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On imperfectly known Hauterivian representatives of the families Holcodiscidae Spath, 1923 and Barremitidae Breskovski, 1977 in Butkov Quarry (Central Western Carpathians, Slovakia)

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ABSTRACT:

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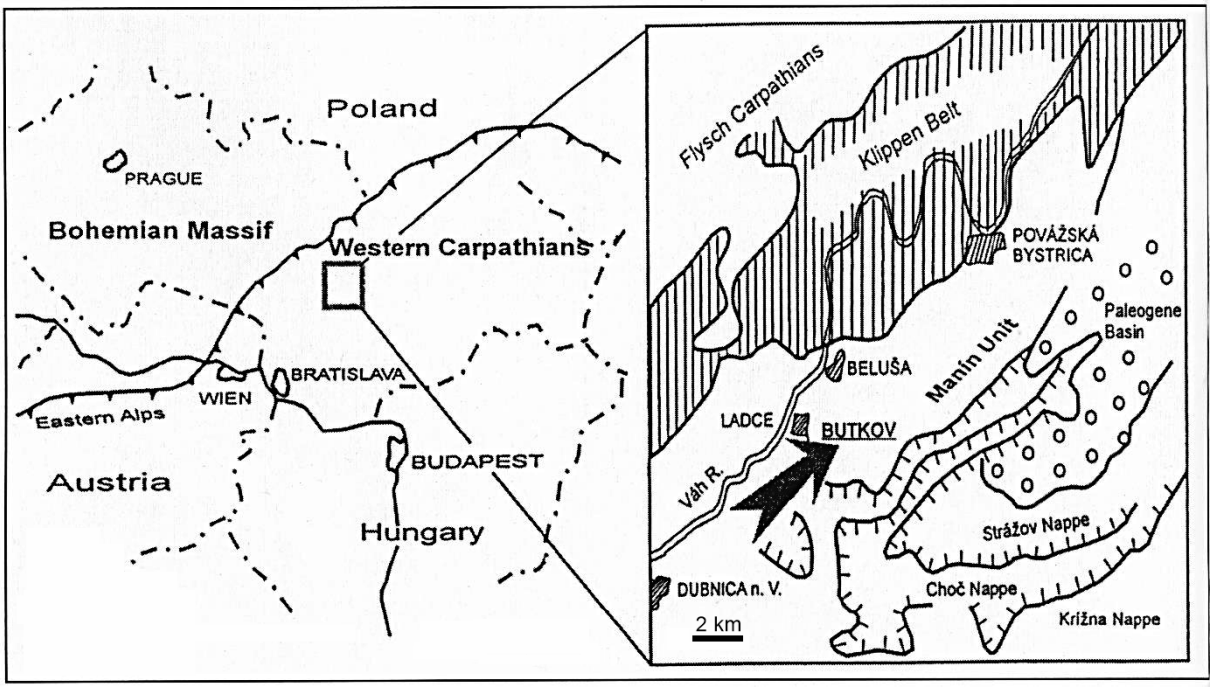
In Butkov Quarry, ammonites of the families Holcodiscidae Spath, 1923 and Barremitidae Breskovski, 1977 occur in the pelagic Lower Cretaceous pelagic deposits of the Manín Unit. This contribution discusses the taxonomy of both families and presents their distribution in the layered sequences of the quarry. The genus *Spitidiscus* Kilian, 1910 classified as a member of the Superfamily Perisphinctoidea Steinmann in Steinmann and Döderlein, 1890 is an important representative of the Holcodiscidae from a stratigraphic point of view. In areas where the zonal index *Acanthodiscus radiatus* (Bruguière, 1789) does not occur, as in Butkov Quarry, the first representatives of *Spitidiscus* indicate the base of the Hauterivian. The genus *Plesiospitidiscus* Breistroffer, 1947 was long regarded as a member of the Superfamily Desmoceratoidea Zittel, 1895. This superfamily was based on its type species, *Eodesmoceras celestini* (Pictet and Campiche, 1860), which is not Valanginian in age, as now clearly proven. As a consequence, this superfamily is considered invalid. Vermeulen and Lahondère (2011) proposed an alternative by selecting a suitable initial genus, namely *Plesiospitidiscus*, for the Family Barremitidae, Superfamily Barremitoidea Breskovski, 1977 (*nom. transl*. Vermeulen and Lahondère, 2011).

Key words: Early Cretaceous; ammonites; taxonomy; stratigraphy; Manín Unit; Carpathians.

INTRODUCTION

Butkov Quarry is one of the richest localities for Early Cretaceous ammonites in Slovakia. At present, the productive quarry for the cement factory at Ladce is exposed on fifteen levels. About half of the quarry levels provide more or less continuously exposed sequences of strata in marly-calcareous deposits, dated approximately to between the lower Valanginian and the upper Barremian. Macropalaeontological collections were performed by means of bed-by-bed sampling in individual sections on particular quarry levels. The presented ammonite collection from Butkov Quarry is a result of our long-term activity with many colleagues from 1982 until now.

This contribution deals with the composition and taxonomy of a related group of ammonites which occurs in the upper Valanginian to upper Hauterivian stratigraphic succession of Butkov Quarry. It describes the taxonomic position of the Family Holcodiscidae and its important genus *Spitidiscus* Kilian, 1910 in the context of the evolution of this group.



Text-fig. 1. Geographical and geological situation of Butkov Quarry, Slovakia (after Vašíček 2010). Circles illustrate conglomerates and sandstones in the post-tectonic basin.

In addition, it focuses on similar issues within the genus *Plesiospitidiscus* Breistroffer, 1947 leading to its inclusion in the Family Barremitidae Breskovski, 1977. Important also is the distribution of accompanying species in sections on Levels 7 (Vašíček 2020b) and 8 (figured herein) in Butkov Quarry, and their correlation with the international ammonite zonation for the upper Valanginian and Hauterivian within the so-called Mediterranean bioprovince (Reboulet *et al.* 2018).

GEOLOGICAL SETTING

Butkov Quarry (Text-fig. 1) is situated near the municipality of Ladce, c. 10 km NE of the town of Dubnica upon Váh, Slovakia. The exposed Jurassic and Cretaceous succession belongs to the Manín Unit (also Nappe) of the western margin of the Central Western Carpathians. The unit is in an allochthonous position and in tectonic contact with the Pieniny Klippen Belt. The structural interpretation and the position of the Manín Nappe in the Carpathian System were discussed by Michalík and Vašíček (1987). Palaeogeographically, Vašíček and Michalík (1999) interpreted the Manín Unit as being part of the Fatric Superunit of the Central Western Carpathians.

Borza *et al.* (1987) subdivided the Lower Cretaceous succession exposed in Butkov Quarry into several lithostratigraphic members. The ammonitiferous Cretaceous pelagic deposits start with the beige-coloured marly limestones of the Ladce Formation overlain by the grey-coloured marly-calcareous, usually spotted deposits of the Mráznica Formation. Layers of a sandy-calcareous turbiditic sequence overlain by pale grey limestones up to brown-grey ones, with the so-called 'contour cherts' passing into black cherts, belong to the Kališčo Formation. The Kališčo Formation with gradually disappearing cherts transits into the marly pale-coloured Lúčkovská Formation.

MATERIAL

The marly Lower Cretaceous deposits of Butkov Quarry mostly provide finds of deformed ammonites usually preserved as external moulds, therefore the study of suture lines is impossible. Better preserved finds include specimens that are compressed onto the bedding plane by simple overburden pressure. Among them, the values of the measured parameters, e.g.,

the whorl height, increase continuously with growth. The following parameters were measured: *D* – shell diameter (*Dmax* – maximum preserved diameter), *H* – whorl height, *U* – umbilicus width. The whorl breadth *B* is usually not measurable. For biometric characteristics, ratios *H/D* and *U/D* were calculated; where possible the *B/D* ratio was also calculated.

More frequently, the flattened specimens are affected by lateral compression to a varied degree. In this case, if both lateral sides of the ammonite can be seen on suitably preserved specimens, then striking differences in their size parameters, which do not reflect the natural growth of the shell, are noticeable. Measurements on these specimens have doubtful significance for the diagnostic features for species determination.

The original whorl shape and cross-section, as important taxonomic features – apart from some finds in the Kališčo Formation – were not available due to deformation. However, if the fossilized shell was infilled by chert, then rock compaction was suppressed and to a certain degree, the spatial structure of the original shell can be reconstructed.

The specimens illustrated and measured herein are deposited in the Slovak National Museum in Bratislava, under depository numbers with the prefix SNM Z, with also other symbols mentioned in my field diary deposited in Ostrava. The latter symbols refer to the exact position of the specimens in the quarry sections (e.g., BK10-20 refers to Butkov Quarry, Level 10, from 20 m in the succession). In addition to the specimens with SNM numbers, the material under study contains other specimens which only have locality symbols. These specimens are housed in the collections of the Geological Pavilion of Prof. F. Pošepný of VŠB – Technical University of Ostrava with numbers mentioned in the field diary.

All figured specimens were coated with ammonium chloride before photographing. The photographs were taken by K. Mezihoráková (Ostrava).

PREVIOUS RESEARCH IN BUTKOV QUARRY

Our first macropalaeontological collections which were connected with detailed sedimentologic documentation and micropalaeontological sampling in Butkov Quarry began in cooperation with the late K. Borza in 1982. The basic taxonomic interpretation of the collected ammonites was published by Vašíček and Michalík (1986). Other findings concerning the composition of the cephalopod assemblage were documented by Vašíček *et al.* (1994). Continued biostratigraphic research resulted in the collection of new ammonite material (Vašíček 2006, 2010, 2020a, b). A comprehensive summary of the geology, stratigraphy, micro- and macropalaeontology of the deposits in Butkov Quarry were published in a book by Michalík *et al*. (2013).

TAXONOMIC REMARKS

The taxonomy of Early Cretaceous ammonites has been modified since the publishing of the latest Treatise (Wright *et al.* 1996). Based on the most recent taxonomic concepts, Klein and co-authors have summarized modern achievements in several parts of the Fossilium Catalogus (I: Animalia; Lower Cretaceous Ammonites, e.g., Klein 2005, 2011), which are applied herein. In the present paper, we supplement this new data and provide proposals to support the taxonomic concepts summarized in the *Fossilium Catalogus* series.

On the genus *Spitidiscus* Kilian, 1910

This genus together with its allied taxa occupies an important stratigraphic position among the studied ammonite associations of Butkov Quarry. In brief, with regard to the ample discussions and opinions of previous authors concerning the taxonomic concept of this genus and the Subfamily Spitidiscinae Vermeulen and Thieuloy, 1999, we agree herein with the taxonomic concept of Aguirre-Urreta and Rawson (2003), summarised in Rawson and Aguirre-Urreta (2012, p. 100). The strong ornamentation of *Spitidiscus* led to the classification of the Spitidiscinae into the Family Holcodiscidae Spath, 1923 and into the Superfamily Perisphinctoidea Steinmann in Steinmann and Döderlein, 1890. Therefore, we consider the genus *Spitidiscus* to be a member of the Holcodiscidae. Aguirre-Urreta and Rawson (2003) and Rawson and Aguirre-Urreta (2012), in accordance with Hoedemaeker (1995), stated that the Family Holcodiscidae is a link between the superfamilies Perisphinctoidea and Desmoceratoidea Zittel, 1895.

On the genus *Abrytusites* Nikolov and Breskovski, 1969

The genus *Abrytusites* was assigned by Nikolov and Breskovski (1969) to the Subfamily Puzosiinae Spath, 1922, of the Family Desmoceratidae Zittel, 1895. In the framework of the Desmoceratidae,

Breskovski (1977, p. 893) classified *Abrytusites* into the Subfamily Abritusitinae Breskovski, 1977 (*nom. correct*. Abrytusitinae in Wright and Kennedy 1984), instead of the Subfamily Barremitinae Breskovski, 1977, which he regarded as part of the Desmoceratidae as well. In contrast, Klein (2005) put this genus into the Family Neocomitidae Salfeld, 1921.

According to Vermeulen (2005), *Abrytusites* may be an initial element for three hypothetical classifications given below:

- *Abrytusites* could be derived from the genus *Spitidiscus*, independently of *Plesiospitidiscus* Breistroffer, 1947. In this case, the Family Holcodiscidae would belong to the Superfamily Perisphinctaceae, close to the Subfamily Spitidiscinae;
- *Abrytusites* could be derived from the genus *Spitidiscus*, leading by cladogenesis to *Plesiospitidiscus*, on the basis of which the Family Barremitidae Breskovski, 1977 was established. Therefore, based on their common origin, the Holcodiscidae and the Barremitidae both have to be included into the Superfamily Desmoceratacеae;
- if the species of *Abrytusites* and *Plesiospitidiscus* have a direct connection, then the Holcodiscidae and Barremitidae belong to the same superfamily, i.e., according to Vermeulen (2005), the Superfamily Desmoceratacеae.

With regard to the similar whorl section and ribbing of juvenile whorls in the case of *A. julianyi* (Honnorat-Bastide, 1891), figured in Thieuloy (1972, p. 38, pl. 4, figs 2, 3), it seems evident that *Abrytusites* could be derived from *Spitidiscus.*

In contrast, Vermeulen (2007a, p. 148) referred *Abrytusites* to the Family Holcodiscidae. However, Vermeulen and Lahondère (2011) later classified the Subfamily Abrytusitinae into the Superfamily Silesitoidea Hyatt in Zittel, 1900. These authors do not even mention the Superfamily Desmoceratoidea.

On the genus *Plesiospitidiscus* Breistroffer, 1947

The genus *Plesiospitidiscus* has been regarded either as a representative of the Family Holcodiscidae (e.g., Arkell *et al.* 1957), or as a representative of the Subfamily Barremitinae in the Superfamily Desmoceratacеae (e.g., Wright *et al.* 1996).

The genus *Eodesmoceras* Spath, 1923, with type species *Eodesmoceras celestini* (Pictet and Campiche, 1860) from the Valanginian was regarded as the primary element of the Superfamily Desmoceratacеae; the Subfamily Eodesmoceratinae Wright, 1955, was established based on this genus. However, Busnardo and Thieuloy (1989, pp. 121, 122) and Wright *et al.* (1996) stated that "the type species *E. celestini* was based on fragments of Albian *Puzosia* and *Desmoceras*." The second possible representative of the genus *Eodesmoceras* could be *E. haughtoni* Spath, 1930. However, according to Wright *et al.* (1996, p. 69), the holotype of this species (a single specimen representing the species) "is too small to be identifiable" (see also Klein and Vašíček 2011 or Rawson and Aguirre-Urreta 2012). For these reasons, and following Vermeulen and Lahondère (2011), it seems that the Subfamily Eodesmoceratinae has lost its validity. As an alternative, Vermeulen and Lahondère (2011), proposed that the Subfamily Barremitinae became initial for the Family Barremitidae and the Superfamily Barremitoidea Breskovski, 1977 (in the Suborder Ammonitina Hyatt, 1900). Vermeulen *et al.* (2014, p. 19) then replaced the Superfamily Desmoceratoidea by the Barremitoidea (*nom. transl.* Vermeulen and Lahondère, 2011). We presume that more research is needed to understand the coherence of various ammonite groups between the Perisphinctoidea and Desmoceratoidea before the newly proposed Superfamily Barremitoidea can be definitely accepted.

After considering all taxonomic circumstances and based on the recognised stratigraphic succession of ammonites in Butkov Quarry, the possible taxonomic concept given below is submitted here for the ammonite genera studied.

SYSTEMATIC PART

In the case of species described in detail in professional papers, where we agree with published synonymies, we avoid repeating the entire synonymy. We only mention here the holotype or type specimen or present references that add new substantial findings and amendments. The ammonite zonation for the Lower Cretaceous is based on Reboulet *et al.* (2018).

Superfamily Perisphinctoidea Steinmann in Steinmann and Döderlein, 1890
Family Holcodiscidae Spath, 1923
Subfamily Spitidiscinae Vermeulen and Thieuloy, 1999

REMARKS: The subfamily Spitidiscinae includes semi-involute to semi-evolute shells with ribbing varying from coarse to fine with generally wide, slightly sinuous constrictions. The subfamily occurs from the upper Valanginian to the Hauterivian.

Genus *Jeanthieuloyites* Cooper, 1981

TYPE SPECIES: *Rogersites quinquestriata* Besaire, 1936, p. 142.

REMARKS: Avram and Grădinaru (1993) studied the European representatives of the genus *Jeanthieuloyites*. These coarsely ribbed spitidiscids are characterized by the occurrence of a smooth band on the venter. According to Bulot *et al*. (1993), in France this genus has a stratigraphic range from the upper Valanginian *trinodosum* Zone (frequent) to the top of the *callidiscus* Zone (a single find by Thieuloy 1972 in bed 252 in La Charce). This bed is now considered, in the Global Boundary Stratotype Section and Point (GSSP) of the Hauterivian Stage at La Charce (Mutterlose *et al*. 2020, p. 4, fig. 3), to belong to the lower Hauterivian (*radiatus* Zone).

Jeanthieuloyites keyserlingiformis Avram and Grădinaru, 1993
(Text-fig. 2A, B)

1993. *Jeanthieuloyites keyserlingiformis* n. sp.; Avram and Grădinaru, p. 674, pl. 1, fig. 13, pl. 2, fig. 11, pl. 4, fig. 3a–c, text-fig. 2/1.
1995. *Jeanthieuloyites keyserlingiformis* Avram and Grădinaru; Avram, p. 15, pl. 1, fig. 1a–c, pl. 7, fig. 1.
2005. *Jeanthieuloyites keyserlingiformis* Avram and Grădinaru; Klein, p. 146.

MATERIAL: Less than half of the ultimate whorl (SNM Z 40090 = BK10-35/1) preserved as an outer mould.

DESCRIPTION: Specimen semi-evolute, with a comparatively low whorl and wide umbilicus. The ultimate whorl bears strong ribs differentiated into main ribs and subsidiary ribs. Between the pair of main ribs, broad constrictions are inserted. The main ribs bear weak bullate umbilical tubercles. In a single case, a main rib bears a strong umbilical tubercle from which two ribs run out. About five subsidiary ribs in the interval between the main ribs begin as simple ribs near the umbilicus. On the incompletely preserved venter, all subsidiary ribs seem to bifurcate at about 3/4 of whorl height. The ribs are S-shaped, in the prevailing part convexly bent toward the aperture; on the venter they are bent concavely. There is a smooth band in the siphonal area.

MEASUREMENTS: With reference to imperfect preservation, measurements are approximate: D = c. 70 mm, H = c. 24.5 mm (H/D = 0.35), U = c. 25 mm.

REMARKS: Characteristic features of *J. keyserlingiformis* include strong ribbing, constrictions, a wide umbilicus and a rib interruption in the siphonal area. Unambiguity in the determination of the Butkov specimen is somewhat influenced by the incompleteness of the specimen. From the close species *J. nodosus* (Mandov, 1976) and *Spitidiscus cankovi* Vašíček and Michalík, 1986, which also occur in Butkov Quarry, the species differs especially by both its wide umbilicus and lack of nodes on the main ribs. In *S. cankovi*, however, ribs cross the venter without interruption.

OCCURRENCE: The species was previously known only from Romania, probably from the uppermost Valanginian and also the basal Hauterivian. A single fragment from Butkov Quarry comes from the Ladce Formation, Level 10 (on section at 35 m), upper Valanginian (*peregrinus* Zone).

Genus *Spitidiscus* Kilian, 1910

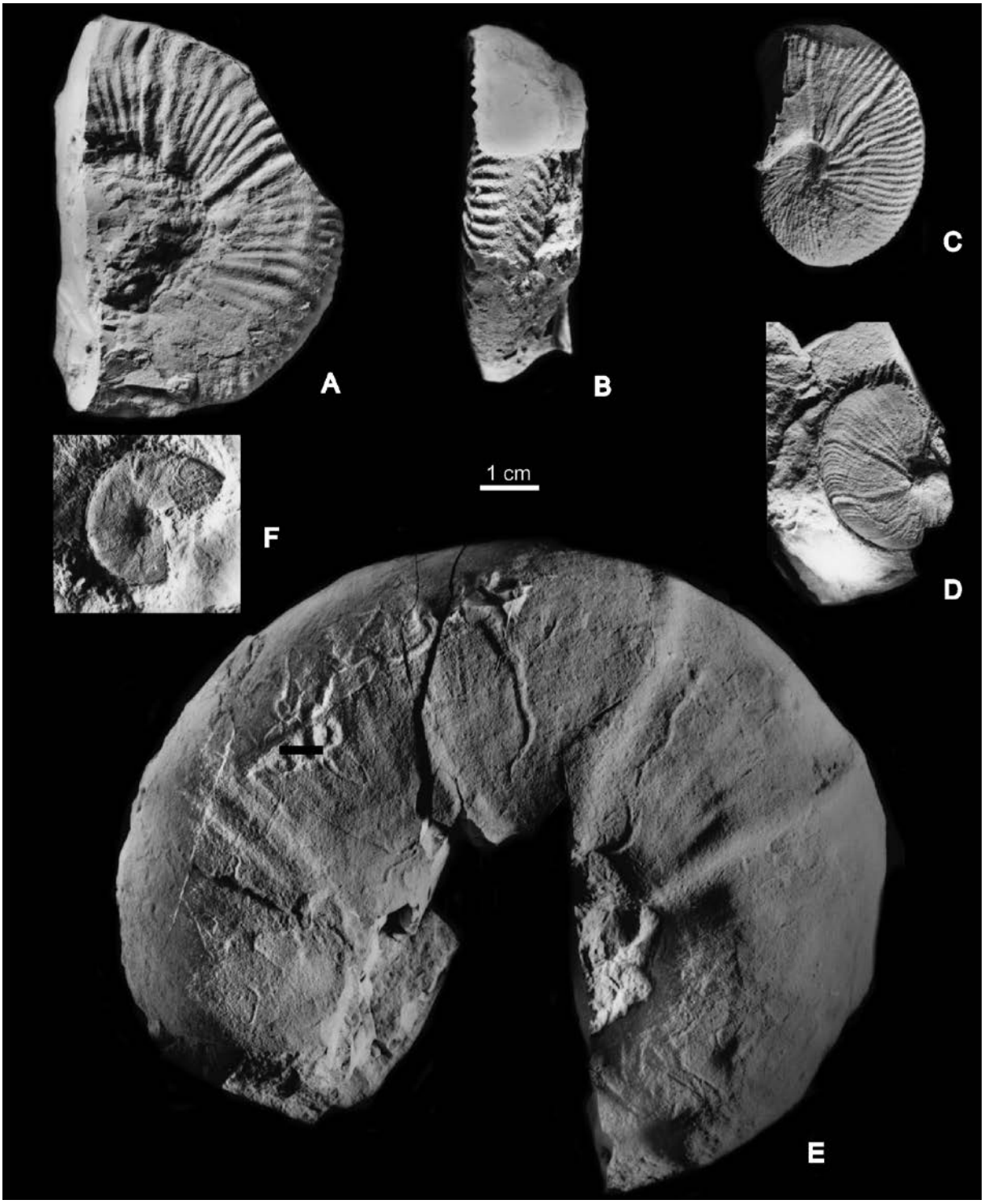
TYPE SPECIES: *Ammonites rotula* J. de C. Sowerby, 1827, p. 136.

REMARKS: Shells semi-evolute to semi-involute, the ribbing of which is periodically intercalated with constrictions. Ribs between constrictions run out individually or in pairs, sometimes from umbilical tubercles. The ribs cross the venter without interruption. Representatives of *Spitidiscus* occur in Butkov Quarry from the basal part of the Hauterivian (*radiatus* Zone) to the lower part of the upper Hauterivian (*ligatus* Zone inclusive).

Spitidiscus meneghinii (Rodighiero, 1919)
(Text-fig. 2C)

pars 1919. *Polyptychites Meneghinii* De Zigno *in schedis;* Rodighiero, p. 94, pl. 10, fig. 7 [non fig. 4 = *Jeanthieuloyites nodosus* Mandov, 1976].
?2001. *Spitidiscus meneghinii* (De Zigno in Rodighiero); Wippich, p. 77, pl. 12, figs 7, 8.
2003. *Spitidiscus meneghinii* (Rodighiero); Busnardo *et al*., p. 49, pl. 3, figs 4–9, 11.
2005. *Spitidiscus meneghinii* (Rodighiero); Klein, p. 150 (cum syn.).

MATERIAL: A relatively complete specimen, deformed considerably by lateral pressure, preserved as



Text-fig. 2. Representatives of the Holcodiscidae Spath, 1923 and Barremitidae Breskovski, 1977 from Butkov Quarry, Slovakia. **A**, **B** – *Jeanthieuloyites keyserlingiformis* Avram and Grădinaru, 1993; SNM Z 40090; Level 10, 35 m; Ladce Formation, upper Valanginian, *furcillata* Zone. A – lateral view; B – ventral view. **C** – *Spitidiscus meneghinii* (Rodighiero, 1919); SNM Z 40091, Level 7 West, 63 m. Ladce Formation, basal Hauterivian, *radiatus* Zone. **D** – *Spitidiscus* ex gr. *rotula* (J. de C. Sowerby, 1827); SNM Z 40094; Level 10, 105 m; Mráznica Formation, lower Hauterivian, *loryi* Zone. **E** – *Abrytusites thieuloyi* Vašíček and Michalík, 1986; SNM Z 40095; Level 7 West, debris; Kališčo Formation, upper Hauterivian, *ligatus* Zone. **F** – *Plesiospitidiscus ligatus* (d'Orbigny, 1841) sp. juv.; SNM Z 40097; Level 7 West, horizon E; Kališčo Formation, upper Hauterivian, *ligatus* Zone.

an outer mould (SNM Z 40091 = BK7Z-63/14) and a single fragment (BK6-18/5).

DESCRIPTION: Specimen involute, with high, slightly arched whorl flanks that incline continuously towards the umbilicus and the venter as well. The umbilicus is narrow. The umbilical wall is probably sharply differentiated from the whorl flanks.

The specimen has dense ribbing; the ribs are relatively fine. At the beginning of the ultimate whorl, constrictions are not apparent. With increasing whorl height, the ribs become stronger. In the final part of the whorl, obvious but not too conspicuous constrictions are inserted between them. The constrictions are almost straight, inclined towards the aperture only on the venter. Between them, inserted ribs run out partly from the line of coiling, partly in pairs. Those bifurcate even in the lower part of the whorl. On the rear side of the constrictions occur ribs of different length. The longest begin at about 1/3 of the whorl height, the last at about 3/4 of whorl height. All ribs cross the venter without interruption but are broken in the siphonal area where a chevron bend is formed. The angle between the constrictions is about 30º.

MEASUREMENTS: The deformed specimen SNM Z 40091 reaches, in the axis of elongation, *Dmax* of c. 45 mm. Between the deformation axes, *D* = 35.0 mm, *H* = 21.0 mm (*H/D* = 0.60) and *U* = c. 4.5 mm (*U/D* = 0.13). Measured and calculated values are distorted as a result of lateral deformation. There are about 6 constrictions per adult half-whorl.

REMARKS: The Butkov specimen with ribs that form a chevron on the venter is very close to the specimens illustrated in Busnardo *et al*. (2003).

OCCURRENCE: According to literature data, the species occurs in northern Italy, Switzerland and the Northern Calcareous Alps in deposits spanning the Valanginian/Hauterivian boundary (according to Immel 1987 it appears in the lower Hauterivian). Specimens from Morocco illustrated by Wippich (2001), unfortunately with no mention of the ribbing on the venter, come from the *radiatus* Zone. Probably, those specimens may belong to *Spiticeras cankovi*. In Butkov Quarry, the specimens come from Level 7 West, section at 63 m in the Ladce Formation and from Level 6, at 18 m in the Mráznica Formation (both basal Hauterivian, *radiatus* Zone).

Spitidiscus rossfeldensis Weber, 1942
(Text-fig. 3A)

1868. *Spitidiscus incertus* d'Orbigny; Winkler, p. 15, pl. 2, fig. 8, 8a.
1942. *Spitidiscus* (*Holcodiscus*) *rossfeldensis* n. sp.; Weber, p. 263, pl. 12, fig. 1 (holotype), pl. 14, fig. 3, text-fig. 2.
1942. *Spitidiscus* (*Holcodiscus*) *pechhaueslensis* n. sp.; Weber, p. 267, pl. 12, fig. 2, text-fig. 3.
?1968. *Holcodiscus* aff. *rossfeldensis* Weber; Nagy, p. 48, pl. 2, figs 3, 4.
?1986. *Spitidiscus rotula inflatus* Kilian; Vašíček and Michalík, p. 476, pl. 5, fig. 2.
?1987. *Spitidiscus rossfeldensis* Weber; Immel, p. 72, pl. 4, fig. 6 (sp. juv.).
1996. *Spitidiscus meneghinii* (Zigno) in Rodighiero; Reboulet, p. 159, pl. 32, figs 14, 15.
2005. *Spitidiscus rossfeldensis* Weber; Klein, p. 152 (cum syn.).
2010. *Spitidiscus incertus* (d'Orbigny); Vašíček, p. 408, pl. 5, fig. 3.

MATERIAL: Two strongly flatly deformed outer moulds (SNM Z 40092 = BK6-2/2 and SNM Z 40093 = BK10-130/1). The original arched character of the whorls and the shape of the venter cannot be established.

DESCRIPTION: Relatively large, semi-involute specimens, with a narrow umbilicus. Sculpture of adult specimens consists of relatively strong ribs and conspicuous constrictions. Ribs on the whorl flanks are generally straight; only near the venter they incline towards the aperture. They cross the venter without interruption. Ribs begin in weak umbilical tubercles individually or in pairs. At about half the whorl height, some bifurcate. Constrictions are wide. On the anterior and the posterior side, they are accompanied by ribs stronger than the other ribs. The rear of the mentioned pair of accompanying ribs bears a stronger umbilical tubercle.

MEASUREMENTS: In specimen SNM Z 40092, *Dmax* = 79 mm, *H* = 33.0 mm (*H/D* = 0.42), *U* = 20.0 mm (*U/D* = 0.25). There are 4–5 constrictions per half-whorl.

REMARKS: The type material was described by Weber (1942) as two new species. However, we regard *S. pechhaueslensis* as a synonym of *S. rossfeldensis* following Immel (1987, see Klein 2005).

OCCURRENCE: *Spitidiscus rossfeldensis* comes from the Rossfeld Sandstone from the Northern Calcareous Alps (lower Hauterivian). The finds of

Reboulet (1996) come from the *radiatus* Zone in the Vocontian Trough. In Butkov Quarry, specimen BK6-2/2 comes from the Mráznica Formation at the beginning of Level 6 (basal Hauterivian), and specimen BK10-130/1 derives from Level 10, section at 130 m, Kališčo Formation, upper part of lower Hauterivian (*nodosoplicatum* Zone).

Spitidiscus ex gr. *rotula* (Sowerby, 1827)
(Text-fig. 2D)

1827. *Ammonites rotula*; J. de C. Sowerby, p. 136, pl. 570, fig. 4.
1907. *Holcodiscus rotula*, Sow. sp.; Karakasch, p. 116, pl. 9, fig. 27a, b.
1972. *Spitidiscus rotula inflatus* Kilian; Thieuloy, p. 32, pl. 2, figs 4, 5, pl. 3, figs 2, 3, text-figs 4c–e, 5.
1980. *Spitidiscus rotula* (Sow.) *inflata* Kilian; Thomel, p. 125, fig. 249.
1981. *Spitidiscus rotula* (J. de C. Sowerby); Kemper *et al*., p. 304, pl. 34, figs 11–13 (refigured holotype), 14, 15.
1996. *Spitidiscus rotula* (Sowerby); Reboulet, p. 160, pl. 32, figs 12, 13.
2005. *Spitidiscus rotula* (Sowerby); Klein, p. 152 (cum syn.).
2010. *Spitidiscus* ex gr. *rotula* (Sowerby); Vašíček, p. 407, pl. 4, figs 6, 7.
2013. *Spitidiscus* ex gr. *rotula* (Sowerby); Michalík *et al*., fig. 93/7.

MATERIAL: Ten deformed fragments of small size, preserved as outer moulds, of which merely a small portion represents at least incomplete half whorls (BK5-90/8, BK6-12/1, BK6-18/1, BK6-90/7, BK7Z-45/2, BK8-470/28, BK10-82/10, SNM Z 40094 = BK10-105/1; BK10-105/4, 9).

DESCRIPTION: Shells semi-involute, with strongly arched whorls and a narrow umbilicus. Relatively wide constrictions conspicuous especially in adult individuals. The constrictions are concavely bent towards the aperture. Between the constrictions, there are medium strong, arched ribs bent less than the constrictions. The ribs usually run out from the line of coiling individually or occasionally in pairs. On the whorl flanks, the ribs bifurcate around the mid-flank. On the rear side of the constrictions, simple incomplete ribs (4–5) occur that make an angle of about 30º with the constriction. These ribs gradually get shorter from the umbilicus to the venter.

MEASUREMENTS: With reference to the incompleteness of specimens, the measurement of particular parameters is not possible. *Dmax* of the largest specimen reaches c. 35 mm. There are usually 3–4 constrictions per half-whorl.

REMARKS: Fragmentary preservation and considerable variability in the material from Butkov Quarry, connected with deformation, do not make unambiguous species determination possible. The holotype of the species is a juvenile specimen, therefore the concept of this species is not certain.

OCCURRENCE: *Spitidiscus rotula* occurs in a considerably large area in Europe. It is known e.g., from Crimea, Bulgaria, Slovakia, Germany, France, Spain and England. It occurs in the lower Hauterivian; according to Reboulet (1996) in the *loryi* and *nodosoplicatum* zones. In Butkov Quarry, specimens of *S.* cf. *rotula* occur in the uppermost Ladce to Mráznica formations, in the lower Hauterivian (*radiatus* and *loryi* Zones).

Subfamily Abrytusitinae Breskovski, 1977

REMARKS: The subfamily Abrytusitinae represents only a lateral, end branch of the family, which appears in the upper part of the lower Hauterivian and disappears in the upper Hauterivian, or maybe in the lowermost Barremian according to Busnardo *et al*. (2003).

In previous literature, information about the early Barremian age of some species, e.g., *Abrytusites loryi* (Paquier, 1900) and *A. sulcatus* Nikolov and Breskovski, 1969 has been presented. However, Busnardo *et al.* (2003) have demonstrated that the type species occurs in the uppermost Hauterivian. Similarly, Paquier (1900) placed *A. loryi* in the upper Hauterivian.

Genus *Abrytusites* Nikolov and Breskovski, 1969

TYPE SPECIES: *Pachydiscus Neumayri* Haug, 1889, p. 204.

Abrytusites thieuloyi Vašíček and Michalík, 1986
(Text-fig. 2E)

1972. *Abrytusites*? nov. sp. A; Thieuloy, p. 39, pl. 4, figs 4, 5, text-figs 4n–p.
1986. *Abrytusites thieuloyi* n. sp.; Vašíček and Michalík, p. 477, pl. 3, fig. 2, pl. 6, fig. 3.
2011. *Abrytusites thieuloyi* Vašíček and Michalík; Klein and Vašíček, p. 3 (cum syn.).

MATERIAL: Two specimens described and illustrated in Vašíček and Michalík (1986; SNM Z 19458 = BK6-95/20, SNM Z 19446 = BK7-530/3s), one incomplete, slightly deformed specimen (SNM Z 40095 = BK7-d/2) preserved as outer mould in rock with cherts with almost undeformed shape of the ultimate whorl, and some other fragments [BK3-210/3, BK7a-1s, 4s (= BK7 – ca. 82 fragments), BK8-290/1, BK8-310/1].

DESCRIPTION: Semi-involute mould with a medium-high whorl and a medium-wide umbilicus. Whorl is higher than wide. Flanks are slightly vaulted, gradually inclined towards the venter. The venter is rounded, medium-wide. Whorl flanks decline to a low umbilical wall through a narrow, rounded zone. On the whorl flanks, the ribs are rather strong, slightly S-shaped and sparse, starting near the umbilicus with an indistinct blunt tubercle. The backside of the ribs bears shallow, rather wide, not sharply restricted constrictions. Constrictions and ribs pass the venter without interruption. Thin inter-ribs running similarly with the main ribs are occasionally distinct between them. Half-whorl bears 4 ribs.

MEASUREMENTS: *Dmax* of specimen SNM Z 40095 reaches approximately 120 mm. At D = 110.0 mm, H = 48.0 mm (H/D = 0.44), U = c. 36.5 mm (U/D = 0.33). At H = 53.0 mm, B = 29.5 mm (B/H = 0.56); at H = 46.0 mm, B = c. 23.0 mm (B/H = 0.50).

REMARKS: *Abrytusites julianyi* is a related species which differs from *A. thieuloyi* by its having a higher number of main ribs on the adult whorl and a wider umbilicus. *Abrytusites neumayri* (Haug, 1889) differs from these species by having a smaller number of main ribs on the adult whorl which are straighter. Other representatives of this genus include *A. loryi* and *A. sulcatus*. In particular, they differ from the previous species by the presence of wide constrictions accompanying the main ribs on both sides. Both species are characterised also by a wider umbilicus. Based on this common morphology, it can be assumed that *A. sulcatus* is a synonym of *A. loryi.* It is probable that Nikolov and Breskovski (1969) did not know *A. loryi.*

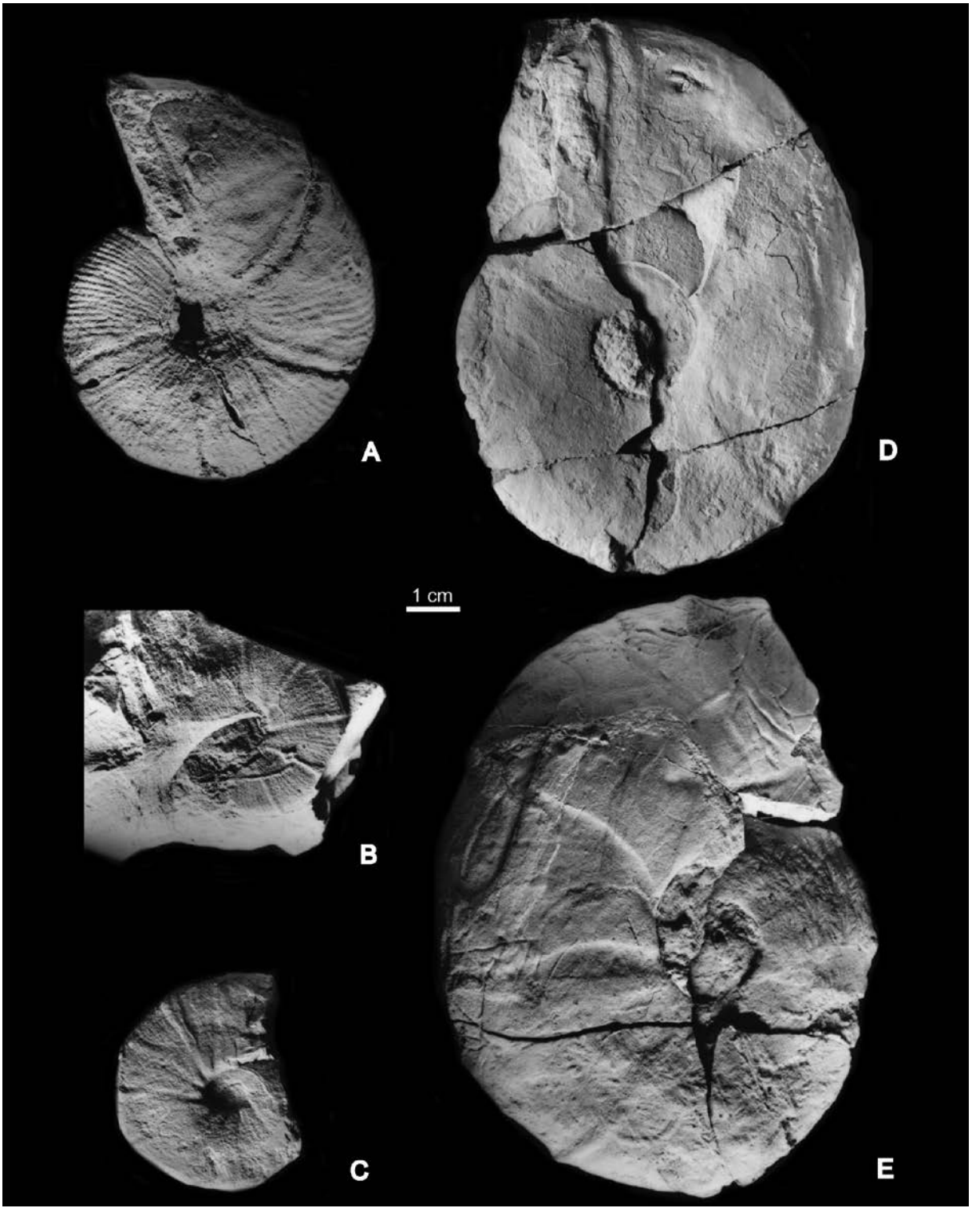
Almella Gorn, 1969 (with the type species *Almella almensis* Gorn, 1969) remains a problematic genus in the Subfamily Abrytusitinae. Gorn (1969) included the type species of *Abrytusites* (*A. neumayri*) into her new genus *Almella*! The juvenile whorls are characterised by constrictions which do not accompany the main ribs. Only the main ribs are developed on the adult ultimate whorl. *Abrytusites neumayri* bears a similar ribbing. *Almella almensis* may differ from the representatives of the genus *Abrytusites* by having a different cross-section and wider adult whorls that cannot usually be compared due to the frequent deformation of specimens. *Almella almensis* is considered to be early Barremian in age.

OCCURRENCE: The species has been reported from France, Spain, Austria and Hungary. Most commonly, it occurs in the lower Hauterivian *nodosoplicatum* Zone. In Butkov Quarry, it has been reported near the lower/upper Hauterivian boundary (*jeannoti* Zone) up to the uppermost Hauterivian (*ligatus* Zone) in the lower part of the Kališčo Formation, especially in Levels 7 and 8.

Superfamily Barremitoidea Breskovski, 1977
Family Barremitidae Breskovski, 1977

REMARKS: The Family Barremitidae includes an extensive group of semi-involutely coiled ammonites, in which periodical main ribs accompanied by straight to sigmoidally bent constrictions are developed. In the intercostal space, only faint lines (striae) to thin ribs occur. Stronger ribs are visible in the initial development stages on the juvenile whorls. The taxonomy of these ammonites is difficult with regard to their poorly conspicuous ornamentation and morphology, usually complicated by considerable deformation of the original shells connected with deposition in marly deposits. Another problem is the usually uncertain stratigraphic position of much type material established in foreign, often historical localities that no longer exist.

At the beginning of the development of barremitid ammonites there still occur evolutionarily older spitidiscids that are, from the point of view of morphology and type of interribs between the constrictions, very close to each other. Transitional forms between *Spitidiscus* and *Plesiospitidiscus* appear. This is proved e.g., by species classified earlier into *Spitidiscus*, i.e., *S. fasciger* Thieuloy, 1972 and *S. darderi* (Fallot and Termier, 1923). According to Vermeulen and Thieuloy (1999), the former species could be an initial element of *Plesiospitidiscus* derived from *Spitidiscus*. The designation *Plesiospitidiscus fasciger* is already used by Vermeulen and Thieuloy (1999). This circumstance led to the fact that the critical genus *Plesiospitidiscus* was earlier considered to be a representative of the Family Holcodiscidae (e.g., Arkell *et al*. 1957), and in other cases as a representative of the Subfamily Barremitinae Breskovski, 1977



Text-fig. 3. Representatives of the Holcodiscidae Spath, 1923 and Barremitidae Breskovski, 1977 from Butkov Quarry, Slovakia. **A** – *Spitidiscus rossfeldensis* Weber, 1942; SNM Z 40092; Level 10, 130 m; Kališčo Formation, lower Hauterivian, *nodosoplicatum* Zone. **B** – *Plesiospitidiscus fasciger* (Thieuloy, 1972); SNM Z 40096; Level 10, 105 m; Mráznica Formation, lower Hauterivian, *loryi* Zone. **C** – *Plesiospitidiscus ligatus* (d'Orbigny, 1841); SNM Z 40038, Level 8 between prospecting galleries nos. 11 and 12; Kališčo Formation, upper Hauterivian, *ligatus* Zone. **D**, **E** – *Plesiospitidiscus* cf. *canalis* Busnardo, Charollais, Weidmann and Clavel, 2003; lateral views of strongly laterally deformed specimen; SNM Z 40100; Level 8, 180 m; Lúčkovská Formation, upper Hauterivian, *balearis* Zone; D – left side; E – right side.

(e.g., in Wright *et al*. 1996). The closeness of both genera is also evident from the similar characters of the suture lines of these genera. A small difference between them is maybe only in the shape of the inner saddles [see more simply formed saddles in *P. ligatus* (d'Orbigny, 1841) (d'Orbigny 1841, pl. 38, fig. 3) or *P. breskovskii* Cecca, Faraoni and Marini, 1998, fig. 6a–d] and the suture line in *S. fasciger* (Fallot and Termier 1923, fig. 26; Thieuloy 1972, fig. 6).

Genus *Plesiospitidiscus* Breistroffer, 1947

TYPE SPECIES: *Ammonites ligatus* d'Orbigny, 1841, p. 126, pl. 38, figs 1, 2 (refigured in Vermeulen *et al*. 1999, p. 78, pl. 1, figs 4, 5; and in Busnardo in Fischer and Gauthier 2006, p. 35, pl. 16, fig. 2a, b, text-fig. 9).

REMARKS: *Plesiospitidiscus* includes species with a comparatively narrow umbilicus and almost straight, obliquely inclined ribs accompanied by constrictions. In the intercostal space, weak lines or very thin up to indistinct, closely spaced ribs may occur. Vermeulen and Lahondère (2011) and Vermeulen *et al*. (2014) consider *P. issarpayensis* (Kilian and Reboul, 1915) to be an initial element of the genus. This imperfectly known, rarely occurring species does not occupy an entirely unambiguous stratigraphic position. Wright *et al*. (1996) and Klein and Vašíček (2011) believe that it represents the genus *Reboulites* Dimitrova, 1967 (with the type species *Puzosia issarpayensis* Kilian and Reboul, 1915, pl. 14, fig. 1) that is a synonym of *Plesiospitidiscus*. Here it should be mentioned that the type specimen of *P. issarpayensis* differs from the Bulgarian material designated by Dimitrova (1967). The specimens that were included by Dimitrova in the genus *Reboulites* differ e.g., by S-shaped ribbing accompanied by constrictions and especially by their Barremian age.

A closely related genus is *Pseudovaldedorsella* Cecca, Faraoni and Marini,1998. Representatives of this genus have wider whorl cross-sections (which cannot be verified in the case of our material) and wider umbilici than the representatives of *Plesiospitidiscus*. According to Főzy and Janssen (2006), the late Hauterivian genus *Pseudovaldedorsella* seems to be an unnecessary genus.

The genus *Plesiospitidiscus* occurs in Butkov Quarry in the Kališčo Formation across the lower/upper Hauterivian boundary and in the upper Hauterivian. *Plesiospitidiscus ligatus* is a zonal index for the lower part of the upper Hauterivian (Reboulet *et al*. 2018).

SPECIES COMPOSITION: *Plesiospitiscus fasciger* (Thieuloy, 1972), *P. ligatus* (d'Orbigny, 1841), *P. subdifficilis* (Karakasch, 1907), *P. issarpayensis* (Kilian and Reboul, 1915), *P. darderi* (Fallot and Termier, 1923), *P. breskovskii* Cecca, Faraoni and Marini, 1998, *P. communis* Busnardo, Charollais, Weidmann and Clavel, 2003, and *P. canalis* Busnardo, Charollais, Weidmann and Clavel, 2003. The late Barremian *P. boljetinensis* established by Vašíček *et al*. (2013) does not belong to *Plesiospitidiscus*.

Plesiospitidiscus fasciger (Thieuloy, 1972)
(Text-fig. 3B)

1972. *Spitiscus fasciger* nov. sp.; Thieuloy, p. 35, pl. 3, figs 4–9, text-fig. 4f–h, text-fig. 6.
1985. *Spitidiscus darderi fasciger* (Thieuloy); Tzankov and Breskovski, p. 6, pl. 1, fig. 3.
1994. *Spitidiscus fasciger* Thieuloy; Vašíček *et al*., p. 61, pl. 18, fig. 6.
1996. *Spitidiscus fasciger* Thieuloy; Reboulet, p. 160, pl. 32, figs 8, 9.
2010. *Plesiospitidiscus fasciger* (Thieuloy); Vašíček, p. 408, pl. 6, ?fig. 4, fig. 5.
2011. *Plesiospitidiscus fasciger* (Thieuloy); Klein and Vašíček, p. 6.

MATERIAL: Four incomplete and deformed outer moulds, usually with a poorly preserved umbilical region or venter (SNM Z 21139 = BK8-360/1, SNM Z 24735 = BK10-105/1, SNM Z 40096 = BK10-105/2; BK10-105/7).

DESCRIPTION: Semi-involute, rather small specimens. Sculpture usually consists of 5 to 6 main ribs on half-whorl that on the rear side are accompanied by weak constrictions. Intercostal space bears weak, thin, closely spaced lines to ribs.

REMARKS: The thickness of ribbing between the main ribs of *P. fasciger* is rather variable, which can be partially caused by the preservation state. A close species is *P. darderi* (Fallot and Termier, 1923), which, according to them, differs in having a smaller number of main ribs per whorl.

OCCURRENCE: *Plesiospitidiscus fasciger* is reported mainly from French localities, where it occurs in the *loryi* to *nodosoplicatum* Zones. Moreover, it is known from Bulgaria, allegedly from lower to upper Hauterivian deposits. In Butkov Quarry, most finds of *P. fasciger* come from the Kališčo Formation on Level 10 in a horizon near the level of c. 105 m (*no-*

dosoplicatum Zone). In the immediate vicinity occur the first representatives of *P. ligatus*.

Plesiospitidiscus ligatus (d'Orbigny, 1841)
(Text-figs 2E, 3C)

pars 1841. *Ammonites ligatus* d'Orbigny; d'Orbigny, p. 126, pl. 38, figs 1–3 [non fig. 4 = *Spitidiscus* sp.]
1990. *Plesiospitidiscus* cf. *ligatus* (d'Orbigny); Duraj *et al*., p. 61, pl. 1, figs 2, 3a, b.
1996. *Plesiospitidiscus ligatus* (d'Orbigny); Wright *et al*., p. 69, fig. 50.3a, 3b.
1999. *Plesiospitidiscus ligatus* (d'Orbigny); Vermeulen *et al*., pl. 1, figs 4, 5.
2011. *Plesiospitidiscus ligatus* (d'Orbigny); Klein and Vašíček, p. 6 (cum syn.).
2013. *Plesiospitidiscus ligatus* (d'Orbigny); Michalík *et al*., p. 114, fig. 94/2.

MATERIAL: A juvenile specimen SNM Z 40097 = BK7Z-E02/1 and specimen SNM Z 40098 = BK7Z-90/2, both preserved as deformed outer moulds; a flatly as well as laterally deformed outer mould preserved on both sides of SNM Z 40038 from the debris between prospecting galleries nos. 11 and 12 on Level 8 in Butkov Quarry, and three incomplete specimens (BK7-a/10s, BK7-d/1, 9 BK10-105/6), partially preserved in chert.

DESCRIPTION: Specimens small, with higher whorls and narrow umbilicus. Fragments preserved in chert indicate that whorls were comparatively broad and whorl breadth is slightly larger than whorl height. Arched flanks are ended, on the base, with an indistinct umbilical edge, after which a low, obliquely inclined umbilical wall runs towards the umbilical seam. On the ultimate whorl there are conspicuous, comparatively closely spaced, almost straight ribs inclined generally towards the aperture; they are accompanied by constrictions. The ribs are medium-strong. They disappear towards the umbilicus, but strengthen towards the outer side, where they are the most conspicuous. The ribs cross the venter without interruption. In the area near the umbilicus, the ribs are generally replaced by distinct, comparatively weak constrictions. Constrictions on the umbilical edge form notches. Towards the venter, the constrictions become shallow. On the rear side, the constrictions accompany the ribs across the venter. Ribs on the venter are accompanied, on their anterior side, even by constrictions weaker than the constrictions on the posterior side. Between the ribs with constrictions, closely spaced lines are usually only indicated.

MEASUREMENTS: Owing to deformation, both sides of the specimen from the debris between prospecting galleries nos. 11 and 12 (SNM Z 40038) are formed differently (see Duraj *et al*. 1990, pl. 1, fig. 3). On one side, where deformation manifests itself in elongation of whorl height (? axis of elongation), at D_1max = 37 mm, H_1 = 17.0 mm (H/D = 0.46) and U_1 = 7.9 mm (U/D = 0.21). On the opposite side at the same D'_1, H'_1 = 21.0 mm (H/D = 0.57), U'_1 = 5.8 mm (U/D = 0.16). Between the major axes of deformation, at D_2 = 36 mm, H_2 = 16.3 mm (H/D = 0.45) and U_2 = 7.0 mm (U/D = 0.19). On the opposite side at D'_2 = 36 mm, H'_2 = 20.5 mm (H/D = 0.57), U'_2 = 5.8 mm (U/D = 0.16). In the axis of shortening, at D_3 = 30.2 mm, H_3 = 15.0 mm (H/D = 0.50) and U_3 = c. 6.0 mm (U/D = 0.20). On the opposite side preserved better, at D'_3 = 30.2 mm, H'_3 = 15.8 mm (H/D = 0.52) and U'_3 = 6.2 mm (U/D = 0.205). There are 7 ribs accompanied by constrictions per half-whorl.

The juvenile specimen SNM Z 40097 has, at D = 24.2 mm, H = 11.9 mm (H/D = 0.50) and U = 4.5 mm (U/D = 0.19). The imperfectly preserved fragment BK7-d/1 has, at H = 19.8 mm, U = 24.2 mm (B/H = 1.22). SNM Z 40098 = BK7Z-90/2 has, at a diameter close to *Dmax*, i.e., 46 mm, H = 24.2 mm (H/D = 0.53) and U = 8.9 mm (U/D = 0.17). There are 8 ribs per half of ultimate whorl.

REMARKS: The Butkov material demonstrates sculpture both on the juvenile specimen of *Plesiospitidiscus ligatus* (BK7E-02/1) and on the adult specimens, i.e., substantially identical in all stages. The stated finding contradicts the content of the published type material of d'Orbigny (1841), when the specimen illustrated in his pl. 38, fig. 4 has distinctly developed interribs. As mentioned in our synonymy of the species, we consider this specimen of d'Orbigny (1841) to be a representative of *Spitidiscus* and not a juvenile stage of *Plesiospitidiscus ligatus.* With reference to our interpretation of the juvenile specimen in d'Orbigny (1841, pl. 38, fig. 4), we believe that this circumstance originally led to *Spitidiscus* being considered as a predecessor of *Plesiospitidiscus* (as indicated by the second part of its generic name). Furthermore, this led to the classification of *Plesiospitidiscus* into the Holcodiscidae (e.g., Arkell *et al*. 1957; Cecca *et al*. 1998 and others).

Plesiospitidiscus ligatus differs from *P. subdifficis* (Karakasch, 1907) and *P. breskovskii* (Cecca, Faraoni and Marini, 1998) by its higher number of constrictions per whorl. The latter species has, in addition, a smooth shell at the beginning, whereas ribs with constrictions begin to appear in the later

growth stage. In both species, the umbilicus is narrower, according to the measurements given in Cecca *et al*. (1998), than that in *P. ligatus*. *Plesiospitidiscus fasciger* differs from *P. ligatus* mainly by having closely spaced lines to thin small ribs in the intercostal space. *Plesiospitidiscus communis* differs by its not very distinct ribbing. In addition to more widely spaced ribbing, *P. canalis* reaches a larger size in the adult stage.

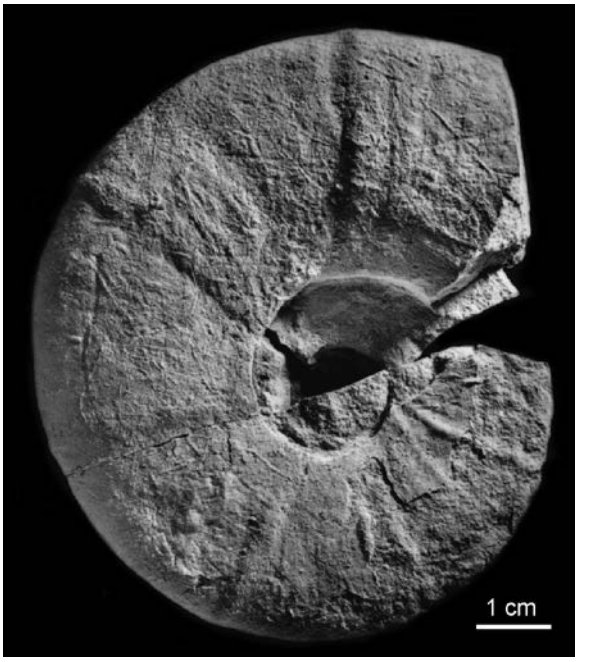
OCCURRENCE: *Plesiospitidiscus ligatus* is a zonal taxon known from upper Hauterivian deposits. Altogether, it is known from all the Mediterranean area of Europe and Morocco. In Butkov Quarry it occurs in the lower part of the Kališčo Formation, in deposits with cherts on Level 7 West, layer a, d (see Material), in a section on Level 7 West at 90 m, in section 10 at 105 m, and debris near prospecting gallery no. 11 on Level 8. All the specimens studied come from the lower part of the upper Hauterivian (*ligatus* Zone).

Plesiospitidiscus cf. *canalis* Busnardo, Charollais, Weidmann and Clavel, 2003
(Text-figs 3D, E; 4)

?1901. *Desmoceras cassidoides* Uhlig; Sarasin and Schöndelmayer, p. 54, pl. 5, fig. 5.
2003. *Plesiospitidiscus canalis* n. sp.; Busnardo *et al*., p. 51, pl. 21, fig. 1, pl. 22, fig. 4, pl. 30, figs 1, 2.

MATERIAL: The best preserved specimen, SNM Z 40099 = BK7Z-D/4, is a considerably flatly deformed outer mould. According to the remains of suture lines on the less favourably preserved side of the specimen, the prevailing part of the ultimate whorl belongs to the body chamber. Two specimens SNM Z 40100 = BK8-180/2 and BK7-S/20 are outer moulds with both sides preserved, strongly deformed also by lateral pressure. Imperfectly preserved and deformed are the four specimens BK7-S/1, BK7-D/2, BK7-B/3 and BK10-142.

DESCRIPTION: Semi-involute, rather large in size specimens, with relatively high, slightly arched whorls and medium wide umbilici. On the last whorl, relatively indistinct, blunt, sometimes even broader ribs occur. The ribs are almost straight to slightly S-shaped, on the largest specimen S-shaped. The ribs cross the venter without interruption. On both sides, the ribs are accompanied by constrictions. On the anterior side, constrictions are shallow, relatively wide and continuous over the whole length. The constrictions on the posterior side of the ribs are less conspicuous, more distinct on the venter. On the better preserved specimens, weak ribbing is usually indicated in the intercostal space.



Text-fig. 4. The barremitid *Plesiospitidiscus* cf. *canalis* Busnardo, Charollais, Weidmann and Clavel, 2003; SNM Z 40099; Level 7 West, horizon D; Lúčkovská Formation, upper Hauterivian, *balearis* Zone.

MEASUREMENTS: On SNM Z 40099, which is flatly deformed, at *D*1 = 89.1 mm (close to *Dmax*), *H*1 = 36.1 mm (*H/D* = 0.405) and *U*1 = 26.9 mm (*U/D* = 0.29). At *D*2 = 79 mm (perpendicular to *D*1), *H*2 = 33.8 mm (*H/D* = 0.43) and U_2 = 21.3 mm (*U/D* = 0.27). The whole measurement on *D*1 is within the body chamber; at *D*2, whorl height *H* is partly on the body chamber, the rest on the phragmocone. Measurement on the specimens deformed also by lateral pressure does not provide reliable results. On the whole ultimate whorl of *P. canalis*, merely 7 ribs with constrictions occur.

REMARKS: The material studied is strongly deformed. It is close in preservation to the type material illustrated in Busnardo *et al*. (2003). The specimen with uncertain stratigraphic position from Switzerland, and also specimen BK8-180/2, indicate that in the final growth stage the ribs with constrictions may become more conspicuously S-shaped. *Plesiospitidiscus* cf. *canalis* differs from *P. communis* by its wider umbilicus and more widely spaced ribbing.

OCCURRENCE: According to Busnardo *et al*. (2003), *P. canalis* occurs in the uppermost Hauterivian in the Vercors Massif in France and in the upper Hauterivian in Switzerland. In Butkov Quarry, it occurs in the lower part of the Lúčkovská Formation in a bed with belemnite marls, Level 7 West and Level 8, 180 m, uppermost Hauterivian (*balearis* Zone).

DISCUSSION

The presented study of Early Cretaceous ammonites from Butkov Quarry is significant from several aspects. From the taxonomic point of view, we regard the Family Holcodiscidae, with the distinct ribbing of shells, as part of the Superfamily Perisphinctoidea. As the stratigraphically oldest representatives of the Holcodiscidae we consider the genus *Jeanthieuloyites*, belonging to the Subfamily Spitidiscinae, in accordance with the justification of Rawson and Aguirre-Urreta (2012). The first holcodiscids (*Jeanthieuloyites*) appear in Butkov Quarry in the upper Valanginian. In the lower part of the *radiatus* Zone (lower Hauterivian), this genus is succeeded by its descendant *Spitidiscus*.

The first to split off from *Spitidiscus* was the genus *Abrytusites*, which is demonstrated by the juvenile whorls of *A. julianyi* (illustrated in Thieuloy 1972, pl. 4, figs 2, 3). In our opinion, this genus and the Subfamily Abrytusitinae represent a dead-end branch of the Subfamily Spitidiscinae.

Plesiospitidiscus can be also derived from *Spitidiscus*. Part of the representatives of *Plesiospitidiscus*, characterised by suppressed ribbing and the reduction of the main ribs accompanied by constrictions, are the first representatives of the Family Barremitidae. In contrast to the opinion of Vermeulen *et al*. (2014, 2017), we prefer *P. fasciger* to be the type species of the Superfamily Barremitoidea *versus* the imperfectly known species *Plesiospitidiscus issarpayensis*.

With reference to the invalidity of the Subfamily Eodesmoceratidae (see introductory remarks on taxonomy), the Family Desmoceratidae as well as the Superfamily Desmoceratoidea has partly lost its substantiation. In accordance with the opinions of Vermeulen and Lahondère (2011) and Vermeulen *et al*. (2014), we use the Superfamily Barremitoidea instead. As suggested above, more research is needed to understand the coherence of various ammonite groups between the Perisphinctoidea and Desmoceratoidea in the sense of Wright *et al.* (1996). The relations between the Barremitidae, Silesitidae, and parts of the Puzosiidae and Desmoceratidae also need further investigation.

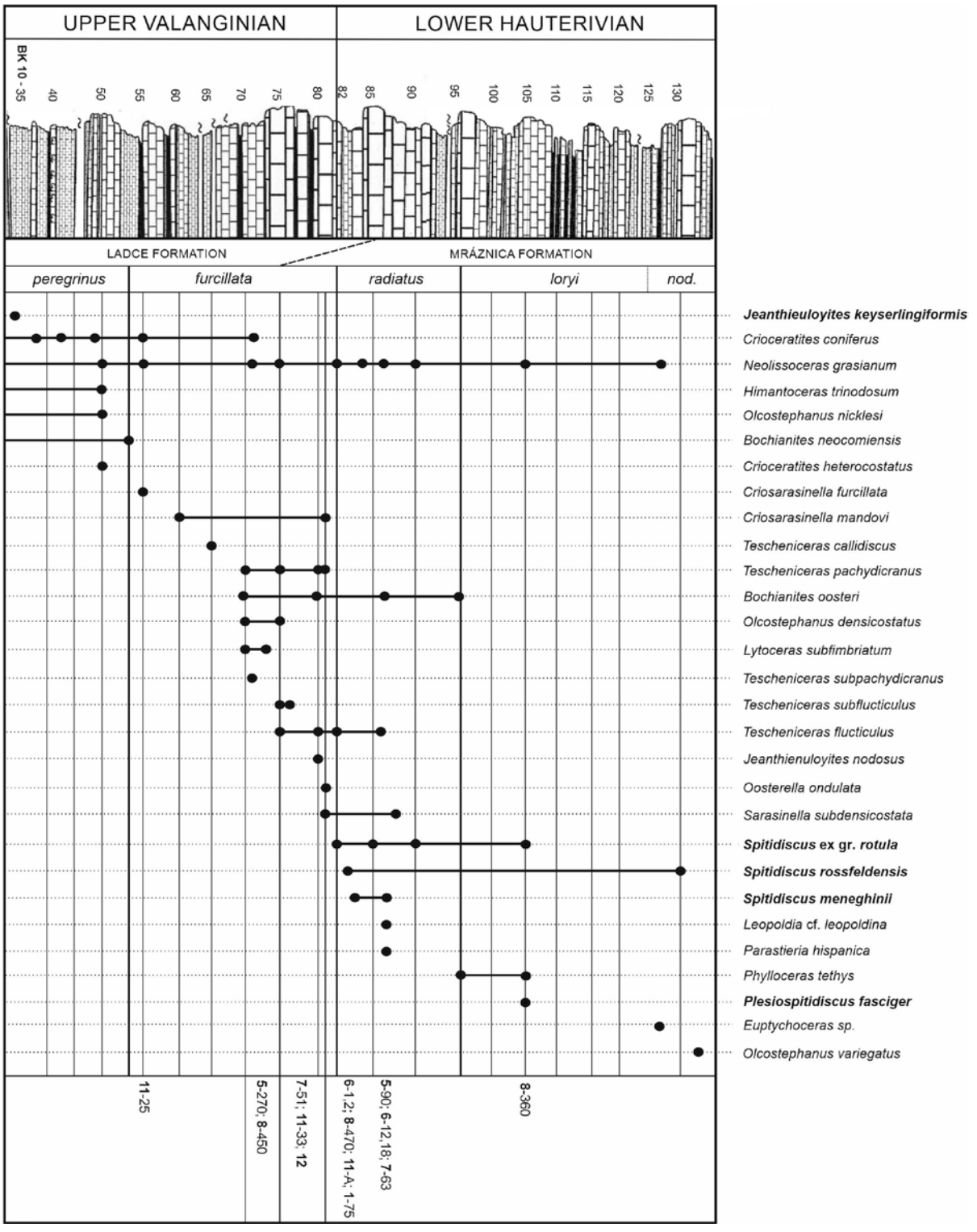
In view of the stratigraphic succession of ammonites in Butkov Quarry (in the framework of the content of the Holcodiscidae in Butkov Quarry in our concept), this association can be characterised in the following simplified generic succession (Text-fig. 5). Already in the late Valanginian, the first representatives of the genus *Jeanthieuloyites* appeared. Stratified collections in Butkov Quarry prove that the first, although imperfectly preserved, representatives of *Spitidiscus* appear in the base of the Hauterivian. Besides their taxonomic significance, these findings are stratigraphically also important especially because in the pelagic limestones of Butkov Quarry as well as other places in the Western Carpathians, the index species *Acanthodiscus radiatus* or its equivalents do not occur. The first occurrence of *Spitidiscus* in the early Hauterivian was also documented by Bulot *et al*. (1993) and Busnardo *et al*. (2003).

Thieuloy (1972) observed that *Abrytusites julianyi* occurs in the later part of the early Hauterivian (*nodosoplicatum* Zone). This species appears in the unstratified lower Hauterivian deposits of the Klippen Belt in Slovakia (Vašíček 2002). In Butkov Quarry, across the lower/upper Hauterivian boundary *A. thieuloyi* occurs relatively abundantly (Vašíček and Michalík 1986), probably in slightly younger deposits than *A. julianyi*. *Abrytusites thieuloyi* ranges further into the lower part of the upper Hauterivian (*ligatus* Zone). Upsection, no specimens equivalent to *Abrytusites* occur in Butkov Quarry. This is why we consider the opinion of Vermeulen (2007b) that *Abrytusites* may belong to the Superfamily Silesitoidea *via* the genus *Maurelidiscus* Vermeulen, 2007b (type species *Ammonites intermedius* d'Orbigny, 1841) to be uncertain or even unsubstantiated.

In the middle part of the lower Hauterivian (*loryi* Zone), the first representatives of *Plesiospitidiscus* appear, together with the last representatives of *Spitidiscus*. *Plesiospitidiscus* dates back to the beginning of the Family Barremitidae leading to the Superfamily Barremitoidea. The distribution of *Abrytusites thieuloyi*, *Plesiospitidiscus ligatus*, *P.* cf. *canalis* and accompanying species in the upper Hauterivian of Butkov Quarry is graphically shown in Vašíček (2020b, fig. 3).

Vermeulen *et al.* (2014, 2017) regarded also the Family Holcodiscidae to be part of the Superfamily Barremitoidea, but, emphasizing the distinct ribbing in this family, we prefer to maintain it within the Perisphinctoidea at this moment.

This discussion points to the complexity, inconsistency and variability of the taxonomic concept



Text-fig. 5. Composite distribution of upper Valanginian and lower Hauterivian ammonites in the Ladce and Mráznica formations on Level 10 of Butkov Quarry (BK10). The upper part of the figure represents basic stratigraphy, lithostratigraphic units, ammonite zones and position of faunal horizons in metres. In the lower part, numerical symbols (e.g., **5**–270 = Level 5, 270 m of section) mark places with same species occurring in other levels of the quarry. Fig. 3 of Vašíček (2020b) is created in the similar way. Both figures facilitate the broader correlation of the family Holcodiscidae with the distribution of the genus *Teschenicerasa* and the other accompanying lower Hauterivian species. Abbreviation *nod*. stands for the *nodosoplicatum* Zone. Species discussed herein are marked in bold.

of the Early Cretaceous ammonite associations in Butkov Quarry. It is evident that our present opinions should be updated if new specimens appear from well stratified sedimentary units.

CONCLUSIONS

We consider the Subfamily Spitidiscinae to be the stratigraphically oldest of the Family Holcodiscidae, which belongs into the Superfamily Perisphinctoidea. The first representatives of this family appeared in the late Valanginian.

The genus *Spitidiscus* appeared at the beginning of the early Hauterivian. In areas where the zonal index species *Acanthodiscus radiatus* does not occur in the base of the Hauterivian, the onset of the genus *Spitidiscus* indicates the beginning of the Hauterivian. This is also the case in Butkov Quarry.

At the end of the early Hauterivian, the genera *Abrytusites* and *Plesiospitidiscus* separated from *Spitidiscus.* Whereas *Abrytusites* represents a dead-end branch of development, the latter species continued further to the late Hauterivian. With regard to the fact that the Family Desmoceratidae has lost its validity, the genus *Plesiospitidiscus* and its followers have been classified into the Family Barremitidae, Superfamily Barremitoidea.

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APPENDIX

The list of specimens from this paper (SNM Z 40090–40100), deposited in the collections of the Slovak National Museum in Bratislava, is supplemented by specimens from the recently published paper of Vašíček (2020b). However, the repository number are missing in that paper, being mentioned only by their field number. To supplement this data, we introduce them herein: Z 40084 = BK7-45/3 – *Bochianites oosteri* Sarasin and Schöndelmayer, 1902 (fig. 2A of Vašíček 2020b); Z 40085 = BK11/10-04/5 – *Bochianites neocomiensis* (d'Orbigny, 1842) (fig. 2B of Vašíček 2020b); Z 40086 = BK7-B/1 – *Euptychoceras meyrati* (Ooster, 1860) (fig. 2C of Vašíček 2020b); Z 40087 = BK7-C27a, Z 40088 = BK7-C27b, and Z 40089 = BK7-D/1 – *Euptychoceras subundulatum* (d'Orbigny, 1850) (figs 2D, 2E and 2F of Vašíček 2020b, respectively).