

Middle Triassic (Anisian) nautilid cephalopods from Aszófő (Balaton Highland, Hungary)

by
Attila VÖRÖS

Abstract — A nautilid fauna of medium abundance (38 specimens) was collected from the Aszófő section, well known for its rich ammonoid (*Balatonites*) fauna, and its biostratigraphic importance (one of the best sections for the Pelsonian Substage). The nautilid fauna is diverse: ten species were determined. Systematic description of the ten species is given; from among them *Encoiloceras balatonicum* sp. n., *Encoiloceras lajosi* sp. n. are new.

Keywords — Triassic, Anisian, Balaton Highland, Hungary, Nautilida, systematic descriptions.

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Introduction

After its golden ages in the Paleozoic, the subclass Nautiloidea reached a secondary flourishing period in the Triassic (see DZIK 1984). Nautilid cephalopods are subordinate to ammonoids in Tethyan Middle Triassic marine sediments, but they are frequently found around the Tethyan region, in the Germanic (MUNDLOS & URLICHS 1984) and the Sephardic provinces (e.g. PARNES 1986, GOY & MARTINEZ 1996) and even in the Arctic basin (SOBOLEV 1989). The Alpine–Mediterranean area is especially rich in Middle Triassic nautilids (HAUER 1887, 1892, 1896, MOJSISOVICS 1882).

Surprisingly, the Balaton Highland, which is among the best known and richest fossil localities of the Alpine Middle Triassic, provided very limited knowledge on Nautiloidea. Apart from some early descriptions of orthoconic forms (“*Orthoceras* cfr. *lateseptatum*” in STÜRZENBAUM 1875), coiled nautiloids (Nautilida s.str.) were rarely mentioned and never figured or described. In his voluminous geological description (“Balaton Monograph”) LŐCZY (1913, 1916) mentioned the following four species of Anisian Nautilida in faunal lists:

Pleuromutilus Mosis MOJS.

Pleuromutilus ambiguus ARTH.

Pleuromutilus cf. *Rollieri* ARTH.

Pleuromutilus sp. ind. ex. aff. *ptychoides* ARTH.

In the last decades the Hungarian Geological Institute carried out a detailed geological mapping of the Balaton Highland. The results of this mapping were published recently (BUDAI et al. 1999). The Middle Triassic paleogeography (sedimentation and paleotectonics) of the Balaton Highland was dealt with by BUDAI & VÖRÖS (1992) and HAAS & BUDAI (1995); a complex paleogeographical picture was outlined in the paper by VÖRÖS et al. (1997). The biostratigraphy of the most important localities and sections have been described and their ammonoid faunas have been listed by VÖRÖS (1998).

In the course of the fieldwork, supported both by the Hungarian Natural History Museum and the National Scientific Research Fund, a great amount of fossils was collected, mainly by T. BUDAI, L. DOSZTÁLY, I. SZABÓ and the present author. The collecting were focused on the ammonoids, but, besides the frequent brachiopods, bivalves and gastropods, some dozens of nautiloids were also found in the Middle Anisian to Upper Ladinian interval. Orthoconic and coiled groups are both represented; the coiled Nautilida are especially diverse. The richest assemblage of Nautilida was collected in the Aszófő section (Pelsonian to Early Illyrian: Balatonicus to Binodosus Subzones); this fauna is described in the present paper.

Locality

Aszófő lies at the central segment of the Balaton Highland (Figure 1). Here the Middle Triassic basal sequence is extremely thick (see BUDAI & VÖRÖS 1992, VÖRÖS et al. 1997). The Aszófő section is located on the slope of the Farkó-kő (Farkó Hill) about 2 km north of village Aszófő near the forestry road leading to Balatonszőlős. The section was excavated, after the assignment by I. SZABÓ, in two parallel, partly overlapping trenches of 50 m length.

The limestone sequence, exposed in about 20 m thickness is underlain by the Megyehegy Dolomite Formation. The lower part of the sequence is dolomitic, then becomes more and more calcareous, marly and nodular; in the yellow-mottled beds (Beds II/40–42) poorly preserved ammonites (*Balatonites ottonis*, *Acrochordiceras* sp.) have been found. The next part of the sequence is dominated by pebbly mudstones and biotrital limestones “Recoaro limestones”, interpreted

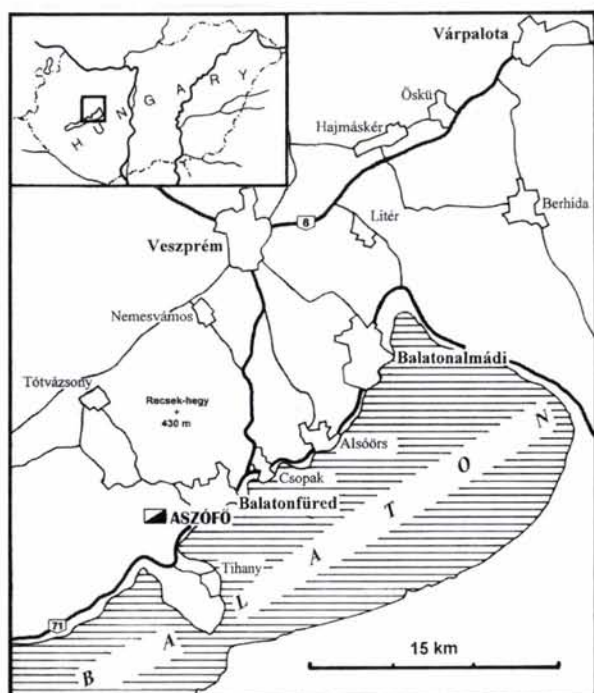


Figure 1 — The location of the Aszófő section.

as a result of submarine gravity sliding and resedimentation. The most common elements of the fauna are the brachiopods, but ammonites (*Balatonites balatonicus*) and thick-shelled gastropods and bivalves are also frequent.

After this phase of redeposition, a more quiet, basinal sedimentation follows. The dark-grey or dark-brown, well-bedded, sometimes laminated limestone is highly bituminous. The fauna is markedly different from the previous one. The ammonite assemblage is extremely rich (*Balatonites*, *Norites*, *Beyrichites*, *Proavites*, *Ptychites*, etc.); in addition, small, thin-shelled burrowing bivalves (*Palaeoneilo*, *Solemya*, *Unionites*) are rather common.

Around Bed I/43 this type of fauna gradually disappears and through 1–2 metres only *Posidonia* and *Daonella* can be found in rock-forming quantity. The undisturbed “pavements” made by the flat shells of these pelagic bivalves, the absence of benthos and bioturbation indicate anaerobic bottom conditions.

Higher up the limestone becomes nodular and cherty. This part contains rare and poorly preserved ammonites (*Bulogites*, *Beyrichites*). This “Reifling-type” limestone is exposed in the uppermost few metres in the trench, but it can be traced in the detritus up in the hillside in more than 50 m thickness.

The section was subdivided on the basis of ammonites (VÖRÖS 1987, TATZREITER & VÖRÖS 1991;

see also for detailed description and logs). The boundary between the *Balatonicus* and *Trinodosus* Zones, i.e. the Pelsonian/Illyrian boundary, can be drawn between Beds I/88 and 89. The *Balatonicus* Zone can be further subdivided: the whole sequence exposed in Trench II, and Beds 1–43 of Trench I, belong to the *Balatonicus* Subzone; Beds I/59–88 to the *Zoldianus* Subzone. After all, the Aszófő section is a very important reference section for Pelsonian ammonite biostratigraphy and is the best, though not perfect, candidate for being the type section of the Pelsonian Substage.

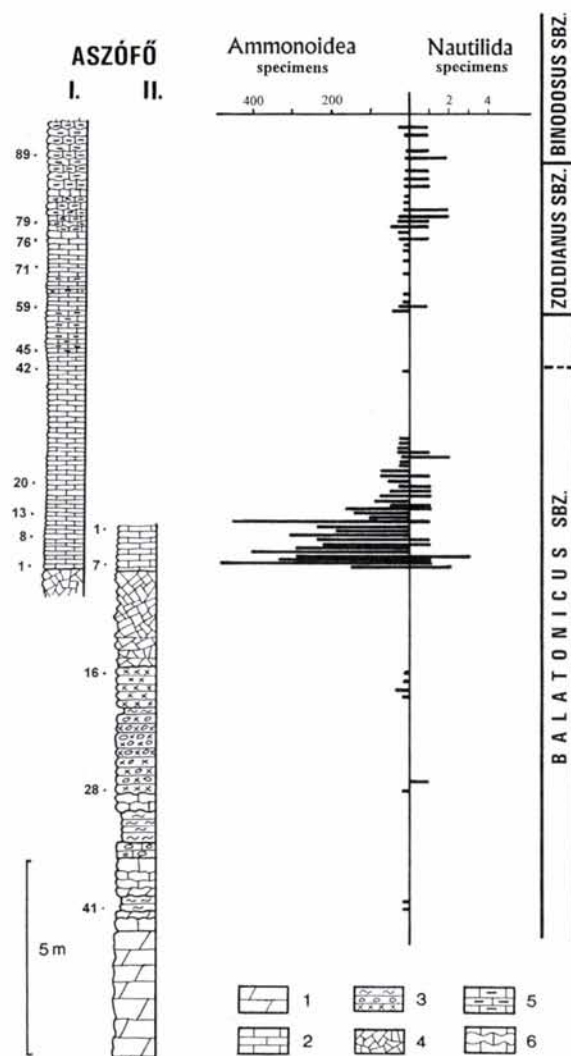


Figure 2 — Stratigraphic columns of the two trenches (I. and II.) of the Aszófő section (after TATZREITER & VÖRÖS 1991) and the frequency distribution of ammonoid and nautilid specimens.

Material

The Aszófő section yielded a relatively rich, but not very well-preserved nautilid fauna. From the 38 specimens, representing the Nautilida, the following 10 species were determined:

- Anoploceras* cf. *rollieri* (ARTHABER, 1896)
- Encoilloceras balatonicum* sp. n.,
- Encoilloceras lajosi* sp. n.,
- Mojsvaroceras* ? cf. *binodosum* (HAUER, 1887)

Pleuromutilus mosis MOJSISOVICS, 1882

Trachynautilus cf. *nodulosus* (ARTHABER, 1896)

Germanonautilus cf. *salinarius* (MOJSISOVICS, 1882)

Paranautilus cf. *indifferens* (HAUER, 1892)

Syringonautilus cf. *lilianus* (MOJSISOVICS, 1882)

Sybillonautilus cf. *pertumidus* (ARTHABER, 1896)

Except the two new species, the others are known mostly from the Alpine–Mediterranean area. Two species (*A. rollieri*, *P. mosis*) were reported earlier from the Balaton Highland (see LÓCZY 1913, 1916).

Most of the nautilids (23 specimens) occurred in the Balatonicus Subzone, comprising the lower, thickest part of the section. The Zoldianus Subzone yielded 9 specimens, whereas in the Binodosus Subzone 5 nautilid specimens were found. The abundance of nautilids seems to change together with that of the ammonoids.

The preservation is variable and shows differences through the section. In the deeper parts (Balatonicus

Subzone) the silification of the shells is prevalent. This is advantageous for the preservation of the external ornamentation, but conceals the suture lines. The body chambers were filled with sediment and were more or less compressed during later compaction. The phragmocones have silica or crystalline quartz infilling. In the higher part of the section (Zoldianus and Binodosus Subzones) the shells were dissolved or were replaced by sparry calcite; nautilids occur here as internal casts. Sometimes only the body chambers were filled with sediment and remained as casts, while the phragmocones, filled with sparry calcite, usually can not be extracted from the matrix.

The material is deposited in the Department of Geology and Palaeontology of the Hungarian Natural History Museum (Budapest). The figured specimens are under the inventory numbers M.99.104 to M.99.108 and M.99.114 to M.99.123.

Systematic descriptions

In the following descriptions the systematics of the “Treatise” (KUMMEL 1964) is used.

The dimensions are given in millimetres and in percentages of the diameter (in parentheses). The abbreviations used:

D = diameter
WH = whorl-height
WW = whorl-width
U = diameter of umbilicus
UP = diameter of umbilical perforation

Subclass **Nautiloidea** AGASSIZ, 1847

Order **Nautilida** AGASSIZ, 1847

Superfamily **Tainoceratoidea** HYATT, 1883

Family **Tainoceratidae** HYATT, 1883

Genus *Anoploceras* HYATT in ZITTEL, 1900

Anoploceras cf. *rollieri* (ARTHABER, 1896)

(Plate I: 1)

1896 *Pleuromutilus Rollieri* ART. — ARTHABER, p. 28, pl. I, figs 3a–c, 4a–b.

v non 1916 *Pleuromutilus* cf. *Rollieri* ARTH. — LÓCZY, p. 109.

Material — A single, incomplete cast of a body chamber (M.99.104.).

Measurements:	D	WH	WW	U	UP
	—	22	—	—	—

Description — One side of the body chamber is almost complete from the trace of the last septum to the slightly perceptible peristome; the other side is broken. The cross-section is slightly depressed, subquadrate. The venter is gently arched, smooth; the ventrolateral margin is blunt. The lateral side is flat, the umbilical margin is angular, slightly overhanging. The lateral side is ornamented with strong, rursiradiate ribs having (or passing into) bullae at their ventrolateral and umbilical ends. The ventrolateral bullae pass into fine, dense, posteriorly projected riblets (growth lines ?) on the ventral margin.

Remarks — *A. rollieri* differs from other *Anoploceras* species in having weaker, more irregular and widely

spaced ribbing. The specimen mentioned in the faunal list by LÓCZY (l. c.) (deposited in the collections of the Hungarian Geological Survey under the inventory number T. 3148) is a smooth form without any ribbing and definitely does not belong to *A. rollieri*.

Distribution — *A. rollieri* was described by ARTHABER (1896) from the Reifling limestones of Tiefengraben representing the upper part of the Balatonicus Zone (Pelsonian, Middle Triassic) (ASSERETO 1971, TATZREITER & VÖRÖS 1991). The Aszófő specimen came from Bed 77 (Aszófő I.), belonging to the Zoldianus Subzone of the Balatonicus Zone (VÖRÖS 1987).

Genus *Encoiloceras* HYATT in ZITTEL, 1900

Encoiloceras was used for a long time as subgenus of *Pleuromantulus* (see e.g. DIENER 1915, p. 346 and KUTASSY 1932, p. 728); in the "Treatise", KUMMEL (1964) put it on the rank of genus. DZIK (1984, p. 173) regarded *Encoiloceras* as synonym of *Anoploceras* without any reasoning or comment. In the present paper, the systematics of the "Treatise" is accepted and *Encoiloceras* is used as an independent genus characterized mainly by its large umbilical perforation and slender, evolute whorls.

Earlier authors (cited above) agreed that *Encoiloceras* was restricted stratigraphically to the Carnian. The two new species described below came from the Anisian; their attribution to *Encoiloceras* expands considerably the stratigraphic range of the genus downward, apparently without record in the Ladinian. It is probable that *Encoiloceras* was more widespread in the Middle Triassic: e.g. the species "*Temnocheilus* (*Pleuromantulus* ?) *quadrangulus*" HAUER, 1892 and "*Temnocheilus triserialis*" HAUER, 1896 described from the Bosnian "Muschelkalk" may well belong to this genus.

Encoiloceras balatonicum sp. n.

(Plate I: 2, 3a–b; Figure 3)

Holotype — Plate I: 2, Figs. 3A, C (M.99.105.)**Paratype** — Plate I: 3a–b, Fig. 3B (M.99.106.)**Type locality** — Aszód, Farkó-kő (Balaton Highland, Hungary)**Type strata** — Brownish-grey, well-bedded limestone, Balatonicus Subzone of Balatonicus Zone.**Derivation of name** — After the Lake Balaton.**Diagnosis** — Very evolute and slender *Encoiloceras* with extremely wide umbilical perforation; height and width of whorls are nearly equal; ventrally widening, trapezoidal cross-section; flanks with strong ventrolateral and weak umbilical nodes.**Material** — Two incomplete specimens.

Measurements:	D	WH	WW	U	UP
Holotype	69	21.8 (31.6)	25.6 (37.1)	33.3 (48.3)	18.2 (26.4)
	41	13.6 (33.2)	15 (36.6)	20.7 (50.5)	15.2 (37.1)

Description — The holotype is a medium-sized, incomplete internal cast with some remnants of silicified shell material of the phragmocone. The body chamber is partly worn and its adoral part is broken. The coiling is very evolute; the slender whorls are in contact, but overlap only very slightly. There is an extremely wide umbilical perforation. The whorl-section is subquadratic, trapezoidal, and much wider ventrolaterally than at the umbilical margin. The umbilical wall is steep; the umbilical edge is well defined. The venter is arched, with a slight depression at the middle. The ornamentation of the lateral flanks consists of nodes. There is a row of regularly spaced, weaker nodes at the umbilical margin. The ventrolateral part of the phragmocone is ornamented with a double row of nodes; the double nodes coalesce toward the end of the phragmocone and appear as strong tubercles on the body chamber. Blunt radial ribs connect the umbilical and ventrolateral nodes. A half whorl of the phragmocone bears 10 ribs/nodes.

Suture lines are very simple, having shallow lateral lobes and wide, arched ventral saddle without ventral lobe. The internal lobe is not visible.

Remarks — *E. balatonicum* differs from *E. superbum* (Mojsovics, 1873), the type species of the genus, by its more evolute and slender whorls, more trapezoidal whorl-section and its ornamentation (nodes and tubercles instead of coarse ribs). Furthermore, *E. superbum* is

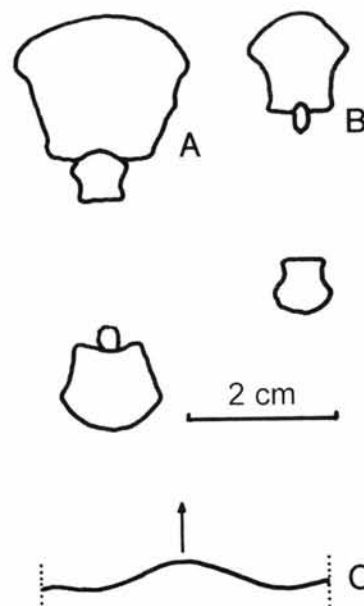


Figure 3 — Cross-sections and suture line of *Encoiloceras balatonicum* sp. n. — **A**: cross-section of the holotype (M.99.105), Aszód I (scree), Balatonicus Zone (Balatonicus Subzone), **B**: cross-section of the paratype (M.99.106), Aszód I, Bed 5, Balatonicus Zone (Balatonicus Subzone), **C**: suture line of the holotype at WH=13 mm.

known from the Carnian, divided stratigraphically from the new species described from the Anisian. The other new, Anisian species of *Encoiloceras*, described below, has significantly more depressed whorls and less coarse ornamentation than *E. balatonicum*.

Distribution — The specimens were collected from the Bed 5 (Aszófő I.) and the scree nearby, belonging to the Balatonicus Subzone of the Balatonicus Zone (VÖRÖS 1987).

Encoiloceras lajosi sp. n.

(Plate I: 4, 5a–b, 6a–c, Plate II: 1a–b; Figure 4.)

Holotype — Plate II: 1a–b; Figure 4 A (M.99.107)

Paratypes — Plate I: 4, 5a–b, 6a–c; Figs. 4 B, C, D (M.99.108, M.99.114, M.99.115)

Type locality — Aszófő, Farkó-kő (Balaton Highland, Hungary)

Type strata — Grey, nodular limestone, Binodosus Subzone of Trinodosus Zone (sensu Vörös 1987).

Derivation of name — Commemorating Lajos DOSZTÁLY, specialist on radiolarians, who was the heart and soul of our collecting works at the Balaton Highland until his unexpected death in 1999 at the age of 38.

Diagnosis — Very evolute *Encoiloceras* with wide umbilical perforation; whorls are depressed, with subquadrate, slightly trapezoidal cross-section; flanks with ventrolateral and umbilical nodes of medium strength.

Material — Four specimens: the holotype and three paratypes.

Measurements:	D	WH	WW	U	UP
Holotype	69	24 (34.8)	33.4 (48.4)	31.8 (46.1)	19 (27.5)
	73	22 (30.1)	31 (42.5)	37 (50.7)	20 (27.4)
	65.5	20 (30.5)	31.8 (48.5)	34.4 (52.5)	19 (29)

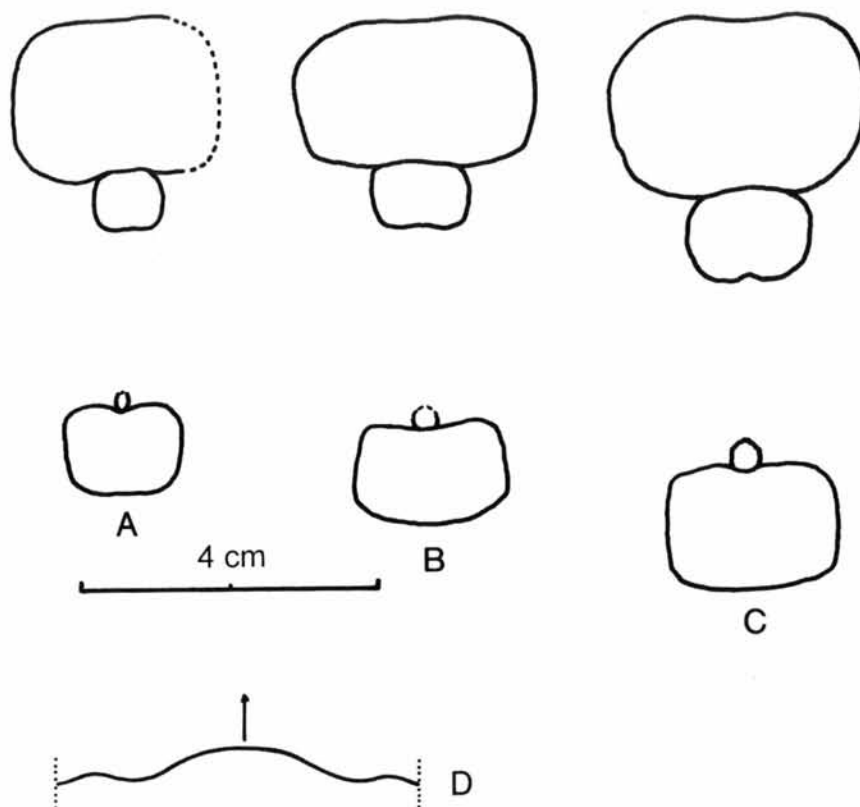


Figure 4 — Cross-sections and suture line of *Encoiloceras lajosi* sp. n. — A: cross-section of the holotype (M.99.107), Aszófő I, Bed 91, Trinodosus Zone (Binodosus Subzone), B: cross-section of the paratype (M.99.108), Aszófő I, Bed 82, Balatonicus Zone (Zoldianus Subzone), C: cross-section of the paratype (M.99.114), Aszófő I, Bed 80, Balatonicus Zone (Zoldianus Subzone), D: suture line of the paratype (M.99.108) at WH=12.4 mm, Aszófő I, Bed 82, Balatonicus Zone (Zoldianus Subzone).

Description — The holotype is a medium-sized, incomplete internal cast with 1/4 whorl preserved body chamber. The coiling is very evolute; the whorls are in contact, but overlap only very slightly. The umbilical

perforation, as seen on the broken axial surface, is very wide. The whorl-section is depressed, slightly trapezoidal, the ventrolateral shoulder is wider than the umbilical margin. The umbilical wall is steep; the

umbilical edge is blunt. The venter is gently arched, with a slight depression at the middle. The lateral flanks are ornamented with nodes of medium strength. The phragmocone has a row of weaker nodes at the umbilical margin and a double row of nodes near the ventrolateral shoulder; the double nodes coalesce toward the end of the phragmocone. On the body chamber the umbilical and ventrolateral nodes are connected by strong, blunt radial ribs; the ventrolateral nodes transform into bullae. A half whorl of the phragmocone bears 12 ribs/nodes.

Suture lines are simple, having shallow lateral lobes and very low, arched ventral saddle, without ventral lobe. The internal lobe (seen on paratype M.99.108) is narrow and deep; annular lobe cannot be seen.

Remarks — *E. lajosi* differs from *E. superbum* (MOJSISOVICS, 1873), the type species of the genus, by

its more evolute and depressed whorls, more trapezoidal whorl-section and its ornamentation (nodes and ventrolateral bullae instead of coarse ribs). *E. superbum* is known from the Carnian, divided stratigraphically from the new species described from the Anisian. *E. balatonicum* has significantly less depressed whorls, more arched venter and coarser ornamentation than *E. lajosi*.

Distribution — The holotype was collected from Bed 91 (Aszófő I.) ranged into the Binodosus Subzone of the Trinodosus Zone by VÖRÖS (1987). The paratypes came from Beds 80 and 82 of Aszófő I. (Zoldianus Subzone of the Balatonicus Zone) and Bed 5 of Aszófő II. (Balatonicus Subzone of the Balatonicus Zone), respectively. *E. lajosi* ranges through the Balatonicus Zone up to the lowermost part of the Trinodosus Zone.

Genus *Mojsvaroceras* HYATT, 1883

Mojsvaroceras ? cf. *binodosum* (HAUER, 1887)

(Plate II: 2a–b, 3; Figure 5)

1887 *Temnocheilus binodosus* n. sp. — HAUER, p. 18, pl. III, figs 5a–e.

1896 *Temnocheilus binodosus* HAU. — HAUER, p. 13 [249], pl. I, figs 3–4.

? 1904 *Temnocheilus binodosus* HAUER 1887 — MARTELLI, p. 134, pl. XIII, fig. 5.

Material — Two specimens; one incomplete phragmocone (M.99.116) and one 1/4 whorl of a body chamber (M.99.117).

Measurements:	D	WH	WW	U	UP
	34.5	19 (55.1)	20 (58.0)	11.8 (34.2)	—

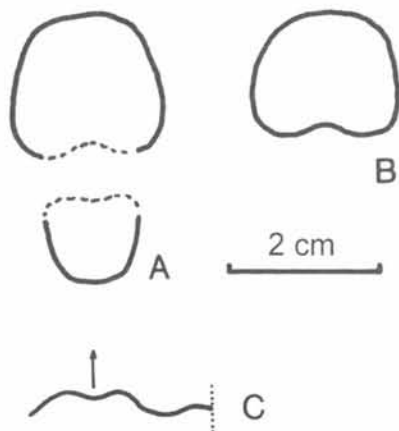


Figure 5 — Cross-sections and suture line of *Mojsvaroceras* ? cf. *binodosum* (HAUER, 1887). — **A**: cross-section of the specimen M.99.116, Aszófő I, Bed 79, Balatonicus Zone (Zoldianus Subzone), **B**: cross-section of the specimen M.99.117, Aszófő I, Bed 18, Balatonicus Zone (Balatonicus Subzone), **C**: suture line of the specimen M.99.116. at WH=11.5 mm, Aszófő I, Bed 79, Balatonicus Zone (Zoldianus Subzone).

Description — The specimens are small-sized for the genus. The coiling is moderately involute (convolute). The whorls are stout, rather depressed; the cross-section is subquadratic, trapezoidal, narrowing

ventrally. The umbilical wall is steep, gently arched; the umbilical edge is well-defined. The flanks are flat and pass gradually into the rounded venter. The flanks are ornamented with two rows of nodes; the ventrolateral nodes are strong, the umbilical nodes are very ill-developed.

The suture lines (Figure 4C) are rather simple, with wide and shallow lateral lobes and ventral saddles and pronounced ventrolateral saddles.

Remarks — The Aszófő specimens seem to be very similar to *M. binodosum*, but their poor preservation does not allow to go into a more detailed discussion of the species. Hauer (l.c.) and some later authors ranged *M. binodosum* into the genus *Temnocheilus*; while DIENER (1915, p. 334) placed it into *Mojsvaroceras*. Considering the general features of the species *binodosum*, it seems to stand closer to *Enoploceras* than to *Mojsvaroceras*. However, up to now, *Enoploceras* is known only from the Upper Triassic, therefore in the present paper *binodosum* is attributed to *Mojsvaroceras* with query.

Distribution — *M. binodosum* was described from Bosnia and Montenegro from the upper part of the Anisian ("Lower Muschelkalk"). Our specimens were collected from Bed 18 (Balatonicus Subzone of the Balatonicus Zone) and Bed 79 of Aszófő I. (Zoldianus Subzone of the Balatonicus Zone), respectively.

Genus *Pleuromutilus* MOJSISOVICS, 1882*Pleuromutilus mosis* MOJSISOVICS, 1882

(Plate II: 4)

1882 *Pleuromutilus Mosis* E. v. MOJSISOVICS. — MOJSISOVICS, p. 274, pl. LXXXV, fig. 3a–b.1896 *Pleuromutilus Mosis* MOJS. — HAUER, p. 10 [246], pl. III, figs 3–6.1916 *Pleuromutilus Mosis* MOJS. — LÓCZY, p. 109.1923 *Pleuromutilus Mosis* E. VON MOJSISOVICS — LUNIEWSKI, p. 74, pl. I.non 1926 *Pleuromutilus* cf. *Mosis* MOJS. — ALMA, p. 114, pl. 10, fig. 1.**Material** — Three specimens; one incomplete phragmocone and two body chamber fragments.

Measurements:	D	WH	WW	U	UP
M.99.118.	—	27	—	—	—

Description — The specimens are rather small-sized for the genus. The whorls are moderately depressed; the cross-section is subquadratic. The umbilical wall is steep and smooth; the umbilical edge is well defined. The flanks are flat and pass rather gradually into the moderately rounded venter. The flanks are ornamented with strong ribs and nodes. The posteriorly concave ribs project over the umbilical margin and pass into bullae at their ventral ends at about the 3/4 height of the flank. Here a longitudinal groove divides the ventral ends of the ribs from the row of the very strong ventrolateral nodes. A 1/4 whorl of the body chamber bears approximately 8 ribs and 10 ventrolateral nodes. The ventral part shows fine, dense, posteriorly arched riblets (growth lines?).

Suture lines are not visible.

Remarks — There are two, closely related species of *Pleuromutilus*, both described by MOJSISOVICS in 1882: *P. mosis* and *P. trinodosus*. The main difference between them clearly shown on the original figures, lies in the much coarser ornamentation of *P. trinodosus* showing two independent ventrolateral rows of strong nodes separated by two longitudinal grooves from each other and from the ventral ends of the strong lateral ribs, instead of only one row of nodes and one groove in *P. mosis*. On the basis of the latter character, our specimens can be ranged into *P. mosis* and the specimen figured by ALMA (l. c.) can be excluded from here. However, from the point of view of the coarseness of

the ornamentation, the Aszófő specimens stand between *P. mosis* and *trinodosus*, perhaps closer to the latter. The Aszófő specimens seem to form a morphological group with those figured by HAUER (l. c., figs 3–4), LUNIEWSKI (l. c.) and DZIK (1984, fig. 61, pl. 43, fig. 8, as *P. trinodosus*), where the coarseness of the ornamentation (e.g. the number of ribs) is in inverse correlation with the number of rows of nodes. The specimen figured by ALMA (l. c.) shows also transitional, though different, characters. These forms may fill the morphological gap between *P. mosis* and *trinodosus*, which may perhaps be united after a more detailed morphological study of the original material.

The specimen mentioned from Felsőörs in the faunal list by LÓCZY (l. c.) (deposited in the collections of the Hungarian Geological Survey under the inventory number T 3376) and studied earlier also by MOJSISOVICS (1882, p. 275) belongs to the “transitional” group with fewer and coarser ribs. The specimen was first determined by J. BÖCKH, whose handwriting can be identified on the original label with the statement: “A köldök bordásabb voltánál fogva látszik nekem *Pl. mosis*-től eltérni.” [i.e.: “This seems to me to deviate from *Pl. mosis* by its more strongly ribbed umbilicus.”]

Distribution — *P. mosis* was described from the Middle and Upper Anisian of the Alps, Dinarides, Balaton area and southern Poland. Our specimens were collected from beds 3, 4 and 26 of Aszófő I. section (Balatonicus Subzone of the Balatonicus Zone).

Genus *Trachynautilus* MOJSISOVICS, 1902*Trachynautilus* cf. *nodulosus* (ARTHABER, 1896)

(Plate II: 5a–b)

1896 *Pleuromutilus nodulosus* ART. — ARTHABER, p. 36, pl. II, figs 7a–b.**Material** — Two incomplete specimens.

Measurements:	D	WH	WW	U	UP
M.99.119	38	18 (47)	19 (50)	14 (37)	—

Description — The better-preserved specimen is an incomplete cast of a body chamber with some remnants of the calcite-filled phragmocone. It is rather large-sized for the genus. The coiling is moderately evolute

(convolute). The whorl-section is subquadrate; the venter is slightly arched, the lateral parts are vertical (parallel). The umbilical wall is steep; the umbilical margin is rather marked. The flank is ornamented with

weak longitudinal strigation (lirae) and weak, rursiradiate riblets. There are four longitudinal lirae: one at the umbilical margin, another at the 1/5 height of the flank, a third at 2/3 height of the flank and a fourth at the ventrolateral margin. The crossings of the longitudinal lirae and the riblets appear as faint nodes. The venter is smooth, except the very fine, posteriorly arched growth lines and a very weak longitudinal lira at the middle.

Suture lines are not visible.

Remarks — On the basis of their subquadrate whorl-section and four longitudinal lirae on their flanks, the Aszófő specimens can well be identified with *T. nodulosus* (ARTHABER). There are many Middle Triassic forms showing similar pattern of ornamentation. A group of them, e. g. *T. subgemmatus* (MOJSISOVICS, 1882), *T. clathratus* (HAUER, 1896) has subrounded whorl-section. The other group with subquadrate whorl-

section may be further differentiated on the basis of the strength, number and position of the longitudinal lirae: the ribs and nodes are strong in *T. crassescens* (ARTHABER, 1896) and *T. ambiguus* (ARTHABER, 1896); "*T. crassescens* var. *jugulatus*" (ARTHABER, 1896) has weak longitudinal lirae only near the umbilical margin, whereas "*T. crassescens* var. *semijugulata*" (ALMA, 1926) has five longitudinal lirae. These latter two nominal taxa may probably be included into *T. nodulosus*.

Distribution — *T. nodulosus* was described by ARTHABER (1896) from the Reifling limestones of Tiefengraben representing the upper part of the Balatonicus Zone (Pelsonian, Middle Triassic) (ASSERETO 1971, TATZREITER & VÖRÖS 1991). Our specimens came from Beds 90 and 95 of the section Aszófő I., ranged into the Binodosus Subzone of the Trinodosus Zone by VÖRÖS (1987).

Genus *Germanonautilus* MOJSISOVICS, 1902

Germanonautilus cf. *salinarius* (MOJSISOVICS, 1882)

(Plate II: 6a–b; Figure 6)

1882 *Nautilus salinarius* E. v. MOJSISOVICS — MOJSISOVICS, p. 282, pl. XCI, fig. 3a–b.

1882 *Nautilus* indet. — MOJSISOVICS, p. 282, pl. XCII, fig. 1a–b.

1907 *Germanonautilus* cf. *salinarius* v. MOJS. — DIENER, p. 29, pl. III, fig. 1.

1937 *Nautilus gorasdzensis* n. sp. — ASSMANN, p. 99, pl. 19, fig. 1a–b.

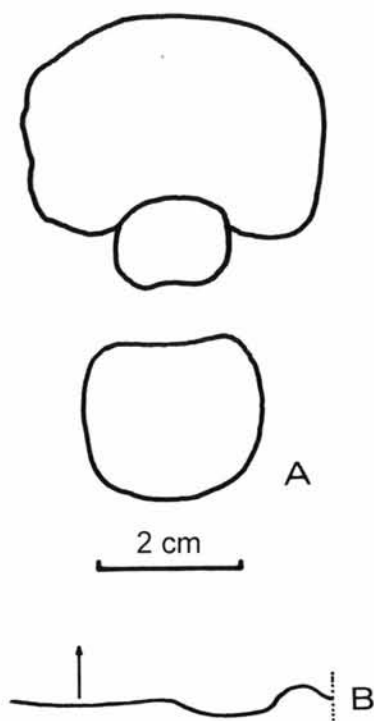
1960 *Germanonautilus salinarius* (MOJSISOVICS) — KUMMEL, p. 291, pl. 3, figs 1–2.

1984 *Germanonautilus salinarius* (MOJSISOVICS) — MUNDLOS & URLICHS, p. 20, pl. 3, figs 3–4.

1986 *Germanonautilus salinarius* (MOJSISOVICS) 1882 — PARNES, p. 41, pl. 20, figs 5–6 (? non pl. 9, figs 5–6 and pl. 20, fig. 7).

Material — Three incomplete specimens; two internal casts and a fragmentary and slightly crushed silicified shell.

Measurements:	D	WH	WW	U	UP
	64.5	26.5 (41.1)	41.7 (64.7)	16.8 (26.0)	
	31	13.5 (43.5)	21 (67.7)	11.4 (37.1)	



Description — This is a rather small-sized *Germanonautilus*. The coiling is moderately involute (convolute); with rather rapidly expanding whorls. The whorl-section is subquadrate, slightly depressed trapezoidal, narrowing ventrally. The umbilical wall is convex; the umbilical margin is blunt, not well-defined. The flanks are flat and pass gradually into the venter, which is flat to gently arched. This is a smooth form without any ornamentation. The terminal part of the body chamber of the largest and best preserved specimen (M.99.120) shows a constriction parallel to the peristome.

The suture lines are simple, with a moderately deep lateral and a very shallow ventral lobe.

Remarks — The genus *Germanonautilus* (including *G. salinarius*) was revised recently by MUNDLOS & URLICHS (1984). Their interpretation is by and large accepted here, therefore "*Nautilus* indet." MOJSISOVICS

Figure 6 — Cross-section (A) and suture line at WH=23 mm (B) of *Germanonautilus* cf. *salinarius* (MOJSISOVICS, 1882) (M.99.120), Aszófő I, Bed 90, Trinodosus Zone (Binodosus Subzone).

(l. c.) and "*Nautilus gorasdzensis*" ASSMANN (l. c.) is included in the synonymy, whereas KUMMEL's (l. c.) record from Israel is taken as doubtful. One of the recently figured *salinarius* specimens from Israel (PARNES l. c.) seems to be a proper representative of this species, while the affiliation of the other specimen is questionable.

Distribution — *G. salinarius* was originally described from the Alpine "Schreyeralp" limestones (Middle to Upper Anisian), later on it was found in the Anisian of the Germanic and Sephardic domains and in the Himalaya. The Aszófő specimens were collected from Bed 90 (Binodosus Subzone of the Trinodosus Zone) and the Beds 60 and 82 of Aszófő I. (Zoldianus Subzone of the Balatonicus Zone), respectively.

Superfamily **Trigonoceratoidea** HYATT, 1884

Family **Syringonautilidae** MOJSISOVICS, 1902

Genus *Syringonautilus* MOJSISOVICS, 1902

Syringonautilus cf. *lilianus* (MOJSISOVICS, 1882)

(Plate II: 8a–c)

1882 *Nautilus lilianus* E. v. MOJSISOVICS — MOJSISOVICS, p. 286, pl. LXXXII, figs 3a–b, 4a–b.

Material — One complete, poorly preserved specimen (M.99.121).

Measurements:	D	WH	WW	U	UP
	35.5	16.5 (46.5)	14 (39.4)	10.5 (29.6)	

Description — This is a medium-sized *Syringonautilus* with calcite-filled phragmocone and the cast of the little crushed body chamber showing parts of the peristome. The coiling is moderately involute (convolute). The whorl-section is subrounded, elliptical, slightly compressed. The umbilical wall is rather steep; the umbilical margin is blunt. The flank is gently convex and passes gradually into the arched venter. The ornamentation is very weak; it consists only of faint growth lines, which are slightly convex on the flanks and strongly arched posteriorly on the venter. The peristome follows the same pattern: it protrudes on the flanks (as weak lappets) and is deeply incised on the ventral side.

The suture lines are poorly visible; they are very simple, with shallow lateral lobes.

Remarks — *S. lilianus* is the type species of the genus *Syringonautilus*. Other Anisian representatives of the genus [e.g.: *S. carolinus* (MOJSISOVICS, 1882), *S. subcarolinus* (MOJSISOVICS, 1882)] differ from *S. lilianus* by their more rounded whorl-section.

Distribution — *S. lilianus* was described from the Middle and Upper Anisian of the Alpine–Mediterranean region. The Aszófő specimen was collected from Bed 7 of the section Aszófő II. (Balatonicus Subzone of the Balatonicus Zone).

Superfamily **Clydonautiloidea** HYATT in ZITTEL, 1900

Family **Liroceratidae** MILLER & YOUNGQUIST, 1949

Genus *Paranautilus* MOJSISOVICS, 1902

Paranautilus cf. *indifferens* (HAUER, 1892)

(Plate II: 7)

1892 *Nautilus indifferens* n. sp. — HAUER, p. 5 [253], pl. I, figs 2a–b.

Material — One almost complete, slightly crushed specimen (M.99.122).

Measurements:	D	WH	WW	U	UP
	44.7	28.5 (63.8)	17 (38)	—	—

Description — A medium-sized *Paranautilus*; an internal cast, partly with silicified shell; slightly crushed. The coiling is involute; the umbilicus is occluded. The whorl-section is subrounded, high elliptical, moderately compressed. The flank is gently convex, and passes gradually into the highly arched venter. It is an almost smooth form; only faint growth lines, slightly convex on the flanks and arched posteriorly on the venter, are visible.

The suture lines are seen only where the silicified shell is removed; they seem to be very simple, with low amplitude.

Remarks — *P. indifferens* stands morphologically very close to *P. simonyi* (HAUER, 1849), the Upper Triassic type species of *Paranautilus*. It is closely related to *P. bosnensis* (HAUER, 1892); the latter has a narrow, but markedly open umbilicus in contrast to the occluded umbilicus of *P. indifferens*.

Distribution — *P. indifferens* was described from Bosnia, from the upper part of the Anisian ("Lower Muschelkalk"). The Aszófő specimen was collected

from Bed 12 of the section Aszófő I., (Balatonicus Subzone of the Balatonicus Zone).

Genus *Sybillonutilus* DIENER, 1915

Sybillonutilus cf. *pertumidus* (Arthaber, 1896)
(Plate II: 9)

1896 *Nautilus pertumidus* ART. — ARTHABER, p. 42, pl. III, figs 4, 5, 6.

non 1915 *Nautilus pertumidus* V. ARTH. — RASMUS, p. 285, text-figs 1–2.

non 1986 *Sybillonutilus* sp. cf. *S. pertumidus* (ARTHABER, 1896) — PARNES, p. 49, pl. 6, figs 12–14.

? 1986 *Sybillonutilus rugosus* n. sp. — PARNES, p. 49, pl. 6, figs 9–11.

Material — One poorly preserved, incomplete specimen (M.99.123).

Measurements:	D	WH	WW	U	UP
	38	16 (42.2)	21 (55)	14 (36.8)	—

Description — This is a rather small-sized *Sybillonutilus*; an incomplete internal cast, partly with silicified shell. The coiling is rather involute, with deep umbilicus. The inner whorls are stout, rather depressed; the cross-section is subquadratic, narrowing ventrally; the flanks are flat and pass gradually into the rounded venter. The end of the phragmocone and the body chamber rapidly expands laterally, giving a funnel-shaped appearance (though the true, trumpet-like peristome is broken from our specimen). The umbilical wall is steep, flat to gently convave; the umbilical edge is well-defined. The ornamentation is very weak; it consists only of faint growth lines, which are strongly arched posteriorly on the venter.

The suture lines are poorly visible; they are simple, with very shallow lateral and ventral lobes.

Remarks — DIENER (1915, p. 357) erected a new genus *Tumidonautilus* for the species *pertumidus* ARTHABER and this generic name was applied by KUTASSY (1932, p. 742). On the other hand, Kummel (1964), in the "Treatise", took *Tumidonautilus* as a synonym of *Sybillonutilus*; this view is accepted here.

The Aszófő specimen is incomplete: especially the end part of the body chamber is broken. However, the

change in the growth pattern (expansion) can well be observed on the fragment and the trumpet-like body chamber can be reconstructed by extrapolation. It looks most similar to *S. pertumidus* described by ARTHABER (l. c.).

The specimen figured by RASMUS (l. c.) from Silesia was included to *Germanonautilus dolomiticus* (QUENSTEDT, 1845) by MUNDLOS & URLICHS (1984, p. 18) and this opinion is accepted here. By its similar morphology, the specimen figured by PARNES (l. c.) from Israel is here regarded as a *Germanonautilus*. On the other hand, the other species of *Sybillonutilus* described by PARNES (l. c.: *S. rugosus* n. sp.) shows very strong similarity to *S. pertumidus* and is here tentatively placed into the synonymy of this species.

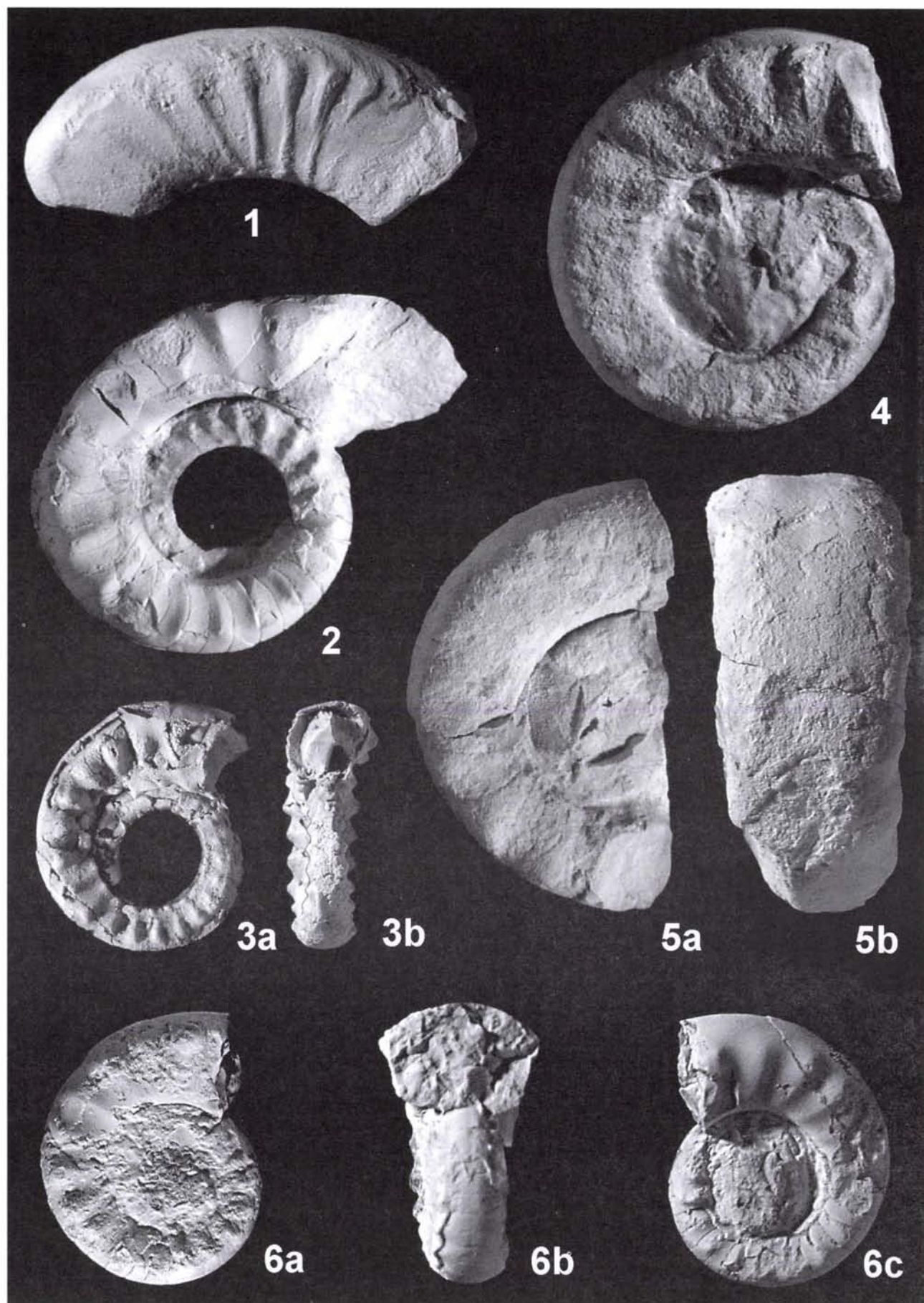
Distribution — *S. pertumidus* was described by ARTHABER (1896) from the Reifling limestones of Tiefengraben representing the upper part of the Balatonicus Zone (Pelsonian, Middle Triassic) (ASSERETO 1971, TATZREITER & VÖRÖS 1991). The Aszófő specimen was collected from Bed 8 of the section Aszófő I., (Balatonicus Subzone of the Balatonicus Zone).

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Explanation to Plate I

- 1 *Anoploceras* cf. *rollieri* (ARTHABER, 1896) (M.99.104.), × 1. — Aszófő I, Bed 77, Balatonicus Zone (Zoldianus Subzone).
- 2 *Encoiloceras balaticum* sp. n., Holotype (M.99.105.), × 1. — Aszófő I (scree), Balatonicus Zone (Balatonicus Subzone).
- 3 a–b *Encoiloceras balaticum* sp. n., Paratype (M.99.106.), × 1. — Aszófő I, Bed 5, Balatonicus Zone (Balatonicus Subzone).
- 4 *Encoiloceras lajosi* sp. n., Paratype (M.99.108.), × 1. — Aszófő I, Bed 82, Balatonicus Zone (Zoldianus Subzone).
- 5 a–b *Encoiloceras lajosi* sp. n., Paratype (M.99.114.), × 1. — Aszófő I, Bed 80, Balatonicus Zone (Zoldianus Subzone).
- 6 a–c *Encoiloceras lajosi* sp. n., Paratype (M.99.115.), × 1. — Aszófő II, Bed 5, Balatonicus Zone (Balatonicus Subzone).

Plate I



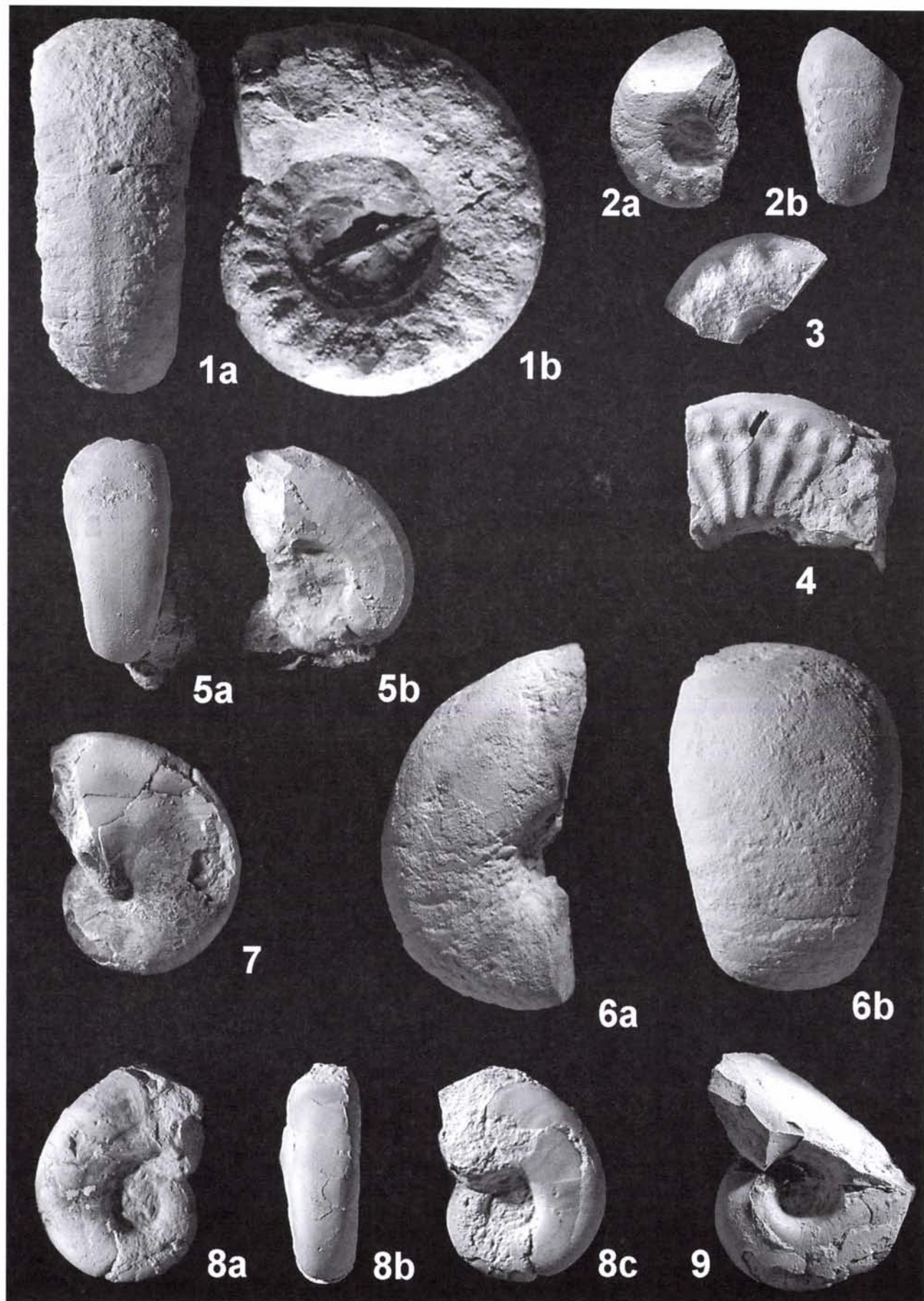
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Explanation to Plate II

- 1 a–b *Encoiloceras lajosi* sp. n., Holotype (M.99.107.), × 1. — Aszófő I, Bed 91, Trinodosus Zone (Binodosus Subzone).
- 2 a–b *Mojsvaroceras* ? cf. *binodosum* (HAUER, 1887) (M.99.116.), × 1. — Aszófő I, Bed 79, Balatonicus Zone (Zoldianus Subzone).
- 3 *Mojsvaroceras* ? cf. *binodosum* (HAUER, 1887) (M.99.117.), × 1. — Aszófő I, Bed 18, Balatonicus Zone (Balatonicus Subzone).
- 4 *Pleuronutilus mosís* MOJSISOVICS, 1882 (M.99.118.), × 1. — Aszófő I, Bed 4, Balatonicus Zone (Balatonicus Subzone).
- 5 a–b *Trachynautilus* cf. *nodulosus* (ARTHABER, 1896) (M.99.119.), × 1. — Aszófő I, Bed 90, Trinodosus Zone (Binodosus Subzone).
- 6 a–b *Germanonutilus* cf. *salinarius* (MOJSISOVICS, 1882) (M.99.120.), × 1. — Aszófő I, Bed 90, Trinodosus Zone (Binodosus Subzone).
- 7 *Paranautilus* cf. *indifferens* (HAUER, 1892) (M.99.122.), × 1. — Aszófő I, Bed 12, Balatonicus Zone (Balatonicus Subzone).
- 8 a–c *Syringonutilus* cf. *lilianus* (MOJSISOVICS, 1882) (M.99.121.), × 1. — Aszófő II, Bed 7, Balatonicus Zone (Balatonicus Subzone).
- 9 *Sybillonutilus* cf. *pertumidus* (ARTHABER, 1896) (M.99.123.), × 1. — Aszófő I, Bed 8, Balatonicus Zone (Balatonicus Subzone).

Plate II



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Author's address:

Dr. Attila VÖRÖS
Geological and Palaeontological Department
Hungarian Natural History Museum
Múzeum krt. 14–16.
H-1431 Budapest, Pf. 137
Hungary
E-mail: voros@paleo.nhmus.hu