), U = 4.9 (0.38) and B (affected by slight deformation) = 4.7 (0.36).

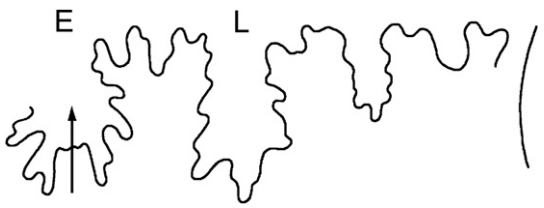

Fig. 11. Outer suture-line of *Silesites trajani* (Tietze), specimen RGF DR 4/34 at D = 9 mm (H = 3.5 mm).

Suture-line. Almost the entire outer part of the suture-line (Fig. 11) on specimen RGF DR 4/34 is characterised by rather weak denticulation and especially by a not too great difference in depth between the outer and the first lateral lobe. The first lateral lobe is simply slightly asymmetrically trifid. Saddles are slightly non-asymmetrically bifid.

Remarks. At first sight the shells described here are strongly reminiscent of *S. seranonis* (d'Orbigny, 1841, p. 361, pl. 109, figs 4, 5) from France and the whole Mediterranean area. The whorls of part of Tietze's material (1872, pl. 9, fig. 1, which has not been preserved in the Vienna collection) as well as of Avram's material (1978) from the Late Barremian (the Sviniţa Formation) of Romania, determined as *S. seranonis trajani* (Tietze), and also of our Serbian material, are characterised, however, by a whorl width that is larger than whorl height. As for the typical representatives of *S. seranonis* (d'Orbigny, 1841, pl. 109, figs 4, 5), the situation is reverse (Fig. 9L, M). Problems in differentiation may be encountered in cases of planar compaction of shells. However, it can be stated that the representatives associated with the name *trajani* bear four constrictions per whorl in contrast to the larger number of constrictions (6–7) in *S. seranonis.* In the former, the whorl cross-section is circular, while in the latter it is elliptical. Based on the stated facts, we believe that the above-mentioned specimens represent an independent species, i.e., *Silesites trajani.* The neotype replacing the lost Tietze's specimen was determined by Avram (1978, pl. 4, fig. 7). The justification for the independent species is evidenced better by the Serbian shells illustrated here (Fig. 9G-I), found in the Late Barremian section of the Boljetin Hill that are more perfectly and more completely preserved than the incomplete neotype of Avram. Based on the joint occurrence of *S. trajani* and *S. seranonis* in Romania localities, Avram does not exclude that it is a case of a dimorph pair.

Occurrence. Avram (1978) reports the Late Barremian of Romania. The Boljetin specimens come from Late Barremian (the *Imerites giraudi* Zone), Donji Milanovac Formation.

6. Discussion

In the Boljetin Hill section, where the thickness of ammonite-bearing deposits is 34 m (see Fig. 3) and darker grey marlstones alternate with grey marly limestones, a collection of ammonites containing a hundred specimens was obtained using the bed-by-bed method. One merit of the collection is that the ammonite shells are not deformed and often have favourably preserved suture-lines. The prevailing part of the specimens however belongs to juvenile shells in which the living chambers are missing.

In the submitted study, ammonites s. str. have been processed taxonomically so far.

From the quantitative point of view, representatives of the genera *Barremites, Montanesiceras* and *Pseudohaploceras* occur most frequently; *Barremitites*, *Silesites*, and *Melchiorites* are less abundant and *Plesiospitidiscus, Torcapella* and *Patruliusiceras* are rare (Fig. 12). In addition to the known species, the following species are determined as new: *Montanesiceras breskovskii, Plesiospitidiscus boljetinensis* and *Torcapella serbiensis.*

The lithological character of the deposits in the studied locality corresponds to a facies of pelagic deposits in an environment of sea bottom with a lack of oxygen. This is indicated by the preservation of ammonites prevailingly in the form of pyrite moulds (later limonitic moulds) and the lack of benthonic fauna. Benthos occurs sporadically in stronger marly limestones; the limestone material with benthos was periodically transported from a shallower water environment.

From the point of view of stratigraphic classification, the collected association of ammonites represents, above all, long-lived species that occurred largely in the Late Barremian. For a definition of the more precise stratigraphical position within the framework of the Late Barremian of the section under study, we used the stratigraphical data from the literature concerning the occurrence of the species determined by us (without the new species) and data about the stratigraphy of analogical deposits from the left bank of the Danube River in Romania. The majority of the herein determined species of the families Barremitidae and Silesitidae are limited to the Balkan area.

According to Manolov (1975) and Breskovski (1980), *Barremites balkanicus* is known from the Late Barremian of Bulgaria, *Barremitites strettostoma strettostoma* according to Avram (1997) in the Late Barremian to the Early Aptian in Romania and also on other European localities, *Barremitites panae* in underlie deposits of the *Imerites giraudi* ammonite Zone (Avram, 1997), *Pseudohaploceras tachthaliae* according to Avram (1978) in the upper part of the Early Barremian and the Late Barremian in Romania, *Patruliusiceras crenelatum* in the uppermost part of the Early Barremian in Romania, *Silesites trajani* according to Avram (1978) in the Late Barremian of Romania, and the cosmopolitan species *Silesites seranonis* according to Busnardo in Fischer and Gauthier (2006) in the spam of the boundary Early/Late Barremian to upper part of the Late Barremian inclusive of the *Martelites sarasini* Subzone (the middle part of the *Imerites giraudi* Zone).

Based on the presented data, we can suppose that the Boljetin Hill section represents especially the Late Barremian ammonite Zone with *Gerhardtia sartousiana* (ammonite zonation according to Reboulet et al., 2011). We cannot exclude that the lowermost part of section belongs to the uppermost part of the *Toxancyloceras*

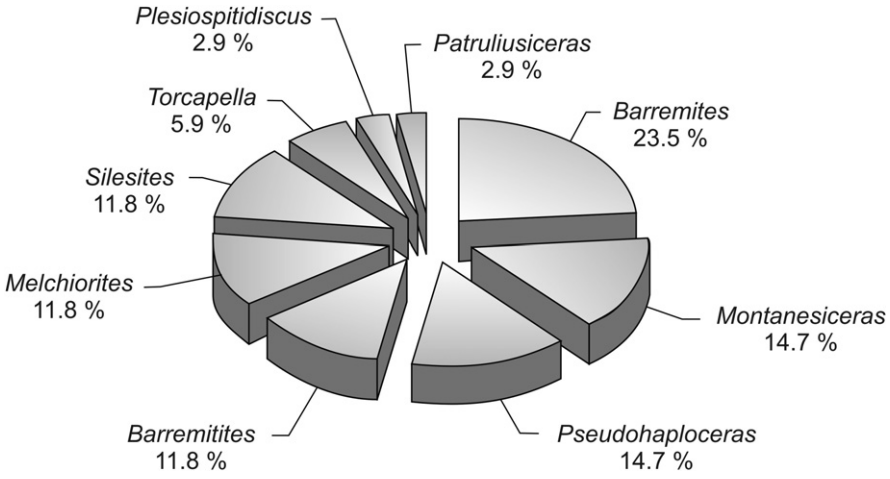

Fig. 12. Total percentages of the ammonite genera from the Late Barremian (Donji Milanovac Formation) of Boljetin Hill, eastern Serbia. Based on a total of 34 specimens. Note the dominance of the genus *Barremites*.

vandenheckii Zone. We assume that the uppermost part of section belongs to the lower part of the *Imerites giraudi* Zone. However, we are not able to define in the section the boundaries among the mentioned ammonite zones.

Our premise on the stratigraphical position of the Boljetin Hill section coincides with the modern processing of the neighbouring Romanian localities (above all the Svinita region) that was performed by Avram (1976, 1978, 1988, 1995a, b, 2002). In contrast to the Romanian localities in a similar pelagic development, neither stratigraphically significant pulchelliids nor representatives of a rang of guide species *Imerites giraudi* (Kilian) occur in the Boljetin Hill section at all. In addition, unambiguous Aptian elements, such as deshayesitids, are missing.

7. Conclusion

In the relatively new ammonite collection of Dragoman Rabrenović from the Boljetin Hill section, belonging to the Donji Milanovac Formation, we first taxonomically elaborated some of the ammonites of the suborder Ammonitina, the superfamilies Desmoceratoidea and Silesitoidea. They reperesented 34 determinable and about 20 fragmentary preserved undeterminable specimens.

The determinable part of ammonites represent twelve species that belong to nine genera. Three species are new: *Plesiospitidiscus boljetinensis, Montanesiceras breskovskii* and *Torcapella serbiensis.* To newer knowledge belongs the classification of the genus *Patruliusiceras* into the family Barremitidae and that *Silesites trajani* is an independent species.

The composition of ammonite association indicates a pelagical milieu. The bottom of sedimentary basin was badly oxygenated.

In the association under study, long-lived species dominate. According to data concerning the distribution and stratigraphical position of the determined species, we suppose that the section is unambiguously of Late Barremian age. The composition of the species and the lithology of relative sections on the territory of Romania allowed us to conclude that the predominant part of the Boljetin Hill section corresponds to the ammonite zone with *Gerhardtia sartousiana.* We cannot exclude that the basal part of section lies in the uppermost part of the *Toxancyloceras vandenheckii* Zone and that the upper part belongs to the lower part of the *Imerites giraudi* Zone. We did not find any Aptian ammonite elements.

Acknowledgements

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