

# Macroconch ammonites from the Štramberk Limestone deposited in the collections of the Czech Geological Survey (Tithonian, Outer Western Carpathians, Czech Republic)

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**Key words:** megaammonites, Tithonian, Silesian Unit, Outer Western Carpathians.

**Abstract.** 11 specimens of large sized ammonites from the Štramberk Limestone deposited in the collections in Prague represent 6 species. Two species belong to the superfamily Lytoceratoidea, the remaining ones to the superfamily Perisphinctoidea. The perisphinctid specimens belong to the Lower and the Upper Tithonian, and the lytoceratids probably correspond to the same stratigraphic level. Two species, namely *Ernstbrunnia blaschkei* and *Djurjuriceras mediterraneum* were not known from the Štramberk Limestone earlier.

## INTRODUCTION

When revising the palaeontological collections of the Czech Geological Survey in the depository at Lubná near Rakovník in the year 2017, Dr. Eva Kadlecová recorded an unprocessed collection of large specimens of ammonites whose preservation and matrix suggested they had been collected from the Štramberk Limestone. The finds lack any data indicating where they had been collected. It is possible that they could come from the Castle Quarry (Fig. 1) The assumption is that the collection came from the museum of the geological institute of the German Carl Ferdinand University in Prague which no longer existed after the First World War.

The Štramberk Limestone is known for the richness and quality of its fauna which has been systematically processed since the second half of the 19<sup>th</sup> century. The history of palaeontological research up to the year 2005 is provided by Vašíček and Skupien (2004, 2005). The Štramberk Lime-

stone in the Silesian Unit of the Baška Development in the Outer Western Carpathians is located in the surroundings of Štramberk reaches (see Fig. 2). According to its ammonites, the stratigraphic range is from Lower Tithonian to Lower Berriasian (Vašíček, Skupien, 2016).

The quality of preservation of most specimens, their variety and the presence of species not described yet from the Štramberk Limestone has led to the presently submitted taxonomic processing. Preliminary information on the specimens was first presented at a conference in Bratislava (Vašíček, 2018).

## MATERIAL

The collection of ammonites consists of 11 planispirally coiled specimens with comparatively large dimensions. The specimens are undeformed, partly almost complete, partly only whorl fragments. Some of the collection is preserved as

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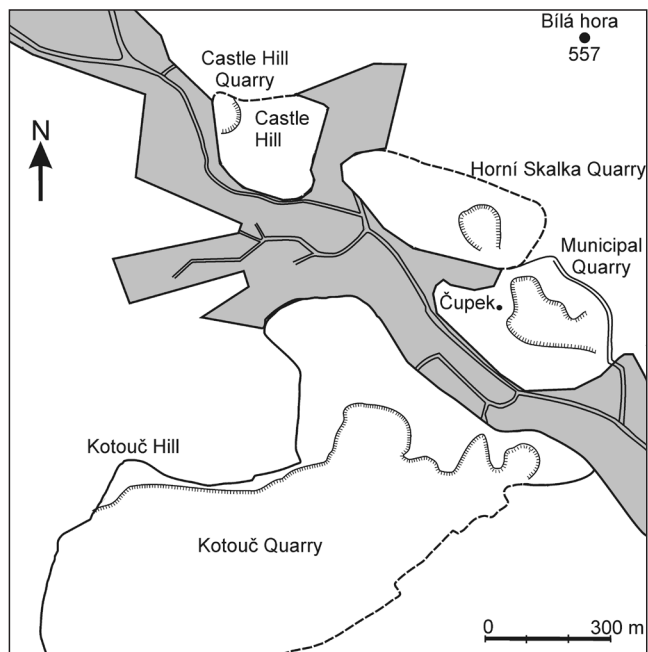


Fig. 1. Geographical situation of quarries and outcrops of Štramberk Limestone

external moulds and steinkerns, often with recrystallized remains of the original shells. A smaller portion of more complete specimens has, in addition to the final whorl, also visible the preceding whorls. This makes it possible to observe ontogenetic changes in rib development.

The collection under study is deposited in the depository of the Czech Geological Survey in Prague at Lubná near Rakovník.

The favourable preservation makes it possible to measure all usual size parameters of ammonites, *i.e.* whorl diameter  $D$ , height of whorl  $H$  lying on the same radian, whorl breadth  $B$  and umbilical width  $U$ . From the measured values, ratios  $H/D$ ,  $B/D$ ,  $U/D$  and  $B/H$  were calculated; they characterise numerically the shape of whorls and the style of coiling.

## TAXONOMY

The Tithonian megaammonites in the collection under study belong to two superfamilies: the stratigraphically less significant superfamily Lytoceratoidea and the more significant superfamily Perisphinctoidea.

A significant number of the lytoceratid ammonites from the Štramberk Tithonian are remarkable for the fact that they were described as new species in the monograph by Zittel

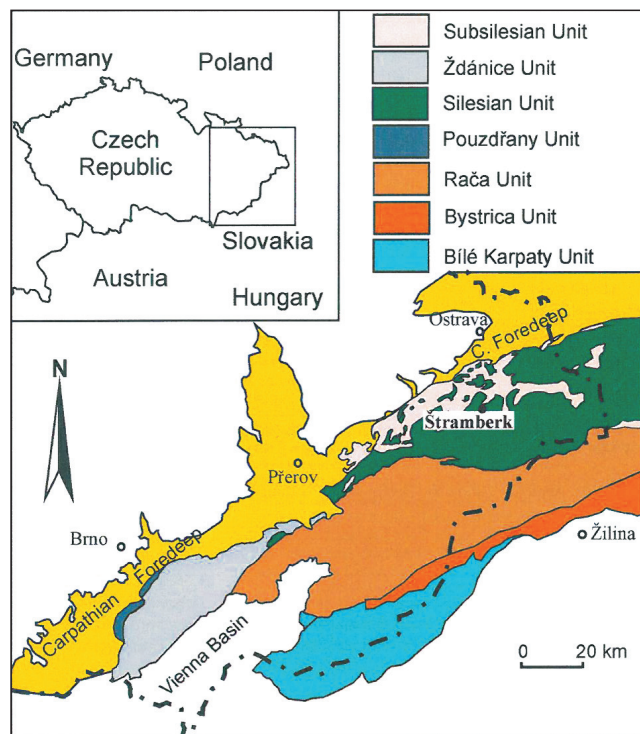


Fig. 2. Simplified geological map of the Outer Western Carpathians in the Czech Republic and the position of Štramberk

(1868). These originals which were deposited in the Bayerische Staatsammlung für Geologie und Paläontologie in Munich are, according to Zeiss (2001, p. 33), lost. With reference to the fact that the mentioned collections are closed at present, the stated information cannot be verified.

### Superfamily Lytoceratoidea Neumayr, 1875

#### Family Lytoceratidae Neumayr, 1875

##### Subfamily Lytoceratinae Neumayr, 1875

In classical literature (*e.g.* Arkell *et al.*, 1957; Wright *et al.*, 1996; Zeiss, 2001), among the other genera (or subfamilies) occurring in the Tithonian, *Lytoceras* Suess, 1865, *Hemilytoceras* Spath, 1927 and *Proteragonites* Hyatt, 1900 belong to the subfamily Lytoceratinae. With the suborder Lytoceratina, and thus also with the subfamily Lytoceratinae, not long ago Hoffmann (2010) was concerned about the detailed significance from the point of view of phylogenesis of a so-called septal lobe. He classified, based on the formation of this lobe, many previously existing genera, including the genus *Hemilytoceras* Spath, 1927 (in detail and similarly as Wright *et al.*, 1996) as subjective synonyms under the ge-

nus *Lytoceras*. The same view is taken by Klein *et al.* (2009) where the synonyms for Lower Cretaceous representatives of the genus *Lytoceras* are given.

With regard to the collection under study and the morphology of the adult whorls, we consider *Hemilytoceras* to be a separate genus (with justification given below).

#### Genus *Lytoceras* Suess, 1865

**Type species.** *Ammonites fimbriatus* J. Sowerby, 1817, p. 145.

Basic characteristics are, in the adult stage, a circular up to subquadratic cross-section of whorls and thin, crinkled ribs.

#### *Lytoceras sutile* (Oppel, 1865)

Pl. 1: 1, 2

1865. *Ammonites sutilis* Opp.; Oppel, p. 551.

1868. *Lytoceras sutile* Opp.; Zittel, p. 76, pl. 12: 1a, b, 2 (= lectotype designated by Patrušius and Avram, 1976, p. 163), figs. 3–5.

2009. *Lytoceras sutile* (Oppel); Klein *et al.*, p. 124 (*cum syn.*).

**Material.** Two specimens, a larger one (spec. XA 922) and a more complete one (XA 927) have preserved their corroded, thin, recrystallized original shell. In places where the original shell is split off, it is evident that the steinkern is smooth. The larger specimen (XA 922) with its recrystallized shell has the incomplete final whorl affected by fissure without displacement. Both specimens have for the most part the inner whorls preserved too.

**Description.** Specimens evolutely coiled, with whorls of round (circular) cross-section. On juvenile whorls and on the whole smaller specimen, sculpture is formed of thin, closely spaced, slightly crinkled ribs. On the larger specimen, ribs are more prominent. On the ultimate whorl, ribs are stronger and more widely spaced. Near the umbilical seam, ribs are concavely bent towards the aperture. Further out, the ribs become straight. The ribs cross the venter without interruption, shallowly convexly bent towards the aperture. The thin ribbing of the juvenile whorls of spec. XA 922 is disturbed in places by the occurrence of slightly stronger ribs accompanied by an indistinct constriction on their posterior side. Both specimens on the adult whorl bear 4–5 such ribs.

**Measurements.** On specimen XA 927 at  $D_{\max}$  177 mm,  $H = 69.5$  (0.39),  $U = 65.0$  (0.37),  $B = 64.0$  (0.36),  $B/H = 0.92$ . Specimen XA 922 reaches, by estimation, a maximum size of about 200 mm. At  $D = 134$  mm,  $H$  is *ca.* 50.0 (0.37),  $U = 52.7$  (0.39),  $B$  *ca.* 52.0 (0.39),  $B/H = 1.04$ .

**Remarks.** The larger specimen with a non-corroded shell (XA 922) bears, on the ultimate whorl, stronger and

more widely spaced ribs than specimen XA 927. The first specimen is close to the lectotype illustrated by Zittel (1868, pl. 12: 1), the other corresponds in sculpture to a fragment of whorl in Zittel on pl. 12: 5. Unambiguity in the determination of this species in foreign localities is often influenced by preservation imperfectness in the form of deformed specimens and specimens preserved only as smooth steinkerns.

The *L. sutile* occurring in sediments around the Jurassic/Cretaceous boundary is morphologically and by its type of ribbing close to the type species of the genus *Lytoceras*, *i.e.* *L. fimbriatum* (J. Sowerby, 1817) from the Liassic, this being *Lytoceras* s. str. Other similar species from the lower part of the Cretaceous such as *Lytoceras subfimbriatum* (d'Orbigny, 1841) and *Lytoceras subsequens* Karakasch, 1907 bear similar thick and slightly corrugated ribbing. Contrary to the situation in *L. sutile*, the distinct main ribs of *L. subfimbriatum* (uppermost Valanginian – Early Hauterivian), accompanied by stronger constrictions on the posterior side of the ribs, are developed already in the juvenile stage of growth. About 7 constrictions can be found on a single whorl. The main ribs on the type species of *L. subsequens*, which is stratigraphically younger (Barremian), are not developed, and this is the case with the vast majority specimens figured by Drushchits (1956).

**Distribution.** *L. sutile* is reported from the Tithonian and Berriasian in France, Italy, Bulgaria, Rumania, the Crimea and Armenia.

#### Genus *Hemilytoceras* Spath, 1927

**Type species.** *Ammonites immanis* Oppel, 1865, p. 551

#### *Hemilytoceras liebigi liebigi* (Oppel, 1865)

Pl. 1: 3–5

1865. *Ammonites Liebigi* Opp.; Oppel, p. 551.

1868. *Lytoceras Liebigi* Opp. sp.; Zittel, p. 74, pl. 9: 6a–c, 7a–c, pl. 10: 1a–c (= lectotype designated by Avram, 1976), non pl. 11: 1a–c – 3a–c (= *Lytoceras Liebigi* var. *Strambergensis* in Zittel, 1868 = *Hemilytoceras immane* Oppel, 1865).

?1976. *Lytoceras liebigi* Oppel; Avram, p. 21, pl. 7: 4a, b.

?1979. *Lytoceras liebigi* (Oppel); Sapunov, p. 37, pl. 5: 1, 2 (*cum syn.*).

1997. *Biasaloceras liebigi* (Oppel); Arkadiev, Bogdanova, p. 109, pl. 32: 2.

2000. *Biasaloceras liebigi* (Oppel); Arkadiev *et al.*, p. 98, pl. 2: 4a, b.

2001. *Lytoceras (Hemilytoceras) liebigi* (Oppel); Zeiss, p. 34.

2009. *Lytoceras liebigi liebigi* (Oppel); Klein *et al.*, p. 116 (*cum syn.*).

2013. *Lytoceras liebigi* (Oppel); Fözy, Scherzinger, p. 212, pl. 2: 1a, b, pl. 16: 8.

**Material.** Specimen XA 928 has a preserved quarter of the final whorl belonging to the body chamber and with an even smaller part of the preceding whorl belonging to the phragmocone. The specimen is preserved as a steinkern. Specimen XA 926 is a fragment of the incomplete half of the ultimate whorl bearing the corroded remains of the original shell. It belongs to the body chamber.

**Description.** Evolute specimens, with depressed whorls the breadths of which are considerably greater than their heights. The flanks of the ultimate whorl are markedly arched. The lower part of the whorl declines, in a rather long rounded part, to the umbilicus, the upper part comparatively suddenly passes to a wide, arched venter. The steinkern is smooth. The thin permineralised shell bears comparatively faint, unclearly undulated (due to corrosion), widely spaced ribs of the same type. In the lower part of the whorl, the ribs are concavely bent towards the aperture. They cross the venter without interruption in a wide, convex bend.

**Measurements.** Specimen XA 926 reaches a diameter of about 160 mm. At H = 48.0, B is 69.0 mm; B/H = 1.44. Specimen XA 928 reaches a diameter of about 230 mm. The end of the phragmocone occurs at D of about 145 mm. At H = 59.5 mm, B = 91.0 mm; B/H = 1.53.

**Remarks.** In the case of flatly compressed specimens, determination is not usually unambiguous (see question marks in synonymy). In addition to *Lytoceras liebigi*, Zittel (1868) also described the subspecies *Lytoceras liebigi* var. *strambergensis*, which is however, with regard to Oppel's data, a synonym of the species *Ammonites immanis* Oppel, 1865, or of *Ammonites atrox* Oppel, 1865 (see Zeiss, 2001, p. 33–34), established somewhat earlier. *H. immane* bears many stronger and sharper main ribs. To the type subspecies of *H. liebigi*, Zeiss (2001) also added the subspecies *H. liebigi costatus* that bears widely spaced and comparatively coarse ribs on the end of the adult whorl. *H. montanum* (Oppel, 1865) has numerous strong crinkled ribs. In the interspaces between ribs lie one or two thin interribs.

Distribution *H. liebigi liebigi* is a subspecies that occurs in many European localities in the Tithonian. Arkadiev *et al.* (2000) mentioned that this subspecies is known from the Berriasian of the South-Western Crimea.

Superfamily Perisphinctoidea Steinmann, Döderlein, 1890

Family Lithacoceratidae Zeiss, 1968

Subfamily Sublithacoceratinae Zeiss, 1968

In principle, the classification of Tithonian perisphinctids in this paper respects the taxonomy published by Zeiss (2001).

Genus *Blaschkeiceras* Zeiss, 2001

Type species. *Perisphinctes (Aulacosphinctes) schoepflini* Blaschke, 1911, p. 76.

*Blaschkeiceras kittli* (Blaschke, 1911)

Pl. 2: 1

1911. *Perisphinctes (Pseudovirgatites) Kittli* n. sp.; Blaschke, p. 158, pl. 3: 1.

2001. *Blaschkeiceras* cf. *kittli* (Blaschke); Zeiss, p. 43, pl. 18: 1, 3.

2017. *Blaschkeiceras kittli* (Blaschke); Vašíček *et al.*, p. 590, fig. 5a, b (holotype).

**Material.** A single corroded external mould of large dimensions (specimen XA 931). The initial quarter of the ultimate whorl has been artificially modelled to be complete; the inner whorls are partly unfavourably preserved.

**Description.** Specimen semi-evolute coiled, with medium-high, comparatively narrow whorls and with a wide umbilicus. The heights of the whorls are greater than their breadths. The umbilical wall is low, slightly arched, inclined obliquely to the line of coiling. It passes through a zone which is comparatively suddenly rounded up to slightly arched flanks. Those continuously pass to a comparatively narrow, conspicuously arched venter.

The exposed part of the inner whorls bears medium-strong, more widely spaced ribs of uniform type. On the umbilical wall they are slightly concavely bent towards the aperture; on the flanks they are straight. In the vicinity of the end of the penultimate whorl (at D of about 200 mm), this type of ribs disappears. After the beginning of the ultimate whorl, which was modelled to be complete, corroded, comparatively strong and blunt umbilical tubercles occur. On the corroded flanks of the whorl, only unclear, probably simple ribs run out from the tubercles.

**Measurements.**  $D_{\max}$  exceeds 320 mm. At D of about 320 mm, H is ca. 92.0 (0.29), U = 155.0 (0.48), B ca. 70.0 (0.22); B/H ca. 0.76. At D = 320 mm, there are 14 umbilical tubercles per half-whorl. Along the ray identical with the ray along which the maximum diameter of the specimen is measured, there are 22 primary ribs per half-penultimate whorl.

**Remarks.** *B. kittli* could be, according to Zeiss (2001, p. 43), a macrococh to *B. schoepflini* (Blaschke). *B. kwasnitszkai* Zeiss, 2001 differs from the other species of the genus in a way of arrangement of primary ribs on the adult whorl.

**Occurrence.** The mentioned species as established by Blaschke (1911) lacks detailed localization and real stratigraphic position from the area of Štramberk. According to the data of Zeiss (2001), it occurs in the Lower Tithonian in the area of Ernstbrunn in Lower Austria.

## Subfamily Paraulacosphinctinae Tavera, 1985

Genus *Paraulacosphinctes* Schindewolf, 1925

**Type species.** *Ammonites senex* Oppel, 1865, p. 556.

*Paraulacosphinctes senex* (Oppel, 1865)

Pl. 1: 6

1865. *Ammonites senex* Opp.; Oppel, p. 556.
1868. *Ammonites senex* Oppel in Zittel; Zittel, p. 113, pl. 23: 3a, b, ?figs. 1, 2 (= ?*Paraulacosphinctes senoides* Tavera, 1985).
1979. *Paraulacosphinctes senex* (Oppel); Sapunov, p. 126, pl. 25: 1.
1985. *Paraulacosphinctes senex* (Oppel); Tavera, p. 82, pl. 10: 1, 2.
2001. *Paraulacosphinctes* (cf.) *senex* (Oppel); Zeiss, p. 61, pl. 20: 1–3 (non text-fig. 21).
2016. *Paraulacosphinctes senex* (Oppel); Vašíček, Skupien, p. 19, figs. 5a–c, 6a.

**Material.** Two well preserved specimens (XA 925 and XA 932), partly with preserved recrystallized original shell on several of the inner whorls. The ultimate whorl of specimen XA 925 preserved as a steinkern belongs to the body chamber. Two other large specimens (XA 929 and XA 930) are strongly corroded, without or with only slightly preserved sculpture.

**Description.** Specimens semi-evolute, with medium-high, comparatively slender whorls and with a wide umbilicus. The umbilical wall is low and passes through a rounded zone to slightly arched whorl flanks. The whorl reaches the largest breadth at about half the whorl height. The outer half of the whorl inclines to the venter more than the lower half to the umbilicus. The flanks continuously pass to the venter; it is comparatively narrow and rounded.

Juvenile whorls bear uniform, moderately strong, quite sharp, not too widely spaced, simple ribs. Ribs are not sharp as they begin above the umbilical seam. On the umbilical wall and on the flanks, the ribs are slightly prorsiradial, concavely bent towards the aperture. At diameters of 110–130 mm, ribbing changes. Ribs at the base become swollen to form bullate umbilical tubercles. As low as the lower fifth of the whorl height, the ribs disappear in the direction of the venter. Further on, merely wide and blunt tubercles remain. On the final half of the ultimate whorl, the blunt umbilical tubercles are followed by indistinct (corroded) blunt ribs. It seems that the ribs cross the venter without interruption. The steinkerns, with the exception of umbilical tubercles, are smooth.

**Measurements.** The corroded largest specimen XA 930 reaches a diameter of about 300 mm. On specimen XA 932,

at  $D_{\max} = 243$  mm is  $H = 72.0$  (0.30),  $U = 110.5$  (0.45),  $B \text{ ca. } 55.0$  (0.22);  $B/H = 0.76$ . Per half whorl there are 13 umbilical tubercles. On the penultimate whorl (in the case of juvenile ribbing) there are 50 ribs per half whorl. On specimen XA 925 at  $D_{\max} = 239$  mm,  $H = 67.5$  (0.28),  $U = 115.5$  (0.48),  $B \text{ ca. } 48.0$  (0.20);  $B/H = 0.71$ . Per ultimate half whorl there are 12 umbilical tubercles.

**Remarks.** The described material enriches knowledge of the morphology of *P. senex*. Furthermore, it demonstrates that specimens with a quite corroded, penultimate whorl occur more frequently as well. Such specimens then seem to be smooth.

In addition to *P. senex*, the genus *Paraulacosphinctes* also contains *P. transitorius* (Oppel, 1865). The differences of these species were discussed in detail by Vašíček and Skupien (2016) and Vašíček *et al.* (2017). The inner whorls of the herein described macroconchs of *P. senex* are not visible enough to show whether or not they bear a ventral furrow. The ribbing and cross section of juvenile whorls differ minimally. However, significant differences are obvious on the adult whorls of macroconchs. The different cross sections of the adult whorls were illustrated by Vašíček and Skupien (2016, text-fig. 6). Another distinctive feature is the ribbing of the body chamber. The well-preserved specimens of *P. senex* bear simple and sparse blunt ribs. In an unfavourable state of preservation the ultimate whorl is more or less smooth. In case of *P. transitorius*, sparsely spaced main ribs occur already before the body chamber and split multiple times about the mid-height of the whorl. On the ultimate whorl, strong and sparse ribs split into less distinct thin ribs in the outer part of the last whorl.

**Occurrence.** According to Zeiss (2001), *P. senex* occurs in the Upper Tithonian (ammonite Microcanthum Zone) in the areas of Ernstbrunn and Štramberg.

Genus *Ernstbrunnia* Zeiss, 2001

**Type species.** *Ernstbrunnia bachmayeri* Zeiss, 2001, p. 49.

*Ernstbrunnia bachmayeri* Zeiss, 2001

Pl. 2: 2

2001. *Ernstbrunnia bachmayeri* nov. sp.; Zeiss, p. 52, pl. 11: 1–4 (4 = holotype), text-fig. 10–13.
- ?2001. *Ernstbrunnia* aff. *bachmayeri* nov. sp.; Zeiss, pl. 19: 4, 5.
2013. *Ernstbrunnia* cf. *bachmayeri* Zeiss; Fözy and Scherzinger, p. 237, pl. 27: 3.

**Material.** A medium-sized specimen (XA 923), preserved as a sculpture mould, with partially exposed juvenile whorls. The ultimate whorl, especially its final part, is quite considerably corroded.

**Description.** Specimen semi-evolutely coiled, with a medium-high whorl, with a height exceeding its breadth and with a wide umbilicus. The cross-section of the whorl is sub-elliptical. The low, oblique umbilical wall passes through a rounded zone to moderately arched whorl flanks. At the beginning, they are comparatively flat, and from the 2/3 of whorl height they become rounded and incline more markedly towards the venter. The venter is comparatively narrow, strongly rounded.

The juvenile whorls bear as far as the first half of the ultimate whorl, thin, closely spaced ribs. Inner ribbing is somewhat more distinctly developed on juvenile whorls than on the ultimate whorl. On the inner whorls, ribs are probably only simple; further they may, on the transition of the umbilical wall to the flanks, bifurcate. The ribs are concave, slightly inclined towards the aperture. On the ultimate whorl, the ribs are slightly S-shaped. At about half the whorl height, some ribs bifurcate in places. The ribs cross the venter directly and without interruption. In places, indistinct constrictions occur.

At a diameter D of about 150 mm, stronger ribs appear in the umbilical area. They are succeeded by the thin, closely spaced ribs of the previous style which are intercalated between them. In the final corroded part, widely spaced, blunt umbilical tubercles are present; in the form of indistinct corroded ribs they proceed to the venter.

**Measurements.** The specimen reaches a maximum diameter of about 200 mm. At D = 195.5 mm, H = 64.6 (0.33), U = 83.5 (0.43), B ca. 50.0–52.0 (0.255–0.265); B/H ca. 0.79. At the maximum diameter, 11 umbilical tubercles are there per half whorl. At a diameter D of about 140 mm, 72 thin ribs are there per half whorl. The holotype of *E. bachmayeri* reaches a diameter of 213 mm. H/D = 0.33, U/D = 0.45, B/D = 0.27.

**Remarks.** Other species of the genus *Ernstbrunnia* established by Zeiss (2001) are close in size to *E. bachmayeri*. They differ however in the sculpture of the adult whorls. In the case of *E. zapfei* Zeiss, ribs on the body chamber do not disappear towards the venter; the whorl cross-sections are different too. In *E. fasciculata* Zeiss, a change in juvenile ribbing can be seen earlier (at D of ca. 100 mm) than in *E. bachmayeri*. In the area of transition of juvenile ribbing to adult ribbing, bundles of thin, closely spaced ribs run out from umbilical tubercles. *E. densicostata* (Tavera, 1985) reaches in adulthood a substantially smaller cross-section of the shell without a change in the juvenile style of ribbing.

**Occurrence.** According to Zeiss (2001), *E. bachmayeri* occurs in the lowermost Upper Tithonian in the Ernstbrunn Limestone in the area of Ernstbrunn and in the Gerecse Mts. In Hungary.

## Family Himalayitidae Spath, 1925

### Genus *Djurjuriceras* Roman, 1936

**Type species.** *Djurjuriceras djurjurensense* Roman, 1936, p. 17.

#### *Djurjuriceras mediterraneum* Tavera, 1985

Pl. 2: 3, 4

1936. *Himalayites (Corongoceras) savornini* nov. sp.; Roman, p. 27, pl. 3: 1, 1a, non pl. 3: 2, 2a, 3, 3a, non pl. 4: 3, 3a (= *Djurjuriceras mutari* Tavera).

1985. *Djurjuriceras mediterraneum* n. sp.; Tavera, p. 152, pl. 19: 1, text-fig. 11a.

**Material.** An ultimate whorl incomplete in places and with a half of the penultimate whorl preserved as a steinkern (specimen XA 924). The specimen is affected by fissure without displacement affecting the final quarter of the ultimate whorl. The final half of the ultimate whorl belongs to the body chamber.

**Description.** Specimen semi-evolute, with a medium-high ultimate whorl and with a wide umbilicus. The breadth of the whorl is greater than its height. The low, rounded umbilical wall passes continuously to the flanks of the whorl. The flanks are arched and pass continuously to a wide, flatly rounded venter.

On the penultimate whorl, almost straight, simple ribs of uniform type, inclined obliquely towards the aperture, are present. On the umbilical wall, as far as the line of coiling, ribs are concavely bent towards the aperture. On a poorly preserved part of the ultimate whorl, approximately at the end of the phragmocone, sculpture changes markedly. Several ribs at the end of the phragmocone reach as far as the umbilical seam. These ribs are stronger than the previous ribs and are more widely spaced. At about two thirds of whorl height, the ribs bifurcate or trifurcate. Over a short distance, ribs do not reach as far as the umbilical seam and appear only from the base of the flanks. Ribs which are comparatively blunt at the beginning become sharper towards the aperture and are more and more widely spaced. At the beginning of the described part, the ribs are triple in the upper third of the whorl, then only bifurcating and further they run as only simple ribs. One of them bifurcates at about half the whorl height. After the bifurcated rib, on the outer side, always one rib is inserted between the widely spaced pairs of simple ribs. The inserted ribs reach only as far as the level of previous bifurcation of ribs. At the end of the specimen, only widely spaced, simple, strong ribs are present. They are straight to slightly convexly bent towards the aperture. The ribs cross the venter without interruption, almost directly.

**Measurements.** The specimen reaches a diameter of almost 230 mm. At D of about 227 mm, H is about 63.0 (0.28), U = 110.5 (0.485), B ca. 70.0 (0.31); B/H ca. 1.1. At D of about 135 mm, belonging partly to the phragmocone and partly to the body chamber, about 42 ribs near the umbilicus are there per half whorl. The phragmocone ends at D of about 165 mm.

**Remarks.** The genus *Djurjureras* was studied especially by Tavera (1985); he defined several new species. *Dj. mediterraneum* has, in comparison with *Dj. mutari* Tavera, stronger juvenile ribs, more widely spaced ribs on the body chamber, and a somewhat subquadratic cross-section of whorls. *Dj. sinuosum* Tavera bears more widely spaced ribs on the phragmocone and closely spaced, bent ribs on the body chamber. The type species *Dj. djurjurense* is characterised by widely spaced double varices in the adult part.

**Occurrence.** According to Tavera (1985), *Dj. mediterraneum* is known from the Upper Tithonian in Algeria and Spain.

## DISCUSSION AND CONCLUSION

With reference to the fact that, according to Zeiss (2001), the type material of the species *Hemilytoceras liebigi* exists no more, the specimens from the Czech Geological Survey can be used as specific documentary material from the type area of Štramberk.

In the collection under study, the ammonites from the Štramberk Limestone that are stratigraphically more significant than the lycoceratids are the perisphinctids. They belong to four species: *Blaschkeiceras kittli*, *Ernstbrunnia bachmayeri*, *Djurjureras mediterraneum* and *Paraulacosphinctes senex*. It is the last mentioned species that is the most abundant and has the biggest size.

The first two mentioned species occur, according to published data, in the Lower Tithonian. *Dj. mediterraneum* occurs at the base of the Upper Tithonian, *Par. senex* in higher Upper Tithonian. *Ernst. bachmayeri* and *Dj. mediterraneum* were not known earlier than from the Štramberk Limestone.

Macroconchs of ammonites occur in the Štramberk Limestone only sporadically. They are included in the category of exceptionally favourably preserved finds. To the already mentioned species, e.g. other historical finds of macroconchs, such as *Lithacoceras eigeltिंगense* Ohmert and Zeiss described in Vašíček *et al.* (2016) from the basal Tithonian and the Lower Tithonian *Simoceras szentei* Fözy, Scherzinger (described in Vašíček *et al.*, 2018), can be added.

Thin sections from the rocks surrounding some specimens were made. The pelbiomicritic wackestone, sometimes passing into grainstone, does not contain guide micro-

fossils. The only exception is a thin section of *P. senex* (spec. XA 929) matrix. According to D. Reháková, *Crassicollaria minutissima*, *Cr. parvula*, *Calpionella alpina* and *Tintinnopsella remanei* (Late Tithonian, the Crassicollaria Zone) were determined here.

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# Plates

## PLATE 1

Figs. 1, 2. *Lytoceras sutile* (Oppel, 1865), specimen XA 927; 1 – lateral view, 2 – ventral view

Figs. 3, 4. *Hemilytoceras liebigi* (Oppel, 1865), specimen XA 926; 3 – lateral view, 4 – ventral view

Fig. 5. *Hemilytoceras liebigi* (Oppel, 1865), specimen XA 928; lateral view, steinkern

Fig. 6. *Paralaucosphinctes senex* (Oppel, 1865), specimen XA 925; lateral view



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## PLATE 2

Fig. 1. *Blaschkeiceras kittli* (Blaschke, 1911), specimen XA 931; lateral view

Fig. 2. *Ernstbrunnia bachmayeri* Zeiss, 2001, specimen XA 923; lateral view

Figs. 3, 4. *Djurjuriceras mediterraneum* Tavera Benitez, 1985, specimen XA 924; 3 – lateral view, 4 – ventral view in the area of end of phragmocone



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