New Kingenoid brachiopods from the Early Cretaceous iron ore related environment of Zengővárkony (Mecsek Mts, Hungary, Europe)

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Running Header: New Early Cretaceous Kingenoid brachiopods from iron ore deposit, Hungary

Abstract.—The Lower Cretaceous tiny iron ore deposit at Zengővárkony (Mecsek Mts, South Hungary, Europe) provided new brachiopod taxa of Kingenoid relationship. *Dictyothyropsis vogli* nov. sp, *Zittelina hofmanni* nov. sp. and *Smirnovina ferraria* nov. sp. are introduced representing Late Valanginian to Earliest Hauterivian age. The new taxa strengthen the presence of the Early Cretaceous biogeographical connections with the Western Carpathians and the Pieniny Klippen Belt of South Poland. The biometry of the newly described taxa refer to significantly greater mean dimensions, which is in line with previous research on brachiopods from this environment. These brachiopods lived in a

nutrient-rich unique environment related to the iron-ore deposition linked to a former hydrothermal activity on the ocean floor that resulted the size growth of brachiopods.

Introduction

Cretaceous sediments and their fauna were first reported from the Mecsek Mts. by Hofmann (1907) from a shallow marine, littoral sedimentary environment around the Kisújbánya Basin, Eastern Mecsek Mts (Fig. 1). Hofmann (1912) had started to describe the bivalve and gastropod fauna but due to his death Vadász (Hofmann & Vadász, 1912) finalized his manuscript. The remaining faunal elements were listed by Vadász (1935) reporting 14 shallow marine and littoral the brachiopod species. According to Vadász (1935) this near shore marine fauna represents the Hauterivian. Based on ammonites Bujtor (1993) recognized the Lower Valanginian Thurmanniceras pertransiens Zone for the Kisújbánya locality. Cretaceous sediments are known from other localities in the Mecsek Mts, but brachiopods are rarely reported.

The other interesting locality from where Cretaceous brachiopods are reported is situated SE from Kisújbánya in the neighborhood of an abandoned iron ore mine in the vicinity of Zengővárkony (in SE direction from the village) where in the 1950s an active mining took place (Molnár 1961). From the spoil-bank of the ore mine Fülöp (in Hetényi et al. 1968) collected some macrofossils among which there were brachiopods: *Rhynchonella malbosi* Pictet, R. *sparsicostata* Oppel, *Terebratula* aff. *salevensis* Loriol. Bujtor (2006) reported a rich brachiopod assemblage dominated by *Lacunosella hoheneggeri* (Suess) and *Nucleata veronica* Nekvasilova with other, previously unknown brachiopods from the Mecsek Mts: *Moutonithyris* sp. aff. *moutoniana*, *Karadagithyris* sp., and *Zittelina pinguicula* (Oppel). The dominant taxa *L. hoheneggeri* and *N. veronica* distribute 30-70% average size increase compared to their type localities (Bujtor 2006, 2007), therefore Bujtor (2007) proposed a hydrothermal vent related environment in which these brachiopods grew to a remarkably big size. Stable isotope analysis did not support the vent/seep origin, and the interpretation of this unique environment is still ambiguous.

Bujtor (2007, 2011) summarized the earlier researches and put the Zengővárkony locality in a broader geological frame where the iron ore formation is linked to the Late Jurassic - Early Cretaceous continental rifting and volcanism of the region.

Bujtor et al. (2013) defined the age of the sequence. Based on dinoflagellates and belemnites the age of the fossiliferous layers is Upper Valanginian - Lower Hauterivian, that strengthens the the result of Fülöp (in Hetényi et al. 1968). Regarding the microfauna, Bujtor & Szinger (2018) described diactine-type criccorhabd sponge spicules from the same locality. During serial sectioning of the present material sponge spicules are also appeared frequently inside the brachiopod shells.

The continuous sampling from the same locality and the scree from the floor of the valley from 1988 till today have provided some one hundred specimens of brachiopods out of which some are considered new species. The aim of this paper is to describe new taxa of Early Cretaceous Kingenoid brachiopods from the Mecsek Mts. from the iron ore related sediments at Zengővárkony.

Materials and methods

The classification of the brachiopods follows the revised "Treatise" (Williams et al. 2006). The principal dimensions of the appropriate (more or less complete) specimens have been measured by a caliper. The measurements (L = length, W = width, T = thickness, Ch = height of the deflection in the anterior commissure) are given in millimeters. Serial sectioning of brachiopods was prepared by a CutRock grinding machine. Drawings of sections were prepared by a camera lucida and a Zeiss stereomicroscope. Specimens were coated with ammonium-chloride for photographic purposes.

Repositories and institutional abbreviations.—Types, figured, and other specimens examined in this study are deposited in the following institutions: Department of Paleontology and Geology of the Hungarian Natural History Museum (HNHM), Budapest, Hungary; the figured specimens are under the inventory numbers prefixed by "PAL", "INV" and/or "M". and in the paleontological collection of the Mining and Geological Survey of Hungary (MGSH) under the inventory numbers prefixed by "K".

Geologic setting

The southern Hungarian Mecsek Mountains belong to the Tisza Mega-Unit (Haas & Péró 2004), which is considered a Mesozoic microplate (Csontos & Vörös 2004). During the Late Jurassic this microplate detached from the European Plate initiated by continental rifting (Huemer 1997). The intraplate alkaline basaltic volcanism interrupted the continuous basinal carbonate sedimentation and produced mixed volcanosedimentary deposits (Nagy 1967), which are reported from boreholes in distant areas (200 km from the volcanic center in the Great Hungarian Plain) of the Tisza Mega-Unit (Bilik 1983). The volcanic activity built up an ankaramite-alkaline basaltic paleovolcano in the Mecsek Mts. (Császár & Turnšek 1996). The center of the paleovolcano was situated northwest of Magyaregregy (Wein 1961, 1965), forming a volcanic island (Császár & Turnšek 1996). Submarine volcanic bodies are reported from other places in the Eastern Mecsek Mts. and have been thoroughly investigated (Mauritz 1913, 1958; Bilik

1974, 1983). Simultaneously with the volcanism, a sedimentary iron ore body was deposited (Sztrókay 1952; Pantó et al. 1955; Molnár 1961) southeast of the volcanic center that hosted a rich marine fauna (Fülöp in Hetényi et al. 1968, Bujtor 2006, 2007, Bujtor & Szinger 2018, Bujtor et al. 2013).

Studied section.—The section (Fig. 2) is an artificial cut on the western slope of the Dezső Rezső Valley reported in details by Bujtor (2006, 2007, 2012), Bujtor & Szinger (2018) and Bujtor et al. (2013). The section traverses the volcano-sedimentary succession of the Mecsekjános Basalt Formation and the overlying Apátvarasd Limestone Formation. Coordinates: E 18.45299, N 46.18545.

The lower part of the section exposes the fully altered volcanic pillow lava and hyaloclastite version of the Mecsekjános Basalt Fm. A submarine origin is revealed by vesicles (1–6 mm in diameter) in the chilled margin of the pillows. A red, fossiliferous limestone bed rests concordantly upon the volcanic surface and alternates with the iron ore beds and provided large but fragmentary and reworked phylloceratid and lytoceratid ammonites (*Lytoceras subfimbriatum*; cf. Bujtor 2012a), belemnite rostra (Bujtor et al. 2013), a rich and almost monotypic brachiopod assemblage (Bujtor 2006, 2007, 2011, 2012a, b), echinoid spines (Bujtor 2012a), and some internal molds of poorly preserved gastropods. Thin sections of the ammonite body chambers reveal microfaunal elements, such as foraminifera, echinoderm remains, sponge spicules, and rarely crustacean microcoprolites (Bujtor 2012b). The intercalating and metasomatized limestone bed provided rich foraminifer assemblage of *Glomospira*, *Lenticulina*, *Spirillina*, *Nodosaria*, *Epistomina*, *Trocholina*, and *Hedbergella* (Bujtor & Szinger 2018). The fossil content decreases in number of individuals upwards and its diversity also reduced on some badly preserved echinoid spines. Top of the section is covered by debris and soil.

Systematic paleontology

Phylum Brachiopoda Duméril, 1806

Subphylum Rhynchonelliformea Williams, Carlson, Brunton, Holmer & Popov, 1996

Class Rhynchonellata Williams, Carlson, Brunton, Holmer & Popov, 1996

Order Terebratulida Waagen, 1883

Suborder Terebratellidina Muir-Wood, 1955

Superfamily Kingenoidea Elliott, 1948

Family Kingenidae Elliott, 1948

Subfamily Kingeninae Elliott, 1948

Genus *Dictyothyropsis* Barczyk, 1969

Type species: *Terebratulites loricatus* Schlotheim, 1820

Dictyothyropsis vogli new species

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Figures 3.1–3.5

Holotype.—Internal mold partly covered by shell remains (HNHM, PAL 2019.2.1) Upper Valanginian - Lower Hauterivian, Apátvarasd Limestone Formation, east of Zengővárkony, Mecsek Mts., Hungary.

Diagnosis.—Medium-sized *Dictyothyropsis* with subpentagonal outline. Beak erect, truncated. Lateral commissures straight, anterior commissure unisulcate. Sinus shallow and wide. Shell biconvex; entirely and strongly costate; secondary riblets intercalate anteriorly.

Occurrence.—Basal, red ferruginous limestone bed of the Apátvarasd Limestone Formation in the north-western part of the Dezső Rezső Valley, east of Zengővárkony. Coordinates: E 18.45299, N 46.18545.

Description.—External characters: This is a medium sized *Dictyothyropsis*, with rather isometric, subpentagonal, flabelliform outline. The lateral margins are nearly straight, and diverge with an apical angle of 65°. The maximum width lies at about the anterior third of the length. The valves are moderately convex; the ventral valve is slightly more convex than the dorsal valve. After a dominant biconvex stage, a weak and wide sulcus develops in the dorsal valve, which results in an unisulcate anterior margin. The maximum thickness of the double valve is attained in the posterior third. The beak is erect, massive and truncated. The pedicle opening is wide but its rim is partly incomplete. The delthyrium is barely seen, but its lateral sides form a wide and low triangle. The beak ridges are rounded but distinct; the characters of the interarea are not seen. In lateral view the lateral commissures are nearly straight. The anterior commissure is widely unisulcate and shows a series of rather sharp zig-zag deflections. The unisulcation is low trapezoidal and occupies the central two-third of the anterior commissure. The valves are multicostate throughout; eight strong but rounded ribs start at the umbones, four of which fall to the medial sulcus. These primary ribs become somewhat stronger anteriorly. In the anterior one-third, secondary ribs of various strength are inserted by intercalation; their number reaches nine at the anterior margin. In the lateral sectors of the valves the ribs follow a flabelliform pattern, i. e. they are gently arched laterally. Very weak comarginal (growth) lines also appear; their crossings with the secondary ribs result in a poorly seen reticulate pattern.

Internal characters: These were not studied because of the paucity of the material (single specimen).

Etymology.—After the name (Mr. Ferenc Vogl) of the landowner of Dezső Rezső Valley (Zengővárkony).

Materials.—One specimen; Zengővárkony, Upper Valanginian - Lower Hauterivian, red, ferruginous limestone; Table 1.

Remarks.—*Dictyothyropsis vogli* n. sp., besides an overall similarity, markedly different from the type species of the genus *D. loricata* (Schlotheim, 1820) and the other Late Jurassic species *D. roemeri* (Rollier, 1919); both excellently illustrated by Barczyk (1969, p.66-69, pl. XIV, figs. 11-14; pl. XV, figs. 1-6). In addition to the considerable difference in age, *D. vogli* has fewer and much stronger ribs than the mentioned Late Jurassic species and shows less degree of reticulation.

D. tatrica (Zittel, 1870), as figured by Zittel (1870, pl. 14, figs. 21, 22), Barczyk (1979, pl. 2, figs. 1-3) and Krobicki (1994, pl. 1, fig. 1) is much more convex than *D. vogli* n. sp., and Tithonian in age.

D. lilloi Calzada, 1985, described from the early Hauterivian of Spain (Calzada 1985, p. 86, pl. 2, figs. 7,8; Garcia Ramos 2005, pl. 1. fig. 16) and illustrated also from the same age from Serbia (Radulović et al. 2007, p. 122, figs. 6.8, 6.9) seems more closely related to *D. vogli* n. sp. but its primary ribs are fewer and much shorter and shows distinct capillate ornament.

Considering the general similarity in external features of *D. vogli* to the above mentioned species, the attribution of this new species to the genus *Dictyothyropsis* seems justified even in the absence of information on its internal morphology.

Genus *Zittelina* Rollier, 1919

Type species: *Terebratula orbis* Quenstedt, 1858

Zittelina hofmanni new species

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Figures 4.1–4.13; 5–7.

v 2006 *Zittelina pinguicula;* (Zittel, 1870) – Bujtor, p. 140, figs. 12.9, 15.

Holotype.—Internal mold partly covered by shell remains (HNHM, PAL 2019.4.1) Upper Valanginian - Lower Hauterivian, Apátvarasd Limestone Formation, east of Zengővárkony, Mecsek Mts., Hungary.

Paratypes.—Internal molds partly covered by shell remains (HNHM, PAL 2019.5.1 – PAL 2019.7.1), and (MGSH) K2019.1.1. – K2019.2.1.

Diagnosis.—Large *Zittelina* with subcircular outline. Beak erect, high. Lateral commissures straight, anterior commissure gently unisulcate. Shell biconvex, smooth with occasional fine capillation. Pedicle collar strong; septal pillar short; loop reflected, diploform.

Occurrence.—Basal, red ferruginous limestone bed and overlying grey limestone of the Apátvarasd Limestone Formation in the north-western part of the Dezső Rezső Valley, east of Zengővárkony. Coordinates: E 18.45299, N 46.18545

Description.—External characters: Medium to large, globose kingenoids with very rounded, subcircular to oval outline. The apical angle varies between 80-90°. The maximum width is attained at around the middle of the length or a little more anteriorly. The valves are moderately to strongly convex; the maximum convexity lies somewhat posteriorly. The ventral valve is much more convex than the other. The beak is rather high, erect to slightly incurved. The foramen is poorly seen; circular, mesothyrid. The delthyrium is not visible. The beak ridges are blunt. In lateral view, the lateral commissures are almost straight; they join gradually to the weakly unisulcate anterior commissure. The sinus is very shallow, uniformly arched and wide; usually it occupies the major part of the width of the anterior margin. Definite dorsal sulcus or ventral fold is not developed. The surface of the shells is almost smooth, except fine growth lines and occasional radial capillation.

Internal characters (Figures 5–7): *Ventral valve*: The delthyrial cavity is subquadrate in cross-section, with variable amount callus and a definite myophragm on the ventral floor. The umbonal cavities are semicircular. The dental plates are strong and subparallel. Well-developed pedicle collar appears, connecting the middle portion of the dental plates and the myophragm. Deltidial plates were not recorded. The hinge teeth are moderately strong; diagonally oriented;

denticula are poorly seen. *Dorsal valve*: The notothyrial cavity is narrow, lanceolate in cross section. It passes into a deep, V-shaped septalium, formed by the hinge plates attached to the dorsal median septum. The median septum, reinforced by callus, forms a septal pillar, which supports the posterior end of the reflected loop. Hereafter, the median septum abruptly becomes reduced and disappear. The outer socket ridges are very wide and massive. The inner socket ridges are moderately thick, they lean only a little over the sockets. The hinge plates are inclined dorsally. The crural bases emerge from the medial thickenings of the hinge plates, close to the median septum. The crura are subvertical, subparallel. The crural processes are high and crescentic in cross section. The loop is diploform; it attains around 0.7 of the length of the dorsal valve. The descending branches are slightly divergent. The ascending branches are very high, ventrally divergent and irregularly ruffled; their posterior transverse band is hood-like. In one specimen (Figure 6) the posterior end of the hood is subcircular in cross section and is connected to the descending branches with a transverse element. Spinosity was recorded at the distal termination of the loop.

Etymology.—After the name of the outstanding Hungarian geologist, Károly Hofmann.

Materials.—Nine specimens. Table 2.

Remarks.—On the basis of its simple external morphology, our species is rather similar to representatives of several kingenoid genera. Its circular outline reminds *Kingena* Davidson, 1852 and *Zittelina* Rollier, 1919; the globose appearance recalls *Tulipina* Smirnova, 1962 or even *Coriothyris* Ovtsharenko, 1983. However, the latter two genera have different types of loop, bilacunar and teloform, respectively. On the other hand, *Kingena* and *Zittelina* bear diploform loop, comparable to the loop of our sectioned specimens. Considering the stratigraphic position of our species (Late Valanginian to Early Hauterivian), the Tithonian *Zittelina* was preferred as the most closely related genus.

The type species of *Zittelina*, *Z. orbis* (Quenstedt, 1858) has external similarity to *Z. hofmanni*, which latter is however more globose and reaches greater (nearly double) size. For this reason, we defined it as a new species.

One specimen of our present material was described by Bujtor (2006, l.c.) as *Zittelina pinguicula* (Zittel, 1870). The generic attribution is endorsed here. On the other hand, we do not confirm the species name, because the anterior commissure of the species *pinguicula* is parasulcate, in contrast to the straight or gently sulcate commissure of our specimens. Moreover, *pinguicula* was designated as type species of the genus *Oppeliella* by Tkhorszhevsky (1989).

Family Aulacothyropsidae Dagys, 1972

Subfamily Aulacothyropsinae Dagys, 1972

Genus *Smirnovina* Calzada, 1985

Type species: *Smirnovina smirnovae* Calzada, 1985

Smirnovina ferraria new species

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Figures 3.6–3.10; 8

Holotype.—Shelly specimen (HNHM, PAL 2019.3.1); paratypes (HNHM, PAL 2019.8.1 – PAL2019.10.1) Upper Valanginian - Lower Hauterivian, Apátvarasd Limestone Formation, east of Zengővárkony, Mecsek Mts., Hungary.

Diagnosis.—Large, globose *Smirnovina*; outline circular to subpentagonal. Beak massive, incurved, depressed. Anterior commissure plicosulcate. Dorsal sinus wide. Ventral valve bicarinate with sharp crests. Shell covered with dense, comarginal imbrications. Septal pillar short; loop reflected, diploform.

Occurrence.—Basal, red ferruginous limestone bed of the Apátvarasd Limestone Formation in the north-western part of the Dezső Rezső Valley, east of Zengővárkony. Coordinates: E 18.45299, N 46.18545.

Description.—External characters: This is a large, globose *Smirnovina*, with circular to subpentagonal outline. The lateral margins are convex; almost continuously arched; the apical angle is about 90°. The maximum width lies at about the middle of the length. The valves are very strongly convex; the ventral valve attains maximum convexity at mid-length; the maximum convexity of the dorsal valve lies posteriorly, near the umbo. After a short biconvex stage, a wide sulcus with central plica develops on the dorsal valve, which results in a plicosulcate anterior margin. The ventral valve is markedly “bicarinate” throughout, i.e. the two longitudinal folds, corresponding to the sulci of the dorsal valve, bear distinct crests. The beak is incurved, massive and depressed. The pedicle opening and delthyrium are not seen. There are no distinct beak ridges. In lateral view the lateral commissures are nearly straight, gently arched dorsally. The anterior commissure is deeply and widely plicosulcate. The sulcus occupies the central three-fourth of the anterior commissure. Except the ventral crests, the valves have no longitudinal ribbing. The ornamentation consists of numerous, fine comarginal elements. These imbricated growth rings are very regularly and densely spaced and traverse the ventral crests.

Internal characters: *Ventral valve*: The delthyrial cavity is oval to subpentagonal in cross-section, with some amount callus. The umbonal cavities are semicircular. The dental plates are strong and arched laterally. Well-developed pedicle collar appears, connecting the ventral portion of the dental plates. Deltidial plates were not recorded. The hinge teeth are moderately strong; vertically inserted; denticula are poorly recorded. *Dorsal valve*: The moderately deep, U-shaped septalium is formed by the hinge plates attached to the dorsal median septum. The median septum forms a reinforced septal pillar which is just about to support the posterior end of the reflected loop. Then, the median septum abruptly becomes reduced and disappears. The outer socket ridges are narrow but high. The inner socket ridges are moderately thick, and lean a little over the sockets. The hinge plates are inclined dorsally. The crura are subvertical. The crural processes are high and crescentic in cross section. The loop is diploform; it attains more than 0.7 of the length of the dorsal valve. The descending branches are only slightly divergent. The ascending branches are very high, ventrally divergent and irregularly ruffled; their posterior transverse band is hood-like. The posterior end of the hood is subcircular in cross section and is connected to the descending branches with a transverse element. Signs of flaring and spinosity were seen at the distal termination of the loop.

Etymology.—After the nature of the locality; an abandoned iron ore mine (ferraria <latin> = iron ore mine).

Materials.—Four specimens, Table 3.

Remarks.—*Smirnovina ferraria* n. sp. stands rather close to the type species of the genus, *S. smirnovae* Calzada, 1985, (Calzada 1985, pl. 2, figs. 3, 6; also illustrated by Garcia Ramos 2005, pl. 1, fig. 1) but differs from that by its greater convexity and size, by its more significant comarginal imbrications and by its sharp dorsal crests. Moreover it is Late Valanginian in age while the type species was described from the Hauterivian. The apparent discrepancy between the serial sections published by Calzada (1985, fig. 5) and our sections (Figure 8) are probably due to different orientation of the sectioned specimens.

A single ventral valve, illustrated as "?*Dictyothyropsis* sp." by Krobicki (1996, fig. 8.2), seems to belong to *Smirnovina*, but its comarginal imbrications are much more widely spaced than those of *S. ferraria* n. sp.

Smirnovina sp.

Figures 3.11–3.13

Description.—External characters: This is a large *Smirnovina* with elongated subpentagonal outline. The lateral margins are convex; almost continuously arched; the apical angle is about 80°. The maximum width lies at about the middle of the length. The valves are strongly convex; the dorsal valve attains maximum convexity at mid-length; the maximum convexity of the ventral valve lies nearer to the umbo. After a short biconvex stage, a sulcus with elevated central plica develops on the dorsal valve, which results in a plicosulcate anterior margin. The ventral valve is markedly "bicarinate" throughout, i.e. the two longitudinal folds, corresponding to the sulci of the dorsal valve, start from the umbo. The beak is erect, rather elevated. The pedicle opening is wide, oval. The delthyrium is not seen. There are no distinct beak ridges. In lateral view the lateral commissures are almost straight. The anterior commissure is deeply plicosulcate. The sulcus occupies a little more than the half of the anterior commissure. Except the ventral crests, the valves have no longitudinal ribbing. The ornamentation consists of irregularly spaced, fine comarginal elements. These imbricated growth rings are best developed near the anterior margin.

Internal characters: These were not studied because of the paucity of the material (single specimen).

Materials.—One specimen, Table 4.

Remarks.—The *Smirnovina* species differs from *S. smirnovae* Calzada, 1985 and *S. ferraria* new species by its greater length, and more elevated erect beak. Moreover its dorsal sulcus bears a marked medial fold. It is probably a different species of *Smirnovina*, but being represented by a single, partly worn specimen in our material, the introduction of a new species is not advisable here.

Results

New collection and supervision of old repository material derived from the Lower Cretaceous sediments from Zengővárkony (Mecsek Mts., Hungary) resulted the recognition of new brachiopod taxa. *Dictyothyropsis vogli* new species, *Zittelina hofmanni* new species, *Smirnovina ferraria* new species and *Smirnovina* sp. are introduced.

Discussion

The described brachiopod taxa show remarkable size increase compared to the mean dimensions of their closest relatives. This phenomenon is not new for the brachiopods collected from the Lower Cretaceous strata of the Zengővárkony region. Bujtor (2006, 2007) already reported the significant size increase (30-70%) of brachiopods from the unique paleoenvironment at Zengővárkony. The iron ore-related deposit linked to a former hydrothermal sea-floor activity provided a nutrient-rich environment in which the constituents of the fauna lived. The better than average water conditions may be responsible for the size increase of the brachiopod fauna. This study strengthens the previous observations on the remarkable size increase of the brachiopods linked to the iron ore deposit around the sea floor hydrothermal activity.

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Figure 1. Locality map

Figure 2. The Upper Valanginian - Lower Hauterivian Zengővárkony section traversing the Mecsekjános Basalt Formation and the Apátvarasd Limestone Formation.

Figure 3. *Dictyothyropsis vogli* n. sp. from the basal, red, ferruginous bed of the Apátvarasd Limestone Formation, Upper Valanginian - Lower Hauterivian, Dezső Rezső Valley, Zengővárkony, Mecsek Mts. **(1-5)** holotype PAL 2019.2.1; **(1)** dorsal view; **(2, 3)** right and left lateral views; **(4)** anterior view; **(5)** posterior view; *Smirnovina ferraria* n. sp. **(6-10)** holotype PAL 2019.3.1; **(6)** dorsal view; **(7)** lateral view; **(8)** anterior view; **(9)** ventral view; **(10)** posterior view; *Smirnovina* sp. **(11-13)** K.2019.5.1; **(11)** dorsal view; **(12)** lateral view; **(13)** anterior view. All dusted with ammonium chloride. All scale bars represent 10 mm.

Figure 4. *Zittelina hofmanni* n. sp. from the basal, red, ferruginous bed of the Apátvarasd Limestone Formation, Upper Valanginian - Lower Hauterivian, Dezső Rezső Valley, Zengővárkony, Mecsek Mts. **(1-3)** holotype PAL 2019.4.1; **(1)** dorsal view; **(2)** lateral view; **(3)** anterior view; **(4-6)** paratype K 2019.1.1; **(4)** dorsal view; **(5)** lateral view; **(6)** anterior view; **(7-8)** paratype K 2019.2.1; **(7)** dorsal view; **(8)** lateral view; **(9-11)** plaster cast of a sectioned specimen PAL 2019.6.1; **(9)** dorsal view; **(10)** lateral view; **(11)** anterior view; **(12-13)** plaster cast of a sectioned specimen PAL 2019.5.1; **(12)** dorsal view; **(13)** lateral view; All dusted with ammonium chloride. All scale bars represent 10 mm.

Figure 5. Transverse serial sections of *Zittelina hofmanni* n. sp; from the Apátvarasd Limestone Formation, Upper Valanginian - Lower Hauterivian, Dezső Rezső Valley, Zengővárkony, Mecsek Mts; red, ferruginous limestone. Original length of the specimen (in mm): L = 24.7. Numbers refer to distance from the ventral umbo in mm. Paratype PAL 2019.5.1.

Figure 6. Transverse serial sections of *Zittelina hofmanni* n. sp; Upper Valanginian - Lower Hauterivian, Zengővárkony, (Mecsek Mts.) red, ferruginous limestone. Original length of the specimen (in mm): L = 19.1. Numbers refer to distance from the ventral umbo in mm. Paratype PAL 2019.6.1.

Figure 7. Transverse serial sections of *Zittelina hofmanni* n. sp; Upper Valanginian - Lower Hauterivian, Zengővárkony, (Mecsek Mts.) red, ferruginous limestone. Original length of the specimen (in mm): L = 22.6. Numbers refer to distance from the ventral umbo in mm. Paratype PAL 2019.7.1.

Figure 8. Transverse serial sections of *Smirnovina ferraria* n. sp; Upper Valanginian - Lower Hauterivian, Zengővárkony, (Mecsek Mts.) red, ferruginous limestone. Original length of the specimen (in mm): L = 16.4. Numbers refer to distance from the ventral umbo in mm. Paratype PAL 2019.8.1.

Table 1. Measurements of *Dictyothyropsis vogli* nov. sp; holotype PAL 2019.2.1; L = length, W = width, T = thickness, Ch = height of the deflection in the anterior commissure; numbers are given in millimeters.

Specimen	L	W	T	Ch
PAL 2019.2.1	17.3	16.3	10.7	~2.0

Table 2. Measurements of *Zittelina hofmanni* n. sp; holotype PAL 2019.4.1, paratypes PAL 2019.5.1 – 2019.7.1, K 2019.1.1, K 2019.1.2; L = length, W = width, T = thickness, Ch = height of the deflection in the anterior commissure; numbers are given in millimeters.

Specimen	L	W	T	Ch
PAL 2019.5.1	24.7	20.9	17.9	~2.5
PAL 2019.8.1	23.3	19.9	15.7	~3.1
PAL 2019.7.1	22.6	18.9	15.2	~3.0
INV 2019.1	22.3	18.7	13.4	~3.0
PAL 2019.6.1	19.1	17.6	13.2	~2.0
INV 2019.2	18.5	16.8	12.9	~3.5
PAL 2019.4.1	19.3	18.1	12.5	3.9
K 2019.1.1.	17.9	19.3	12.8	3.1
K 2019.2.1.	17.7	15.3	11.1	?

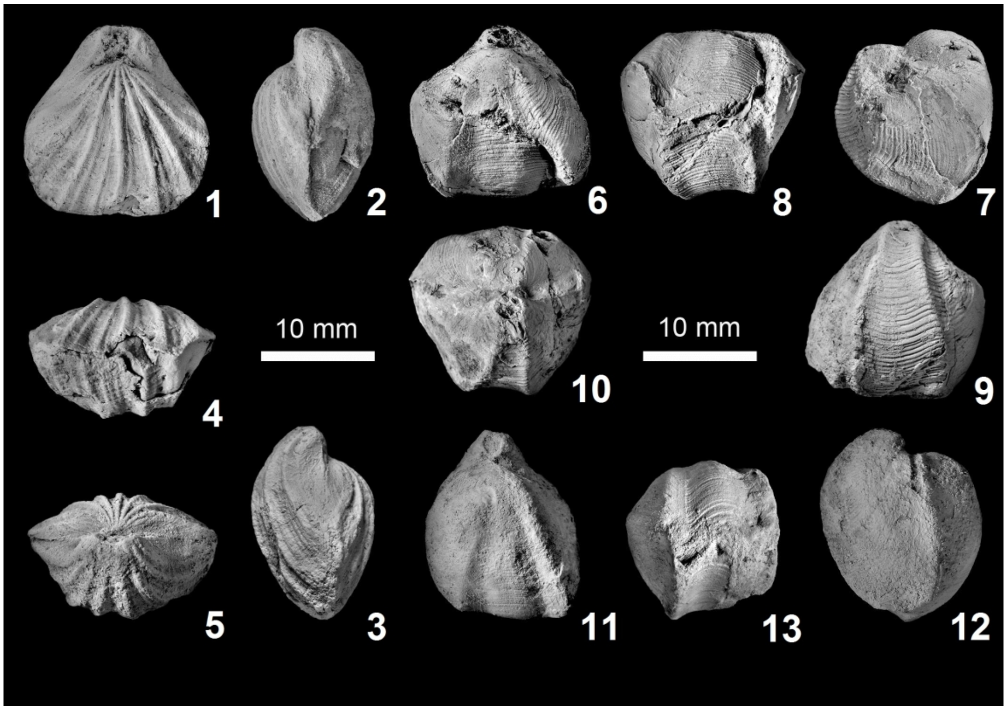
Table 3. Measurements of *Smirnovina ferraria* n. sp; holotype PAL 2019.3.1, paratypes PAL 2019.8.1 – PAL 2019.10.1, L = length, W = width, T = thickness, Ch = height of the deflection in the anterior commissure; numbers are given in millimeters.

Specimen	L	W	T	Ch
PAL 2019.10.1	18.0	14.1	14.9	7.0
PAL 2019.8.1	16.4	14.2	13.5	6.6

PAL 2019.3.1	15.1	15.5	14.8	7.9
INV 2019.3	~12.5	11.9	0	0

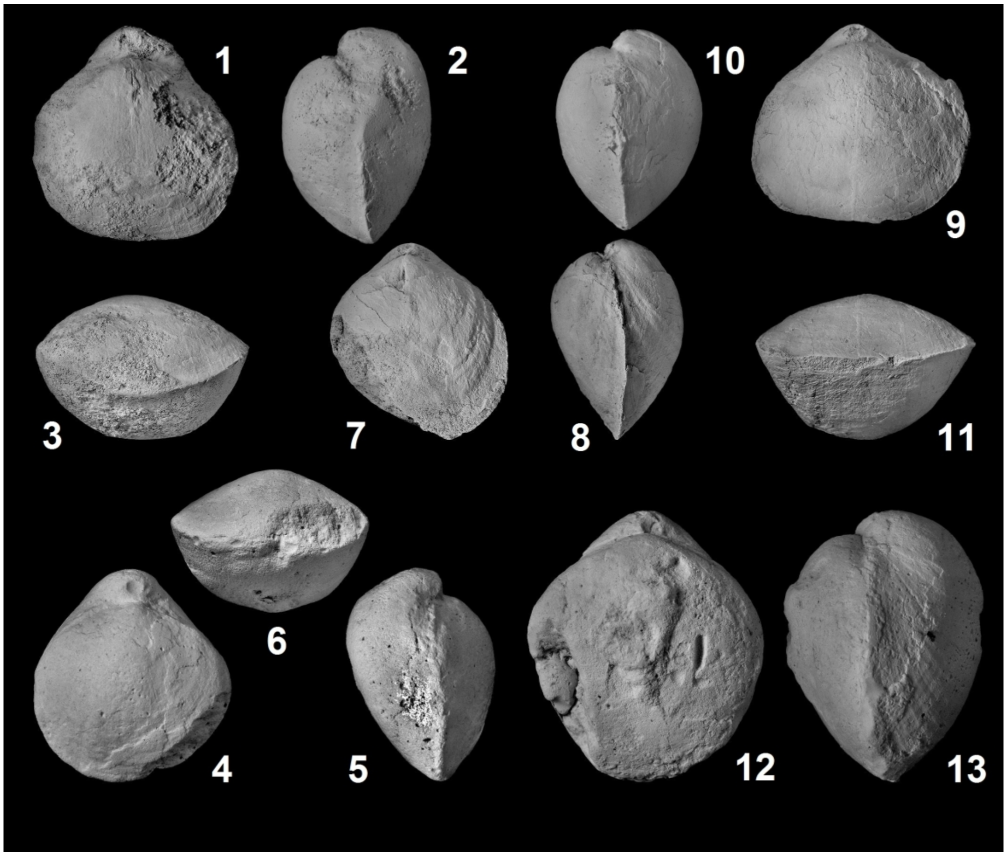
Table 4. Measurements of *Smirnovina* sp; K 2019.5.1, L = length, W = width, T = thickness, Ch = height of the deflection in the anterior commissure; numbers are given in millimeters.

Specimen	L	W	T	Ch
K 2019.5.1.	16.3	~13	12.9	6.8



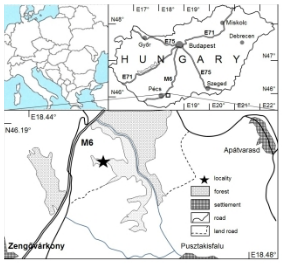
Dictyothyropsis vogli n. sp. from the basal, red, ferruginous bed of the Apátvarasd Limestone Formation, Upper Valanginian - Lower Hauterivian, Dezső Rezső Valley, Zengővárkony, Mecsek Mts. (1-5) holotype PAL 2019.2.1; (1) dorsal view; (2, 3) right and left lateral views; (4) anterior view; (5) posterior view; Smirnovina ferraria n. sp. (6-10) holotype PAL 2019.3.1; (6) dorsal view; (7) lateral view; (8) anterior view; (9) ventral view; (10) posterior view; Smirnovina sp. (11-13) K.2019.5.1; (11) dorsal view; (12) lateral view; (13) anterior view. All dusted with ammonium chloride. All scale bars represent 10 mm.

179x125mm (300 x 300 DPI)



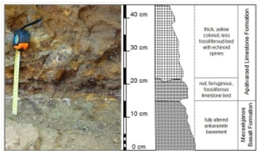
Zittelina hofmanni n. sp. from the basal, red, ferruginous bed of the Apátvarasd Limestone Formation, Upper Valanginian - Lower Hauterivian, Dezső Rezső Valley, Zengővárkony, Mecsek Mts. (1-3) holotype PAL 2019.4.1; (1) dorsal view; (2) lateral view; (3) anterior view; (4-6) paratype K 2019.1.1; (4) dorsal view; (5) lateral view; (6) anterior view; (7-8) paratype K 2019.2.1; (7) dorsal view; (8) lateral view; (9-11) plaster cast of a sectioned specimen PAL 2019.6.1; (9) dorsal view; (10) lateral view; (11) anterior view; (12-13) plaster cast of a sectioned specimen PAL 2019.5.1; (12) dorsal view; (13) lateral view; All dusted with ammonium chloride. All scale bars represent 10 mm.

179x152mm (300 x 300 DPI)



Locality map

785x1056mm (96 x 96 DPI)



The Upper Valanginian - Lower Hauterivian Zengővárkony section traversing the Mecsekjános Basalt Formation and the Apátvarasd Limestone Formation.

785x1056mm (96 x 96 DPI)

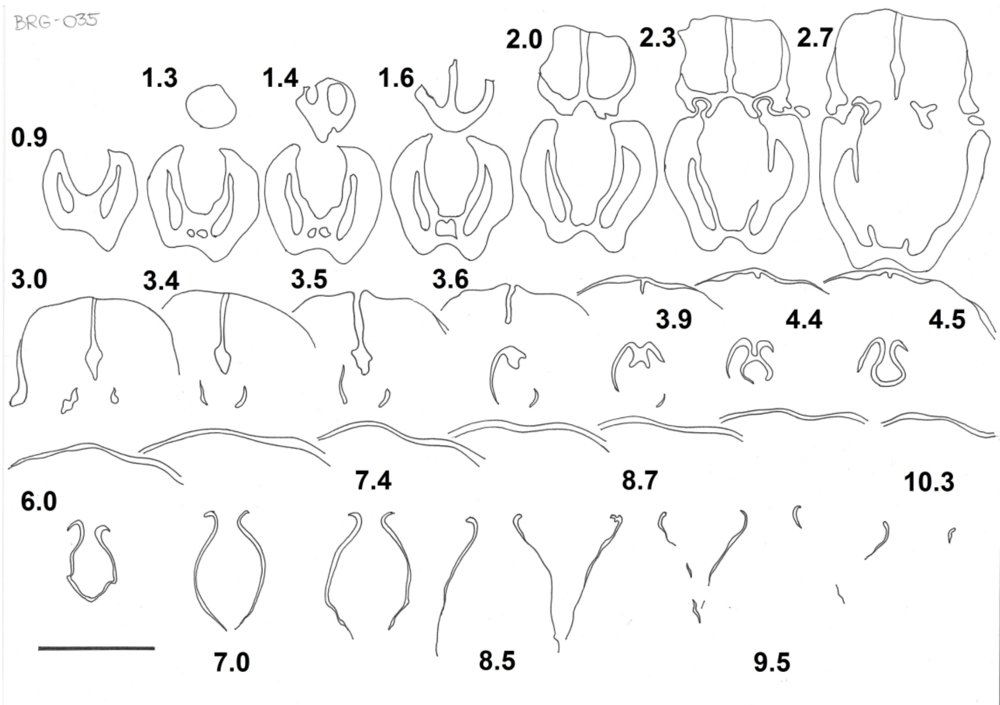


Fig. 8. Transverse serial sections of Smirnovina ferraria n. sp; Upper Valanginian - Lower Hauterivian, Zengővárkony, (Mecsek Mts.) red, ferruginous limestone. Original length of the specimen (in mm): L = 16.4. Numbers refer to distance from the ventral umbo in mm. Paratype PAL 2019.8.1.

420x297mm (300 x 300 DPI)

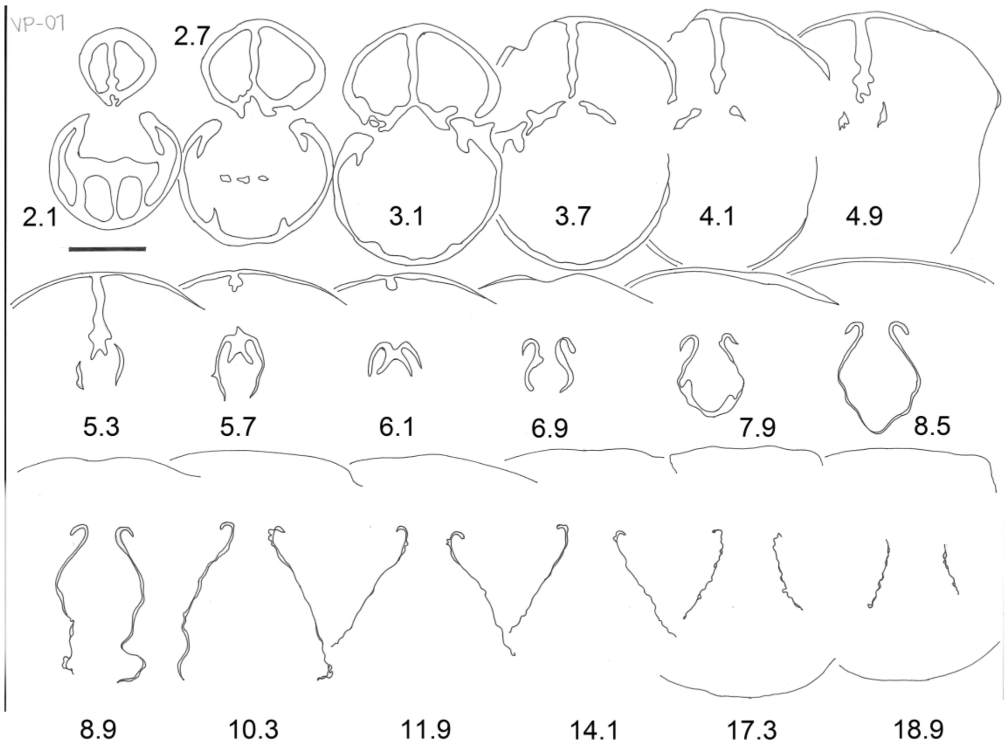


Fig. 5. Transverse serial sections of Zittelina hofmanni n. sp; from the Apátvarasd Limestone Formation, Upper Valanginian - Lower Hauterivian, Dezső Rezső Valley, Zengővárkony, Mecsek Mts; red, ferruginous limestone. Original length of the specimen (in mm): L = 24.7. Numbers refer to distance from the ventral umbo in mm. Paratype PAL 2019.5.1.

1314x986mm (96 x 96 DPI)

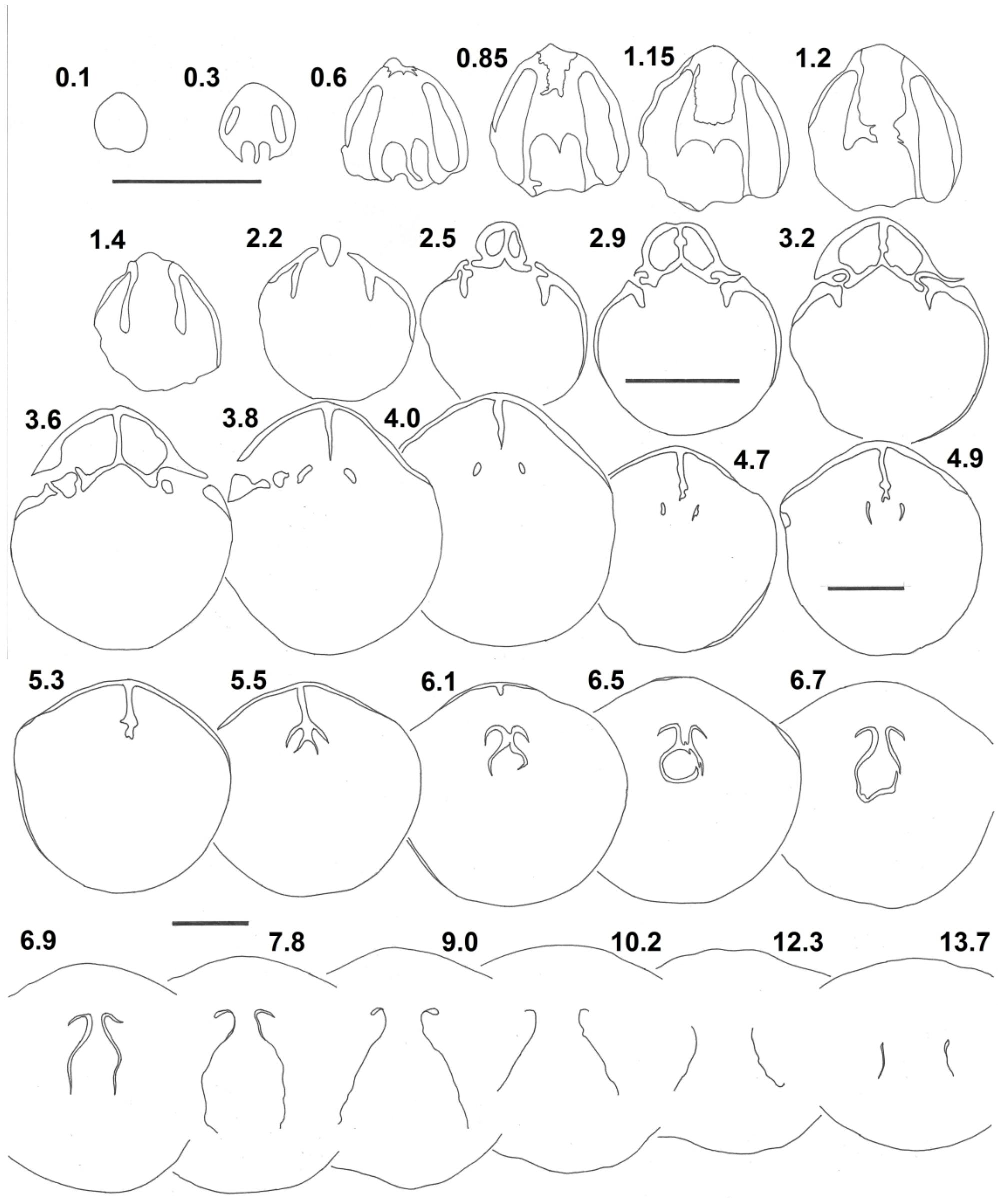


Fig. 6. Transverse serial sections of Zittelina hofmanni n. sp; Upper Valanginian - Lower Hauterivian, Zengővárkony, (Mecsek Mts.) red, ferruginous limestone. Original length of the specimen (in mm): L = 19.1. Numbers refer to distance from the ventral umbo in mm. Paratype PAL 2019.6.1.

1314x1581mm (96 x 96 DPI)

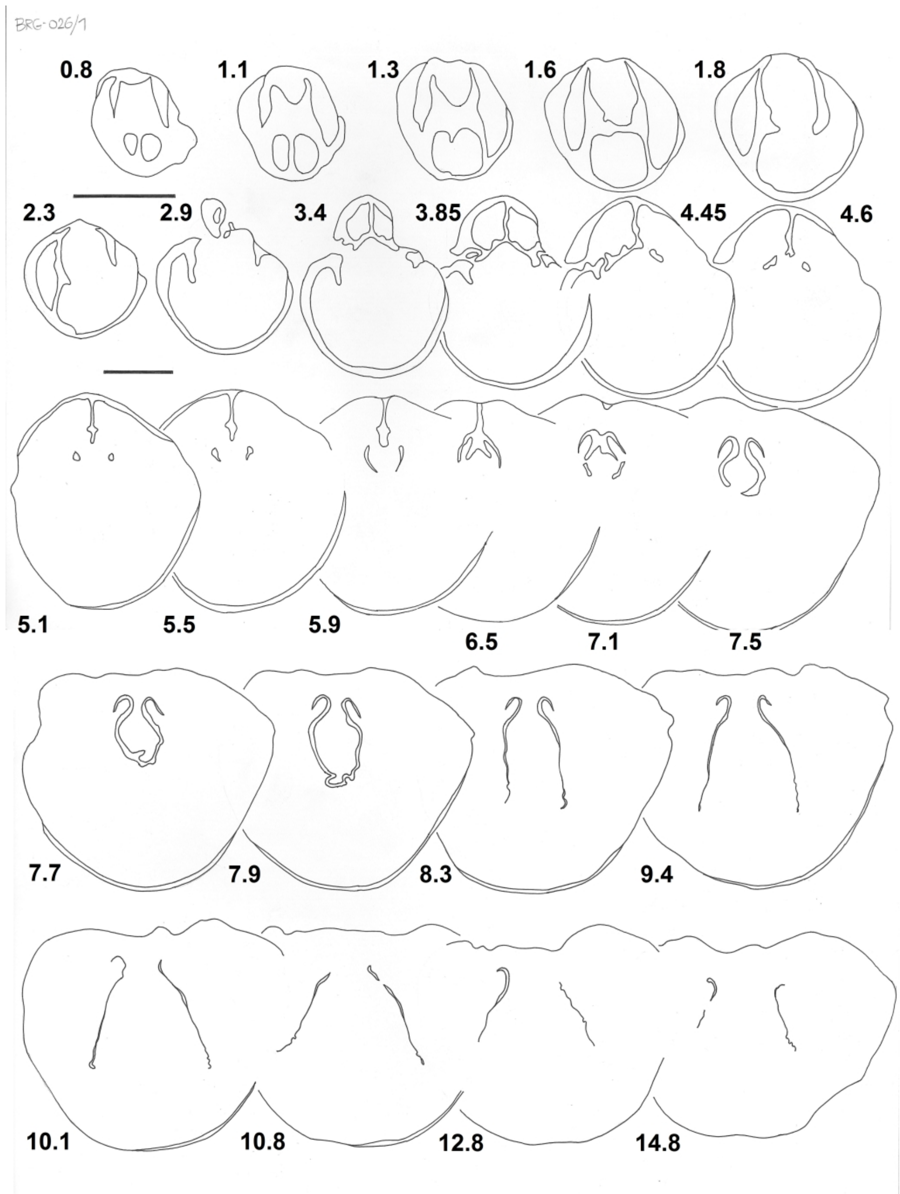


Fig. 7. Transverse serial sections of Zittelina hofmanni n. sp; Upper Valanginian - Lower Hauterivian, Zengővárkony, (Mecsek Mts.) red, ferruginous limestone. Original length of the specimen (in mm): L = 22.6. Numbers refer to distance from the ventral umbo in mm. Paratype PAL 2019.7.1.

Specimen	L	W	T	Ch
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PAL 2019.6.1	19.1	17.6	13.2	~2.0
INV 2019.2	18.5	16.8	12.9	~3.5
PAL 2019.4.1	19.3	18.1	12.5	3.9
K 2019.1.1.	17.9	19.3	12.8	3.1
K 2019.2.1.	17.7	15.3	11.1	?

Specimen	L	W	T	Ch
PAL 2019.10.1	18.0	14.1	14.9	7.0
PAL 2019.8.1	16.4	14.2	13.5	6.6

Specimen	L	W	T	Ch
K 2019.5.1.	16.3	~13	12.9	6.8