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Latest Oxfordian – earliest Kimmeridgian ammonite dominated fauna and microfacies from the ammonitico rosso-type Fonyászó Limestone Formation at Zengővárkony (Mecsek Mountains, Hungary)

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Key words: Upper Oxfordian, Lower Kimmeridgian, Tisza microplate, *Saccocoma* microfacies, Mediterranean ammonite fauna, *Spiraserpula spirolinites*.

Abstract. Field work has resulted in the recognition of a previously unknown outcrop in the vicinity of the Zengővárkony lime-kilns (Mecsek Mountains, South Hungary) which has provided a remarkably rich, but poorly preserved, uppermost Oxfordian – earliest Kimmeridgian fauna dominated by ammonites probably representing the Hypselum–Bimammatum zones. This is the first description and illustration of Oxfordian–Kimmeridgian ammonites from the Mecsek Mountains. The cephalopod fauna comprises *Phylloceras* div. sp., *Holcophylloceras* div. sp., *Sowerbyceras* sp., *Lytoceras* sp., *Lissoceratoides erato*, *Trimarginites* cf. *trimarginatus*, *Glochiceras (Coryceras)* cf. *microdomum*, *Subdiscosphinctes* sp., ?*Wegelea* sp., Passendorferiinae gen. et sp. ind., ?*Orthosphinctes* sp., *Euaspidoceras* cf. *radisense*, *Aspidoceras* sp., *A.* cf. *binodum*, *Physodoceras* sp. ex gr. *altenense-wolfi*, *Lamellaptychus* sp., *Laevaptychus* sp. ex gr. *hoplisus-obliquus*. The fauna has a Mediterranean character (55% of Phylloceratidae and Lytoceratidae) and is similar to the Tethyan assemblages of the Venetian Alps (Italy), and Palma de Mallorca. The spirochaete tube worm *Spiraserpula spirolinites* is also the first record from the Mecsek Mountains. The *Saccocoma* wackestone-packstone microfacies is recorded with benthic foraminifera (*Lenticulina* sp. and *Spirillina* sp.) indicating well oxygenated and nutrient-rich bottom conditions.

INTRODUCTION

Macrofossil bearing Jurassic strata occur at the surface in three territories of the western part of Hungary: the Transdanubian Middle Range (Bakony, Gerecse, Pilis and Vértes Mountains), and in the south the Mecsek and the Villány Mountains. All these mountains expose almost complete Jurassic sequences except for the Villány Mountains and have been known for 160 years. Peters (1862) was the first to report Upper Jurassic sequence from the Mecsek Mountains. A decade later, between 1874 and 1878, János Böckh carried out geological mapping in the Zengővárkony region and visited the lime-kilns of Várkony (today referred to as Zengővárkony). His accurate description helps to identify his localities even today. Böckh (1880, p. 18) referred to an *Aspidoceras perarmatum* Sow. [=*Euaspidoceras perarmatum*] specimen that he collected from a yellowish limestone as a weathered internal mould which was deposited in the collection of the Mining and Geological Survey of Hungary under repository no. J712. Some decades later, in the 1910s, Elemér Vadász revisited and recollected these localities and summarized the knowledge in his monograph (Vadász,

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1935). According to Vadász (1935, p. 60–61) a complete 'Malm' sequence occurs, however, the scarcity of the fossils and the limited presence of the Oxfordian strata at the surface create difficulties regarding the stratigraphic position of the older Upper Jurassic rocks. The beginning of the Upper Jurassic sequence is characterized by cherty-shaly, yellow limestones from which Vadász (1935, p. 61) indicated the presence of the upper part of the Oxfordian stage and listed the following fossils: *Terebratula* sp., *Terebratulina* cf. *substriata* Schlotheim, *Posidonomya* cf. *alpina* Gras, *Holcophylloceras* cf. *polyolcum* Benecke, *Sowerbyceras tortisulcatum* Orbigny, *Peltoceras toucasi* Orbigny, *Ataxioceras breviceps* Quenstedt, *Aspidoceras perarmatum* Sowerby, *Rhynchoteuthis* sp., *Hibolites argovianus* Mayer-Eymar, and *H. hastatus* Montfort. He provided no illustrations or description.

In the mid-1960s geological mapping covered the eastern part of the Mecsek Mountains and brought new information on the surface extensions of the Oxfordian strata, however only a poor macrofauna was indicated. Some localities mentioned by Böckh have disappeared due to human activities (Hámor *et al.*, 1967 p. 18). The total thickness of the Oxfordian strata in the Mecsek Mountains varies from outcrop to outcrop from 1 to 25 m (Hetényi *et al.*, 1968; Földi *et al.*, 1977).

The most complete faunal list was given by one of the mappers (Nagy, 1971 p. 323): *Holcophylloceras* cf. *polyolcum* (Benecke), *Sowerbyceras tortisulcatum* (d'Orbigny), *Perisphinctes* sp., *P. (P.) bakeriae* (Sowerby), *P. (Arisphinctes) plicatilis* (Sowerby), *Gregoryceras transversarium* (Quenstedt), *G. toucasi* (d'Orbigny), and *Euaspidoceras perarmatum* (Sowerby). This fauna suggests the presence of the lower and middle parts of the Oxfordian, however in the collection of the Mining and Geological Survey of Hungary only a *Sowerbyceras tortisulcatum* and a *Euaspidoceras perarmatum* are deposited. The summary of Nagy (1971) on the ammonite bearing Upper Jurassic strata has been neglected for decades (probably because it was written in Russian); however, even today this is the most interesting faunal list of Oxfordian ammonites from the Mecsek Mountains. This material however, seems to be lost: there is no any information available on its repository, therefore we did not include in our study.

Two decades later Főzy (1993) reported an Oxfordian faunal list consisting of 14 specimens representing *Sowerbyceras* sp., *Holcophylloceras* sp., *Phylloceras* sp., *Lytoceras* sp., *Taramelliceras* sp., *Aspidoceras* cf. *binodum* (Oppel), *Euaspidoceras* sp., *Orthosphinctes* sp., and Perisphinctinae div. sp. Based on this list it is obvious, that even in the early 1990s, the interesting material referred by Nagy (1971) could have been lost. Főzy and Meléndez (1996) gave a summary of the Oxfordian ammonites of Hungary and referred to Zengővárkony as a locality for Oxfordian ammonites in the Mecsek Mountains, however their sketchy map did not let us to identify their outcrop in the field. Based on the lithological description of these authors, most probably they referred to the 'classic' Oxfordian limestone bank (Böckh, 1880; Vadász, 1935; Nagy, 1971; Főzy, 1993) at the vicinity of the lime kilns of Zengővárkony on the left bank of the Vasbányavölgy Creek. Főzy and Meléndez (1996) listed a new ammonite assemblage including *Euaspidoceras* cf. *hypselum* (Oppel), *Orthosphinctes* of the *tiziani* group and forms of *Subdiscosphinctes* morphology referred to the Bimammatum Zone, otherwise Főzy and Meléndez (1996, p. 189) referred to the earlier faunal list of Főzy (1993). That is the last contribution regarding the Oxfordian ammonites of the Mecsek Mountains with no illustrations or taxonomic descriptions. The recent revision of the base of the Kimmeridgian Stage on the occasion of the establishing of its GSSP has resulted in the shifting of the boundary between the Oxfordian and Kimmeridgian in the Submediterranean-Mediterranean zonal schemes down to the base of the Bimammatum Zone (Wierzbowski *et al.*, 2016; Hesselbo *et al.*, 2020).

The aim of this paper is to describe an uppermost Oxfordian – lowermost Kimmeridgian ammonite assemblage from the Mecsek Mountains. Field work was performed in July and August, 2020 and resulted the recognition of a previously unknown and untouched locality in Zengővárkony forest, at a remote place in a hidden, small depression that provided a poorly preserved but diverse and rich fauna of ammonites, aptychi, brachiopods, bivalves, belemnites and crinoids. Brachiopods from this locality are reported by Bujtor and Albrecht (2021).

GEOLOGICAL SETTING

The Early Jurassic facies development of the Mecsek Mountains is characterized by shallow, coal bearing clastic and marly sedimentation with a thick sandstone sequence that suggests a rapidly subsiding sedimentary basin with cyclic short-term paleoenvironmental changes from fluvial/deltaic to swamp settings (Ruckwied *et al*., 2008) during the Hettangian and Sinemurian. The younger Early Jurassic (Sinemurian and Toarcian) is characterized by normal marine sedimentation with Toarcian black shales. This basin is the northernmost part of a greater tectonic unit called the Tisza Megaunit (Haas, Péró, 2004). This multiple tectonic unit is considered a microplate that detached from the European margin (Vörös, 1993; Csontos, Vörös, 2004). Detachment brought remarkable changes in sedimentation, which is recorded around the Bathonian/Callovian boundary, when pelagic sedimentation occurred in the Mecsek Mountains

(Galácz, 1984). This phenomenon is supported by recent tectonic results (Tari, 2015): *The opening Penninic (or Alpine Tethys) oceanic realm separated the Tisza Mega-unit from the European margin during the Middle Jurassic*. The separation brought the area of the Mecsek Mountains into Tethyan conditions. The subsidence of this area resulted in pelagic sedimentation of typical ammonitico rosso-type nodular marly limestones (Raucsik in Főzy, 2012) of Bathonian age being the most characteristic Middle Jurassic formation of the Mecsek Mountains (Óbánya Limestone Fm.). Later, the pelagic limestone sedimentation continued through the late Middle and the whole Late Jurassic. The Bathonian, Oxfordian and the early Kimmeridgian are characterized by ammonitico rosso type sedimentation, while the late Tithonian is represented by Maiolica-type sediments. These changes are also reflected in the ammonite faunas. Géczy (1984, p. 388) noted that the ratio of the Phylloceratina and Lytoceratina taxa is around 5–10% altogether in the Lower Jurassic strata (Toarcian), while it increases significantly to 75% during the Bathonian/Callovian (Galácz, 2015). According to Géczy, this significant change in the faunal composition is related to the continuous subsidence, sea-level change and the formation of a pelagic basin that was invaded by bathypelagic ammonites in the Middle Jurassic.

The palaeogeographical positioning of the Tisza Mega-unit (including the Mecsek unit) during the Late Mesozoic is still under debate. Recent reconstructions (van Hinsbergen *et al.*, 2020) placed the Tisza microplate on the northern margin of the Neotethys being stable and immobile till the Middle Jurassic (Bajocian). From the Bajocian till the Berriasian the Tisza microplate detached from the northern Neotethyan margin and traveled southward (van Hinsbergen *et al.*, 2020, figs. 42–44). A similar palaeogeographic position was given by the results of a study of the Early Cretaceous brachiopods from the Mecsek Mountains by Vörös and Bujtor (2020). The palaeogeographical position of the Mecsek Mountains as part of the Tisza microplate proposed by van Hinsbergen *et al.* (2020, figs. 43–44) is remarkably similar to the results of an early attempt of Kovács (1984, fig. 8) to understand the palaeogeographical positions of the Mecsek Mountains.

The study area is situated in the Eastern Mecsek Mountains (Fig. 1), 25 km from Pécs in the Zengővárkony forest being the most important area to investigate continuous Upper Jurassic sequences in the Mecsek Mountains. Figure 2 shows the Upper Jurassic sequence of the area after Nagy (1964) that traverses the continuous Middle Jurassic (pars) – Upper Jurassic sequence represented by three lithostratigraphical formations:

Fonyászó Limestone Fm. is a characteristic, red coloured ammonitico rosso-type limestone with thicker, yellowish-white limestone banks. It is a thin bedded, sometimes nodular limestone. In thin sections globigerinids and *Paleotrix* are characteristic as reported already by Nagy (1971). It represents the Callovian and Oxfordian. Its upper part, the subject of the present study, is poorly separable from the basal beds of the Kisújbánya Limestone Fm. It contains ammonites, globigerinids, *Saccocoma*, and radiolaria.

Kisújbánya Limestone Fm. This is basically a grey coloured, nodular, poorly stratified limestone with rich macrofossil content (ammonites, belemnites, aptychi), sometimes with yellowish-pinkish patches and radiolarite cherts. In the field it is often difficult to separate the uppermost beds of the unit from the lowermost beds of the Márévár Limestone Fm. It represents a stratigraphical range from the Lower Kimmeridgian to the Lower Tithonian.

Márévár Limestone Fm. Around its base this is thick bedded, becoming thin bedded upwards. Basically, it is a white or yellowish white maiolica-type limestone. Typical macrofossils are ammonites that becomes scarcer upwards and disappear by the Upper Tithonian. Its subdivision is based on calpionellids. Sometimes it contains chert nodules or beds. Its age spans from the Upper Tithonian to the Lower Hauterivian. The Márévár Limestone Formation continues into the Lower Cretaceous and it is terminated by volcanic rocks (Mecsekjánosi Basalt Fm.). These three formations

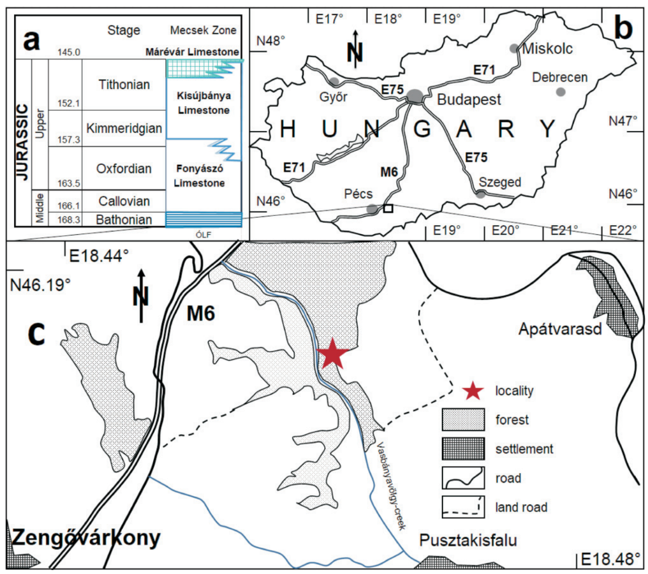

Fig. 1. Locality map and lithostratigraphic subdivision of the Upper Jurassic – Lower Cretaceous (pars) strata mentioned in the text

A. Lithostratigraphy of the Mecsek Zone for the study period. Numerical ages after Cohen *et al.* (2013). ÓLF – Óbánya Limestone Fm. Lithostratigraphic units after Főzy (2012), simplified; **B.** Simplified map of Hungary. Black rectangle indicates the study area; **C.** The Zengővárkony area indicating the locality. Asterisk indicates the locality on the left (=eastern) bank of the Vasbányavölgy creek

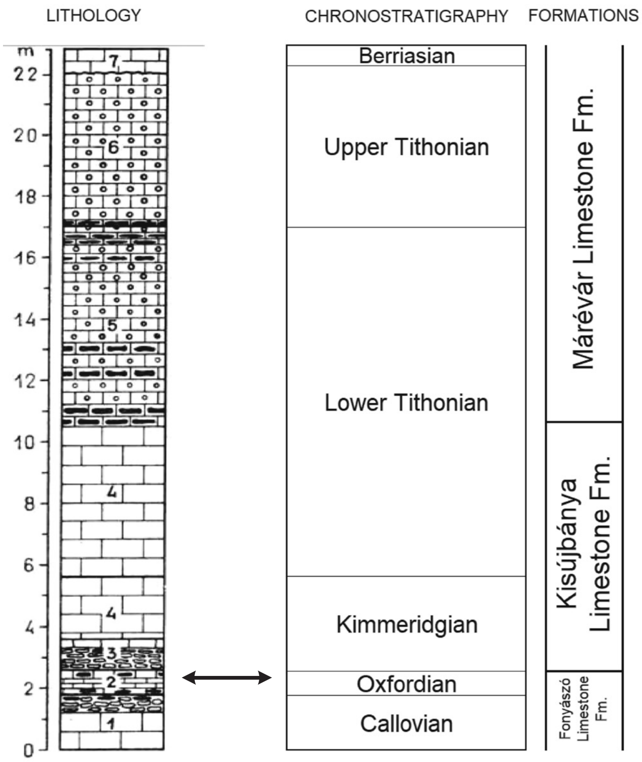

Fig. 2. The Upper Jurassic – Lower Cretaceous sedimentary sequence at Zengővárkony, Mecsek Mountains. Lithological column after Nagy (1964), simplified with indication of the stratigraphic position of the ammonites included in this study (arrowed)

Abbreviations: 1: light coloured yellowish–grey thick bedded limestone; 2: thin bedded limestone; 3: marly–clayey, red coloured, patchy and nodular limestone; 4: light coloured yellowish–grey, thick bedded limestone; 5: light coloured yellowish–grey brecciated limestone with light grey flint nodules; 6: yellowish-white brecciated limestone; 7: brownish-yellow clayey limestone. Chronostratigraphic subdivision of the section is based on micropalaeontological investigations of Nagy (1964). The Upper Oxfordian sensu Nagy (1964) now considered Lower Kimmeridgian *sensu* Wierzbowski *et al.,* 2016; Hesselbo *et al.,* 2020

represent a continuous sedimentary succession with continuous transitions around their boundaries, and reliable subdivision is based on biostratigraphical investigations (Nagy, 1961, 1964).

STUDIED SECTIONS

The studied section is situated in a NE direction from the abandoned lime kilns, close to the edge of the forest (Fig. 1C) on the left bank of Vasbányavölgy Creek. This natural outcrop (coordinates: 46.1854°N; 18.4592°E) is not indicated on the geological maps of Hetényi *et al.* (1968). It is far from the known tourist roads and is hidden in a small depression (Fig. 3). The section is 1 m thick (Fig. 4); the average dip is 305°/40°. Its length is 5 m along the strike. The basal part (Bed 1, about 0.5 m in thickness) is a thin bedded, stratified red coloured ammonitico rosso-type limestone with poor fossil content, which is overlain by Bed 2, which is a thick, unstratified, massive, basically white coloured limestone bank of 46 cm thickness with red coloured patches occasionally. On average there are 3 ammonite specimens per square meter weathering out on the surface. Although there were large sized weathered ammonites on the surface of the limestone bed (Fig. 3B), it was impossible to take them out. On the limestone Bed 2 a dark, red coloured, sometimes nodular, laminated, poorly stratified marly limestone sequence was deposited (Bed 3) with a very rich but poorly preserved macrofaunal content. The thickness of this bed is 40 cm (Fig. 3C). It yielded a rich, ammonite-dominated fauna. The upper continuation of this bed has been eroded away. The lateral continuation of the sequence is covered by soil and debris. Based on the literature, the older Oxfordian strata around Zengővárkony are represented by a thin, but characteristic limestone bank of maximum 1 m thickness (Böckh, 1880; Nagy, 1971; Nagy *et al.*, 1978; Főzy, 1993) possibly belonging to the Middle Oxfordian. Our section thus may represent some directly overlying beds of the Upper Oxfordian and lowest Kimmeridgian at the top of the Fonyászó Limestone Formation.

DISCUSSION

AGE OF THE SEQUENCE

The zonal subdivision of the Oxfordian follows the zonation of Zeiss (2003) with the later modifications of Wierzbowski *et al.* (2016) and Hesselbo *et al.* (2020).

Our ammonite assemblage probably belongs to the Upper Oxfordian (mostly Hypselum Zone) and the lowermost Kimmeridgian (Bimammatum Zone) according to the Submediterranean-Mediterranean zonal schemes (Wierzbowski *et al.*, 2016; Hesselbo *et al.*, 2020), although zonal markers (*Euaspidoceras hypselum* or *Epipeltoceras bimammatum*) were not recovered in our research. It is noteworthy that Főzy and Meléndez (1996) reported a *Euaspidoceras* cf. *hypselum* also from Zengővárkony. A *Glochiceras (Coryceras)* cf. *microdomum* indicates this stratigraphical interval, whereas the presence of a *Trimarginites* cf. *trimarginatus* indicates that these deposits cannot be younger than the Bimammatum Zone. Similar conclusions result from the occurrence of the aspidoceratids: *Euaspidoceras* cf. *radisense* does not occur above the Hypselum Zone, whereas *Aspidoceras* and *Physodoceras* are typical of the Kimmeridgian beginning in the Bimammatum Zone.

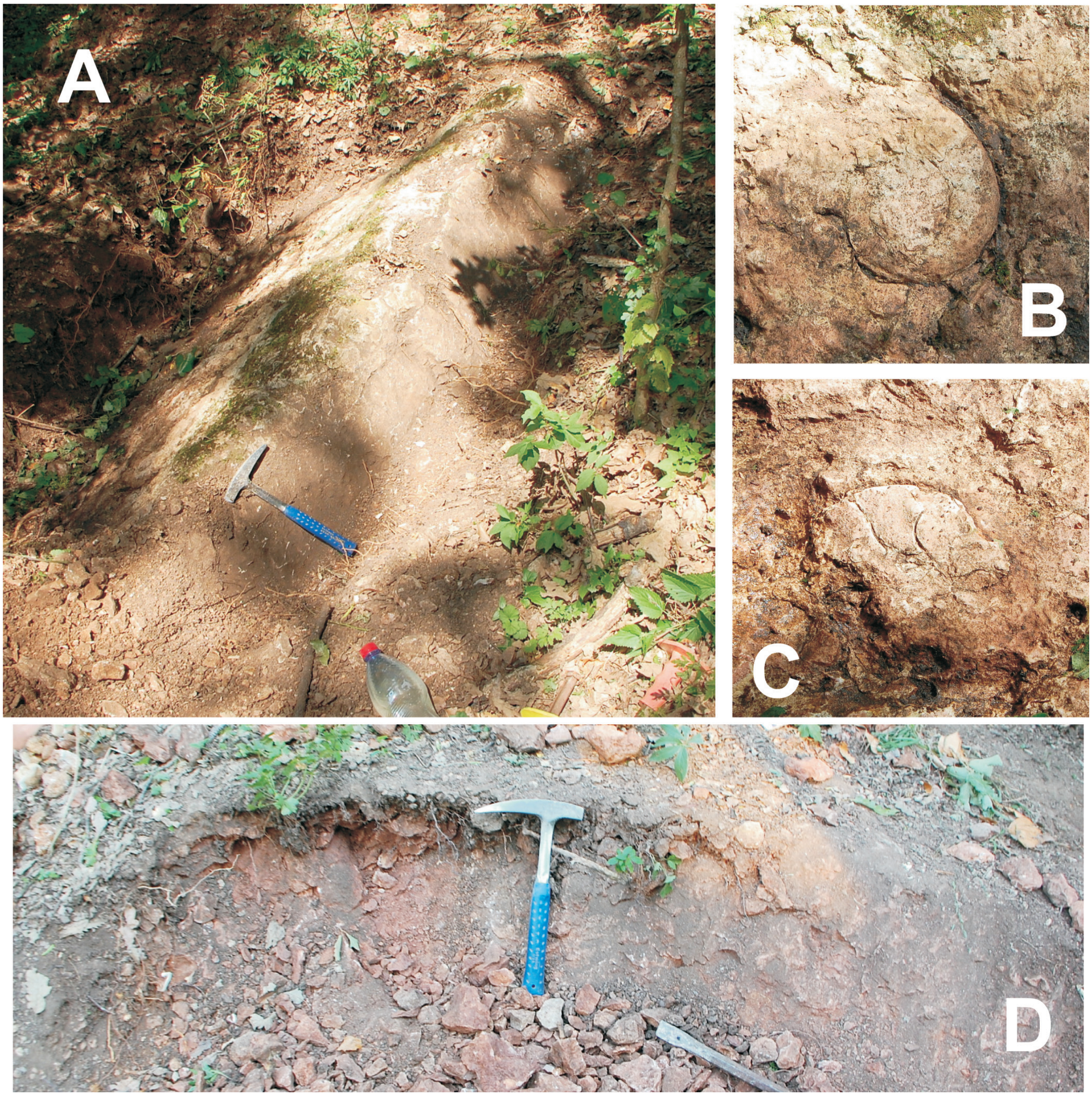

Fig. 3. The Upper Oxfordian – Lower Kimmeridgian outcrop in the Zengővárkony forest

A. Limestone bank with 40° dipping, thickness 46 cm; **B.** Weathered big sized ammonite on the surface of the limestone bank; **C.** Whorl fragment of an ammonite on the surface of the limestone bank (bed 2); **D.** Red, ammonitico rosso-type, nodular, poorly stratified marly limestone bed that yielded a rich fauna of cephalopods, brachiopods, bivalves and crinoids and settled on the limestone bank (bed 3). Coordinates: 46.1854°N; 18.4592°E

PALAEOENVIRONMENT, FAUNAL COMPOSITION AND PALAEOBIOGEOGRAPHICAL AFFINITIES

The ammonite distribution along the northern margin of the Western Tethys outlines a complex picture during the Oxfordian. The Late Oxfordian (and possibly the Early Kimmeridgian too) is considered a warm period (Cecca *et al.*, 2005) with extensive distribution of coral reefs and a very narrow mixing zone of Boreal and Tethyan ammonite faunas along the northern margin of the Tethys. According to the palaeogeographic position of the Tisza microplate (Yilmaz *et al*., 1996) this was situated inside the contact zone of the Submediterranean and Mediterranean ammonites in the southernmost region of the archipelago (Cecca *et al.*, 2005, fig. 7) along the northern Tethyan margin. The first records of uppermost Oxfordian – lowermost Kimmeridgian brachio-

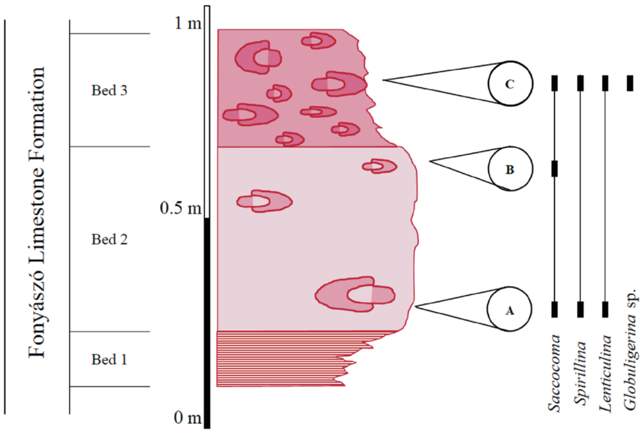

Fig. 4. Sampling points (A–C) of thin sections at the investigated uppermost Oxfordian – lowermost Kimmeridgian section, Zengővárkony locality (Mecsek Mountains, Hungary)

pods (*Nucleata bouei* and *Pygope catulloi*) with Tethyan ancestry (Bujtor, Albrecht, 2021) from the same locality refer to a well oxygenated and nutrient-rich environment in which both nektonic and benthic life was flourishing. This observation is strengthened by our finding of benthic foraminifera in thin sections: in all sampling points well preserved benthic foraminifera (*Lenticulina* sp. and *Spirillina* sp.) are present referring to a continuous nutrient-rich and well oxygenated sea floor offering ideal conditions to benthic fauna as brachiopods and foraminifers.

The appearance of Tethyan and Submediterranean ammonites in the Kimmeridgian of the Mecsek Mountains is supported by recent data (Bujtor *et al*., 2021). In contrast to the occurrence of the typical deep water related brachiopods (*Nucleata bouei* and *Pygope catulloi*; see Bujtor, Albrecht, 2021), the earlier record of the brachiopod (*Terebratulina (Cruralina) substriata* Schlotheim) from the Mecsek Mountains by Vadász (1935, p. 61) is considered to be of European shelf faunal origin. The latter brachiopod clearly indicates a shallower water environment (Grădinaru, Bărbulescu, 1994; Fürsich *et al.*, 2007), and thus it is considered a derivative from a shallower environment being transported into the deeper basin. The deeper basinal palaeoenvironment therefore can be considered a natural biotope of the Tethyan deep-water phylloceratid and lytoceratid ammonites, pygopid brachiopods and benthic foraminifera, whereas the brachiopods of NW European origin must have been transported from neighboring shallower or elevated environments.

The older aged Jurassic ammonite fauna examined in detail from the Mecsek Mountains is Bathonian (Galácz, 1994), however no precise quantitative data was provided by this author on the size of the assemblage and the different ratios of its ammonoid taxa. The next assemblage reported by Galácz (2015) is earliest Callovian, based on 145 specimens revealing an unexpectedly high share of Phylloceratina (76.6%). From the Callovian onward there is a continuous decrease in the ratios of Phylloceratina and Lytoceratina in the ammonite assemblages of the Mecsek Mountains. This agrees with the observation of D'Arpa and Meléndez (2006): they described an Oxfordian–Kimmeridgian ammonite assemblage from the Transversarium to Planula zones of Sicily, where phylloceratid ammonites dominated the fauna by 42%.

The fauna collected from the new locality comprises 232 specimens and represents four phyla (Table 1). The uppermost Oxfordian – lowermost Kimmeridgian cephalopod material from Zengővárkony presently available for our study, numbers 207 specimens (excluding annelids, aptychi, crinoids, brachiopods and bivalves) and it has a clearly Tethyan affinity of the Mediterranean province. The suprageneric ammonite taxa with the respective specimen numbers are shown in Table 2. The fauna is dominated by phylloceratid and lytoceratid specimens, that represent 55% but the less abundant aspidoceratoids account almost 30% of the collected individuals. The most similar faunal composition to that at Mecsek is recognized in the Venetian Alps (Italy). This is in line with the recognized similarities between the Venetian Alps and the Mecsek Mountains during the Kimmeridgian (Bujtor *et al*., 2021).

Table 1

Taxonomic composition of the collected fauna from the uppermost Oxfordian – lowermost Kimmeridgian strata of Zengővárkony, Mecsek Mountains (South Hungary)

Taxonomic unit	Specimens	Share
Annelida	2	0.9%
Ammonites	207	89.2%
Aptychi	16	6.9%
Belemnites	1	0.4%
Brachiopods	4	1.8%
Bivalves	1	0.4%
Crinoids	1	0.4%
TOTAL	232	100%

Table 2

Taxonomic composition of the collected uppermost Oxfordian – lowermost Kimmeridgian ammonite specimens

Taxonomic unit	Specimens	Share
Phylloceratida	41	19.7%
Lytoceratida	72	34.9%
Haploceratidae	16	7.7%
Perisphinctoidea	22	10.6%
Aspidoceratoidea	56	27.1%
TOTAL	207	100%

The palaeogeographical position of the Tisza microplate (including the Mecsek Mountains) is still debated, however most of the authors agree to put it somewhere along the northern margin of the Western Tethys. The reconstruction of Yilmaz *et al.* (1996) puts the Tisza microplate in a similar position to those of Palma de Mallorca and Corse-Sardinia on the southern shelf of Europe, but still in the close vicinity of the stable European margin. In this framework the synchronous presence of shallow marine European shelfal faunal elements and deep water nektonic and benthic fauna of Tethyan origin becomes plausible: shelfal faunal elements were transported into the deep water, Tethyan dominated faunal communities. More faunal information on the composition and evolution of the Late Jurassic ammonite faunas of the Mecsek Mountains will provide crucial information on its palaeogeographic position around the southern margin of the European plate.

MICROFACIES

Nagy (1961) was the first to report the *Saccocoma* (=*Lombardia*) microfacies occurring from the Oxfordian to the Lower Tithonian in the Zengővárkony region. According to Nagy (1971, fig. 1) the *Saccocoma* microfacies appears in the terminal Oxfordian, and is typical of the Kimmeridgian and the Lower Tithonian and becomes very rare in the Upper Tithonian. Figure 4 describes the studied section and indicates the sampling points for microfacies analysis. All thin sections revealed wackestone-packstone microfacies with prevailing *Saccocoma* fragments. Besides these planktic elements, a ‘Globigerina’-like planktic protoglobigerinid foraminifera test fragment (only a single one) was recorded, which is considered a *Globuligerina* sp. (Pl. 1: 3), being similar to the Middle Jurassic planktonic foraminifera from Poland presented by Hart *et al.* (2012). It is noteworthy that there are marked differences in distribution of the microfacies between the Pieniny Klippen Belt in Slovakia, Poland and Ukraine and the Mecsek Mountains in Hungary – in the former areas the whole Oxfordian and possibly lowermost Kimmeridgian are characterized by the *Globuligerina* microfacies (or *Globuligerina*-radiolarian microfacies), whereas in the latter the stages are characterized also by the *Saccocoma* microfacies (Wierzbowski, 1994; Reháková *et al.*, 2011). Nagy (1971) had already underlined that globigerinids in the Mecsek Mountains are abundant in the Bathonian, Callovian and basal Oxfordian, but very rare in younger beds referred to the Kimmeridgian.

Benthic faunal elements are also present in the section. All thin sections contained the benthic foraminifera *Lenticulina* and *Spirillina* often at each sampling point (Pl. 1: 2, 6–8). The *Globuligerina* sp. recognized in thin section came from the body chamber of specimen J 2020.651.1 (aspidoceratid ammonite) that also provided the *Spiraserpula spirolinites*. Some echinoderm test particles (Pl. 1: 5) and unidentifiable mollusk or ostracod shell remains are also recorded (Pl. 1: 3, 8) indicating the presence of a diverse bottom fauna. These results are in line with the macrofaunal composition (Tab. 1) which shows the presence of bivalves, echinoderms and brachiopods.

TAPHONOMIC REMARKS

The collected 16 apytchi belong to the two groups of Parent and Westermann (2016): laevaptychi (=Aspidoceratoidea) and lamellaptychi (=Haploceratoidea). Among laevaptychi, a small sized *Laevaptychus* sp. valve is preserved inside an aspidoceratid specimen (Fig. 5). Another small, fragmentary *Lamellaptychus* is fossilized together with a *Lissoceras (Lissoceratoides) erato*.

An aspidoceratid internal mould (specimen J 2020.9.1) revealed two internally fossilized juvenile ammonites (Fig. 6). Both small-sized ammonites have aspidoceratid coiling with 5 to 6 mm maximum diameter. Most probably these juvenile ammonites drifted/trapped into the empty body chamber of their host ammonite. Later it was filled up by sediment, however the tiny ammonites were not infilled, preserving their negative counterpart. This suggests that certain juvenile ammonites may have found shelter in abandoned adult ammonite shells. The case of the *Spiraserpula spirolinites* specimens attached to the shell of a similar aspidoceratid ammonite is a different one. We do not have evidence as to whether the aspidoceratid shell drifted into the shallow marine setting, where it settled on the sea floor and was occupied by spirorbine worms and ammonites, and was later transported into the deeper basin, (as we have seen in the case of the shallow marine brachiopod *Terebratulina* (*Cruralina) substriata* reported by Vadász, 1935) or whether it floated in the water column while occupied by the juvenile ammonites and the spirorbines.

CONCLUSION

The first record of a latest Oxfordian – earliest Kimmeridgian (probably Hypselum and Bimammatum zones) ammonite fauna collected at Zengővárkony (Mecsek Mountains, South Hungary) provided an interesting ammonite fauna of 14 genera/subgenera and 4 species out of which 3 species are the first reported from the Mecsek Mountains. The fauna is rich and diverse, although poorly preserved,

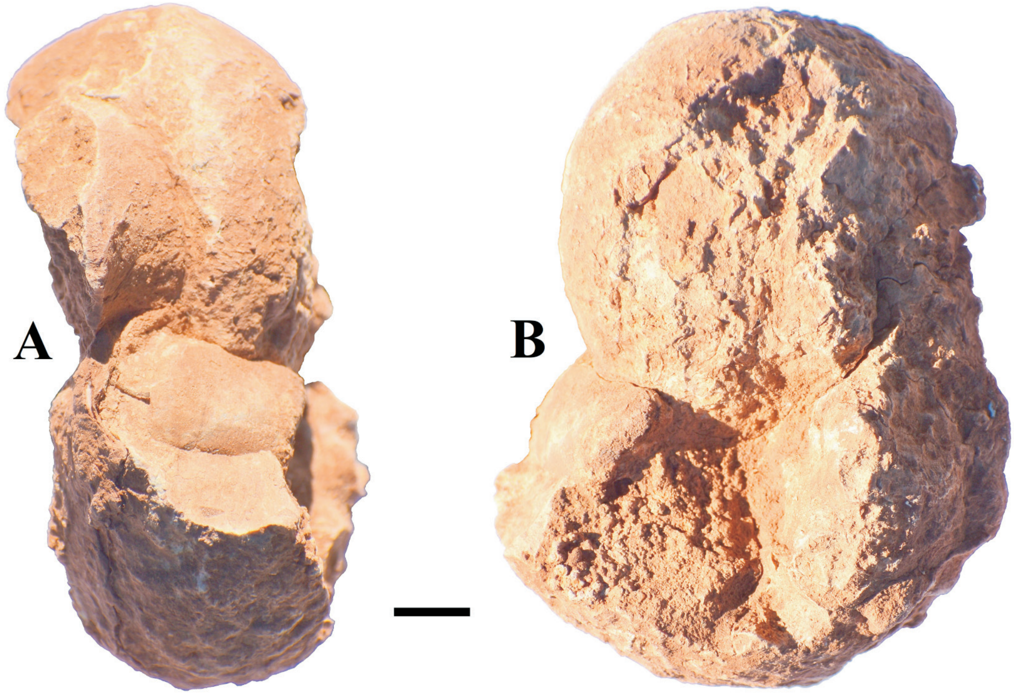

Fig. 5A, B. Aspidoceratid ammonite (specimen no. J 2020.644.1a) preserved with an aptychus (*Laevaptychus* sp.) in its body chamber

Based on the similar sizes of the aptychus and whorl height and width of the ammonite conch, and the fact that laevaptychi is characteristic for aspidoceratine ammonites, the aptychus and the shell most probably may have belonged to the same individual

Fig. 6. Tiny aspidoceratid-like juvenile ammonites preserved in ammonite body chamber of an aspidoceratid ammonite (specimen no. J 2020.9.1)

Note the well-preserved status of the ammonites. Scale bars indicate 1 cm with the dominant presence of phyllo- and lytoceratid ammonites (55%) and aspidoceratids (30%). This faunal composition is explained on one hand by the palaeogeographical position of the Tisza microcontinent in that time: it was still close to the southern continental margin of stable Europe, where the bathypelagic phyllo- and lytoceratids were present; on the other hand, the shallower benthic faunal elements of NW European origin have been transported from neighboring shallower and/or uplifted blocks into the deeper basin. The close vicinity of the northern Tethyan shelfal regions is not plausible: the planktonic *Globuligerina* specimens are extremely rare. The basinal environment was well oxygenated and nutrient-rich proven by deep water brachiopods of Tethyan origin (*Nucleata bouei, Pygope catulloi*), and some benthic foraminifera (*Lenticulina*, *Spirillina*), however, from the shallow marine settings brachiopods and polychaete remains (*Spiraserpula spirolinites*) inside ammonite shells were also transported. Its microfacies is typical *Saccocoma* microfacies. The latest Oxfordian–earliest Kimmeridgian ammonite fauna described herein records a rich, ecologically interesting environment. Further research on the Late Jurassic faunas of the Mecsek Mountains will definitely bring more interesting results that may elucidate the Late Jurassic evolution of the Tisza microplate.

SYSTEMATIC PALAEONTOLOGY

MATERIALS AND METHODS

Conventions. Fm: formation; *Ammonites*, D: diameter of the conch; Wb: width of the conch; Wh: height of the last whorl; U: diameter of the umbilicus; n.d.: no data due to the fragmentary status or poor preservation of the specimen; N/2: number of main ribs on the last half whorl; m: microconch; M: macroconch. *Aptychi*, L: distance between the terminal point and the umbilicus projection; S: distance between the apex and the terminal point; L_{at}: distance between the terminal point and the point of maximum valve width; G: thickness of the valve; l: distance between the terminal point and the widest valve point projection (terms after Gąsiorowski, 1960 and Měchová *et al*., 2010). Dimensions are given in mm and were acquired by a manual caliper. Measurements in brackets refer to estimated data. Pictures were taken by a Nikon D3500 DSLR camera of the specimens in their natural conditions under direct sunlight. (Due to covid restrictions lab facilities are permanently inaccessible therefore pictures were taken in open air conditions).

Repository. The specimens described herein are prefixed as 'J' and deposited in the palaeontological collection of the Mining and Geological Survey of Hungary, Budapest (later abbreviated as MBFSz).

Subclass **Canalipalpata** Rouse and Fauchald, 1997

Order **Sabellida** Levinsen, 1883

Family **Serpulidae** Rafinesque, 1815

Subfamily **Serpulinae** Rafinesque, 1815

Genus *Spiraserpula* Regenhardt, 1961

Type species. *Spiraserpula spiraserpula* Regenhardt, 1961.

Spiraserpula spirolinites (Münster in Goldfuss, 1830)
(Pl. 2: 1, 2)

1831. *Serpula Spirolinites* Münster – Münster in Goldfuss, p. 229, pl. 68: 5a–c.

1996. *Serpula* (*Dorsoserpula*) *spirolinites* Münster in Goldfuss – Gerasimov *et al*., p. 50, pl. 6: 10a, b.

Material. Two specimens on the body chamber of a large-sized aspidoceratid specimen.

Dimensions.

Specimen	Siameter	Number of coils
J 2020.651.2	5.2 mm	4
J 2020.651.3	6.4 mm	5

Description. Small sized, tightly coiled, planispiral structures on surface of the body chamber of an internal mould of a large sized aspidoceratid specimen. Spirals are situated on the lower flank of the ammonite, slightly over the umbilical shoulder, on one side of the internal mould. Aperture not preserved. Diameter of the spiral continuously increases toward the aperture. Number of coils are 4 and 5; diameter of the spirals is 5.2 and 6.4 mm.

Remarks. This species was originally described as individual spirals attached to an ammonite shell. The present specimens are also attached to an ammonite; however, the preservation is different. The collected specimens are internal moulds, the original aragonitic shell having been dissolved therefore leaving the negative imprints of the tubes preserved here. Specimen J 2020.651.2 is smaller, but preserved better and it is most similar to the specimen of Münster (pl. 68. fig. 5a, upper left specimen without the meandering continuation). The spiral structures herein are close to the holotype in the number of spirals, densely packed coils and diameter; however, the meandering continuation is not present but this is not necessarily preserved in every cases.

Stratigraphic and geographic distribution. Callovian (Ippolitov, 2007) to Kimmeridgian – lower Tithonian of Central Russia (Gerasimov *et al*., 1996), Bavaria, Germany (Goldfuss, 1831), Switzerland (Tribolet, 1873), and herein [uppermost Oxfordian to Kimmeridgian of the Mecsek Mountains, Hungary].

Subclass **Ammonoidea** Zittel, 1884

Order **Ammonitida** Fischer, 1882

Suborder **Phylloceratina** Arkell, 1950

Family **Phylloceratidae** Zittel, 1884

Subfamily **Phylloceratinae** Zittel, 1884

Genus *Phylloceras* Suess, 1865

Type species. *Ammonites heterophyllus* Sowerby, 1819.

Phylloceras div. sp.
(Pl. 3: 1, 2)

Material. 31 deformed, dissolved, sometimes corroded and fragmentary, poorly preserved specimens (J 2020.8.1, 38.1, 40.1, 41.1, 46.1, 47.1, 68.1–70.1, 75.1, 76.1, 81.1, 85.1, 636.1, 642.1, 654.1, 657.1, 659.1, 660.1, 666.1, 672.1, 681.1, 686.1, 687.1, 704.1, 718.1, 722.1, 723.1, 727.1, 728.1, 734.1).

Remarks. These specimens may represent different species (*Ph. ardechicum* Munier-Chalmas, *Ph. plicatum* Neumayr, *Ph. praeposterium* Fontannes), however their poor preservation and sometimes deformed umbilical region (U/D between 0.07–0.21) did not allow specific assignments.

Subfamily **Calliphylloceratinae** Spath, 1927

Genus *Holcophylloceras* Spath, 1927

Type species. *Phylloceras mediterraneum* Neumayr, 1871.

Holcophylloceras div. sp.
(Pl. 3: 3, 4)

Material. Three, poorly preserved, fragmentary internal moulds (J 2020.2.1, 7.1, 52.1).

Remarks. These specimens show some resemblance towards *Holcophylloceras mediterraneum* (Neumayr, 1871) and *H. polyolcum* (Benecke, 1866) however their corroded, distorted and dissolved status did not allow specific assignments or the acquisition of dimensions.

Genus *Sowerbyceras* Parona and Bonarelli, 1895

Type species. *Ammonites tortisulcatus* d'Orbigny, 1840.

Sowerbyceras sp.
(Pl. 3: 5, 6)

Material. One moderately preserved internal mould.

Dimensions.

Specimen	D	Wb	Wh	U	Wb/Wh	Wh/D	U/D
J 2020.6.1	64.8	27.0	(33)	(12)	0.818	0.509	0.185

Description. Medium sized phragmocone conch. Umbilicus relatively wide, shallow, with rounded umbilical shoulder. Flanks convex, slightly inflated. Midflanks parallel, venter smooth, rounded. No sculpture preserved. One poorly preserved partial constriction preserved that cross the venter radially. Cross section rounded subtetragonal. Suture, aperture not seen.

Remarks. Due to the poor preservation the surface of the mould is dissolved and partly corroded, therefore on one hand the characteristic, regular constrictions are not preserved, but on the other hand, the relatively wide umbilicus, the wide cross section and an indication of the presence of a constriction are typical of *S. tortisulcatum* (d'Orbigny, 1840), however all these ambiguities did not allow definite specific assignment.

Suborder **Lytoceratina** Hyatt, 1889

Family **Lytoceratidae** Neumayr, 1875

Subfamily **Lytoceratinae** Neumayr, 1875

Genus *Lytoceras* Suess, 1865

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

Lytoceras div. sp.
(Pl. 3: 7–9)

Material. 71 poorly preserved, dissolved specimens (specimens J 2020.28.1, 32.1–35.1, 42.1, 58.1, 60.1.–66.1, 71.1, 74.1, 80.1, 82.1, 594.1.–624.1, 645–647.1, 649.1, 650.1, 652.1, 655.1, 656.1, 658.1, 661.1, 663.1, 667.1, 677.1, 679.1, 684.1, 703.1, 707.1, 711.1, 714.1–716.1, 732.1).

Remarks. These poorly preserved, dissolved specimens definitely represent macro- and microconch forms and probably represent different species (*e.g.*, *L. polyanchomenum* Gemmellaro, *L. orsinii* Gemmellaro and *L. adelae* d'Orbigny) however, *L. adelae* is the least probable because that species is continuously constricted as from 15 mm diameter (*cf.* Galácz, 1980, p. 50). *L. polyanchomenum* is slightly more evolute. According to Böckh (1881) the U/D of this species is 0.37, while Galácz (1994) reported a 0.42 U/D ratio. The U/D ratios of the present specimens range from 0.43 to 0.54. Despite the numerous specimens, the poor preservation neither allows specific assignments nor the acquisition of dimensions.

Suborder **Ammonitina** Hyatt, 1889

Superfamily **Haploceratoidea** Zittel, 1884

Family **Haploceratidae** Zittel, 1884

Genus *Lissoceras* Bayle, 1879

Type species. *Ammonites psilodiscus* Schloenbach, 1865.

Subgenus *Lissoceratoides* Spath, 1923

Type species. *Ammonites Erato* d'Orbigny, 1850.

Lissoceras (Lissoceratoides) erato (d'Orbigny, 1850)
(Pl. 4: 1, 2)

1850. *Ammonites Erato* – d'Orbigny, p. 531, pl. 201: 3, 4.

1875. *Ammonites Erato* d'Orbigny – Favre, p. 28, pl. 1: 15.

1900. *Haploceras Erato* d'Orbigny – Loriol, p. 39, pl. 3: 16.

1928. *Lissoceras erato* d'Orbigny – Maire, p. 50, pl. 3: 20–23.

1975. *Lissoceratoides erato* (d'Orbigny) – Renz *et al.*, p. 442, pl. 1: 9a, b.

1977. *Lissoceras (Lissoceratoides)* aff. *erato* (d'Orbigny) – Bourseau, p. 94, pl. 11: 4–6.

1994. *Lissoceratoides erato* (d'Orbigny) – Énay and Gauthier in Fischer, p. 173, pl. 74: 2a, b.

2011. *Lissoceratoides erato* (d'Orbigny) – Quereilhac and Guinot, pl. 5: 18.

2015. *Lissoceratoides erato* (d'Orbigny) – Cherif *et al.*, p. 376, pl. 1: 3.

Material. 10 poorly preserved, partly corroded, sometimes deformed internal moulds (J 2020.1.1, 37.1, 45.1, 73.1/A, 79.1, 629.1, 633.1, 638.1, 639.1, 683.1).

Dimensions. Due to the fragmentary status, corroded surface, lack of aperture and deformed status, dimensions not given.

Description. Discoidal, compressed phragmocone conch. Umbilicus relatively wide, shallow. Umbilical shoulder rounded, flanks parallel, unsculptured, venter rounded. Cross section compressed, high oval. Aperture, suture not seen.

Remarks. The typical representatives of this species are unsculptured and characterized by parallel flanks and a moderately wide umbilicus. The U/D ratio of Favre's specimen is 0.261. The average U/D of the present specimens is 0.269, which is in line with the previous observation (U/D of the holotype is 0.27, specimen no. 3548 J). Intraspecific variation of this species is expressed in the variation of the U/D ratio that varies between 0.23–0.34 (Maire, 1928, p. 50). The size distribution of the specimens assigned to this species varies on a large scale as from 18 mm (pyritized juvenile) to 118 mm (adult from limestone). Usually their diameters are below 6–8 cm. The present specimens are quite large. First record from the Mecsek Mountains.

Stratigraphic and geographic distribution. This species has a wide stratigraphic distribution from the Lower Oxfordian to the Tithonian in the Tethyan Realm (Mediterranean, Submediterranean and Indo-Malagasy provinces) and also the Andean Realm (Argentina).

Family **Oppeliidae** Douvillé, 1890

Subfamily **Glochiceratinae** Hyatt, 1900

Genus *Glochiceras* Hyatt, 1900

Type species. *Ammonites nimbatus* Oppel, 1863.

Subgenus *Coryceras* Ziegler, 1958

Type species. *Ammonites microdomus* Oppel, 1863.

Glochiceras (Coryceras) cf. *microdomum* (Oppel, 1863)
(Pl. 4: 3, 4)

1863. *Ammonites microdomus* Opp. – Oppel, p. 204, pl. 53: 5a–e.

1997. *Coryceras microdomum* (Oppel) – Schweigert and Callomon, p. 35. [in lit.]

2009. *Glochiceras microdomum* (Oppel) – Bonnot *et al.*, pl. 6: 6–12.

2010. *Glochiceras (Coryceras) microdomum* (Oppel) – Wierzbowski *et al.*, p. 60, fig. 4B.

2014. *Coryceras microdomum* (Oppel) – Jantschke, p. 217, pl. 2: 1.

2020. *Coryceras microdomus* (Oppel) – Jantschke and Schweigert, p. 98, pl. 2: 14–16.

Material. One poorly preserved internal mould.

Dimensions.

Specimen	D	Wb	Wh	U	Wb/Wh	Wh/D	U/D
J 2020.735.1	40.1	(8)	(16)	(13)	0.500	0.399	0.324

Description. Small sized phragmocone conch. Umbilicus comparatively wide, shallow. Umbilical wall short, umbilical shoulder rounded. Flanks parallel, ventral shoulders rounded. Cross section high, rounded quadrangular. Venter rounded, on the last quarter of last whorl fine crenulation preserved in the midsiphonal zone. Eight, fine denticles are placed in the midsiphonal plane on the apertural end of the specimen. Aperture, constriction, suture not seen.

Remarks. The present specimen is most similar to the specimen of Oppel (1863, pl. 53: 5a, b), the only difference is that the present specimen has even fainter crenulation on the mid-siphonal zone on the last quarter of whorl. The size, the coiling and the fine denticulation on the midsiphonal plane clearly refer to this species, although its fine lateral sculpture that consists of fine, prorsiradiate ribbing is not seen, which justifies the open assignment. First record from Hungary.

Stratigraphic and geographic distribution. Oppel (1863, p. 204) described it from the Bimammatum Zone. This is strengthened by recent records (Énay *et al*., 1962; Gygi, 1991; Bonnot *et al*., 2009; Wierzbowski *et al*., 2010; Jantschke, 2014). Recently Jantschke and Schweigert (2020) reported it from the Hypselum Zone. Wierzbowski and Matyja (2014, pl. 1: 14) described it also from the upper part of the Bifurcatus Zone therefore it occurs stratigraphically wider: from the Upper Oxfordian (Bifurcatus to Hypselum zones) to the lowermost Kimmeridgian (Bimmamatum Zone).

Subfamily **Ochetoceratinae** Spath, 1928

Genus *Trimarginites* Rollier, 1909

Type species. *Ammonites trimarginatus* Oppel, 1862.

Trimarginites cf. *trimarginatus* (Oppel, 1862) (Pl. 4: 5, 6)

1857. *Ammonites trimarginatus* n. sp. – Oppel, p. 687. [in lit.]
1862. *Ammonites trimarginatus* Opp. – Oppel, p. 159, pl. 50: 2a, b.
1961. *Trimarginites trimarginatus* (Oppel) – Christ, p. 286, pl. 16: 1.
1975. *Trimarginites* cf. *trimarginatus* (Oppel) – Renz *et al*., p. 442, pl. 1: 5; text-fig. 5c.
1977. *Trimarginites arolicus* (Oppel) – Ziegler, pl. 1: 5.
2000. *Trimarginites trimarginatus* (Oppel) – Gygi, p. 70, pl. 7: 4.
2009. *Trimarginites trimarginatus* (Oppel) – Bonnot *et al*., p. 404, pl. 6: 26, 27.
2014. *Trimarginites trimarginatus* (Oppel) – Jantschke, p. 218, pl. 2: 2.
2020. *Trimarginites trimarginatus* (Oppel) – Jantschke and Schweigert, p. 99, pl. 5: 8.

Material. Two poorly preserved whorl fragments of internal moulds.

Dimensions.

Specimen	D	Wb	Wh	U	Wb/Wh	Wh/D	U/D
J 2020.1.1	n.d.	13.7	(33)	(16)	0.415	n.d.	n.d.
J 2020.670.1	74.4	(14)	(38)	8.5	0.368	0.511	0.114

Description. Worn, corroded, dissolved whorl fragments that represent the body chamber. Conch strongly compressed, oxyconic in cross section. Umbilical region not preserved. Flanks smooth; from middle flank weak, short, rectiradiate ribs rise and disappear below the ventral shoulder. Four faint, low ribs visible on the last quarter whorl. Ventral shoulders bordered by narrow, steep carinae. On the midsiphonal plane a third, poorly preserved carina appears. Suture, aperture not seen.

Remarks. Although the specimens are poorly preserved, the presence of three carinae, the significant oxyconic cross section and the faint sculpture consisting of four radial low ribs on the last quarter whorl clearly refer to this species. The closest species is *T. arolicus* (Oppel). They differ in the width of the umbilicus (Renz *et al*., 1975 p. 442) and in the density of ribbing (Christ, 1961, p. 267). The present specimen is most similar to the specimen no. J25924 of Gygi (2000), both are corroded but the significant upper flank sculpture is the same. There is a superficial resemblance toward *T. eucharis* (d'Orbigny, 1850), but the latter is more compressed showing a more oxyconic cross section, plus its umbilical shoulder is rounded and it is reported from the early Oxfordian. The specimens are only partly preserved and corroded, but on the venter the three carinae are preserved. First record from Hungary.

Stratigraphic and geographic distribution. This species is reported from the Middle to Upper Oxfordian (?Plicatilis, Transversarium, and Bifurcatus zones) and the Lower Kimmeridgian (Bimammatum and Planula zones). Bimammatum Zone of the Submediterranean Province (Switzerland: Gygi, 2000; Swabian Alb, Germany: Jantschke, 2014; central Poland: Matyja, 1977; Wierzbowski *et al*., 2010) It is also reported from the southern margin of the Tethys (Morocco: Renz *et al*., 1975; Algeria: Sapunov, 1973).

Systematics of Perisphinctoidea follows Énay and Howarth (2019).

Superfamily **Perisphinctoidea** Steinmann, 1890

Family **Perisphinctidae** Steinmann, 1890

Subfamily **Perisphinctinae** Steinmann, 1890

Genus *Subdiscosphinctes* Malinowska, 1972

Type species. *Perisphinctes Kreutzi* Siemiradzki, 1891.

Subdiscosphinctes sp. ind. (Pl. 4: 7, 8)

Material. One fairly preserved internal mould.

Dimensions.

Specimen	D	Wb	Wh	U	Wb/Wh	Wh/D	U/D
J 2020.17.1	94.2	(18)	(32)	38.8	0.563	0.340	0.412

Description. Evolute, compressed phragmocone conch. Umbilicus wide, shallow. Umbilical wall short, vertical on inner, oblique on outer whorls. Umbilical shoulder rounded. Cross section high trapezoidal. Two whorls are seen. Flanks gently convex on early and parallel on outer whorl. Fine, narrow primary ribs rise at the umbilical wall, being gently bended forward on early and straight on the outer whorl. Primaries travel toward the upper flank radially and bi- or trifurcating on the upper flank at the height of 2/3 of the whorl height. Nature of bifurcation not seen. There are 74 secondary ribs per 30 primaries. Ribs cross midsiphonal line continuously with gentle sinus. Aperture, suture, constrictions not seen.

Remarks. Brochwicz-Lewiński (1975) considered *Subdiscosphinctes* a genus with stratigraphic distribution restricted to the Upper Oxfordian, from the Plicatilis to the Bifurcatus zones. A later interpretation (*cf.* Cecca and Savary, 2007) stretched its distribution up to the Lower Kimmeridgian Planula Zone. The present specimen represents one of the gently ribbed forms of the genus showing similarities toward *S. lucingae* and *S. mindowe*, however the poor preservation did not allow precise assignment.

Stratigraphic and geographic distribution. *Subdiscosphinctes* is reported from the Upper Oxfordian and Lower Kimmeridgian. Geographically it is reported from the Subboreal Province of the Boreal Realm and many places from the Tethyan Realm (Énay, Howarth, 2019).

Subfamily **Prososphinctinae** Głowniak, 2012

Genus *Wegelea* Gygi, 2000

Type species. *Perisphinctes gredingensis* Wegele, 1929.

?*Wegelea* sp.
(Pl. 5: 5–6)

Material. Two poorly preserved internal moulds (J 2020.631.1, 632.1).

Dimensions.

Specimen	D	Wb	Wh	U	Wb/Wh	Wh/D	U/D	N/2
J 2020.631.1	(51)	(13)	(20)	(20)	0.650	0.392	0.392	n.d.
J 2020.632.1	50.6	(10)	(18)	(17)	0.588	0.356	0.336	32

Description. Small sized, compressed phragmocone conch. Three whorls are seen. Coiling moderately evolute. Umbilicus shallow. Cross section high oval. No umbilical wall, umbilical shoulder rounded. Flanks convex, converging. Venter rounded. Gentle, densely placed primary ribs rise from the umbilical shoulder and travel till midflank, where regular bifurcation observed. No intercalatory or single ribs seen, bifurcation of primaries are strictly regular. Ribs cross the venter continuously. No midsiphonal line. Last half whorl distributes 64 secondaries crossing the venter, reflecting the regular bifurcation. Aperture, suture not seen.

Remarks. The number of ribs on the penultimate half whorl is 32. The cross section of these specimens cannot be compared to that of other specimens of this genus due to their flattened status and broken ventral region. The poor preservation of these specimens justifies the questioned assignment. Based on the cross section, coiling and fine ribbing the specimens are tentatively placed into this poorly known genus. Énay and Howarth (2019, p. 44) consider *Wegelea* as a junior synonym of *Larcheria* Tintant, 1960, however, the merging of these taxa enlarges the scope and stratigraphic distribution of *Larcheria*. The Hungarian material did not provide any further details to elucidate this debate.

Subfamily **Passendorferiinae** Meléndez, 1989

Passendorferiinae (?*Geyssantia*)
(Pl. 4: 9, 10)

Material. Two poorly preserved fragmentary specimens (J 2020.4.1, 5.1).

Dimensions. Due to the poor preservation, fragmentary status, corroded surface, dimensions not given.

Description. Small-sized, compressed phragmocone conch and partly body chamber. Umbilicus wide, shallow. Three whorls seen. Cross section rounded. Umbilical wall short, vertical on early and no umbilical wall on outer whorls. No ventral shoulder; venter rounded, flat. Strong, radial ribs appear on the umbilical shoulder and travel on midflank. Primaries bifurcate on the upper flank of the last whorl. Bifurcation of ribs on inner whorls not seen being covered by later whorls. Ribs cross the venter continuously being perpendicular to the midsiphonal plane. There are 30 ribs on the last whorl. One constriction per whorl present. Traces of midsiphonal line present. Aperture, suture not seen.

Remarks. This interesting form shows similarities towards certain genera of the Passendorferiinae (most probably *Geyssantia*); however, the poor preservation did not enable analysis of the development of the ribbing on the early whorls and number of ribs on the last whorl, which unfortunately did not enable generic assignment.

Family **Ataxioceratidae** Buckman, 1921

Subfamily **Ataxioceratinae** Buckman, 1921

Genus *Orthosphinctes* Schindewolf, 1925

Type species. *Ammonites Tiziani* Oppel, 1863.

?*Orthosphinctes* sp. A
(Pl. 5: 1, 2)

Material. One poorly preserved, disintegrated, and dissolved specimen from the top of a limestone bank (bed 2).

Dimensions.

Specimen	D	Wb	Wh	U	Wb/Wh	Wh/D	U/D
J 2020.57.1	116.2	31.7	37.0	(54)	0.857	0.318	0.465

Description. Large-sized phragmocone conch and partly body chamber. Coiling evolute, umbilicus wide, shallow. Umbilical wall short, vertical, flat. Umbilical shoulder rounded. Three whorls seen. Strong, slightly prorsiradiate primary ribs rise from the umbilical shoulder. Primaries bifurcate at midflank, constrictions thoroughly present on whorls, usually one per whorl. Cross section rounded trapezoidal. Aperture, suture not seen.

Remarks. The complicated systematic position of the type species of this genus is discussed by Kießling and Zeiss (1992) in detail. In the present specimen the number of primary ribs per half whorl varies between 18 to 24. The rib curve is not given due to the fragmentary status of the specimen and the consequent ambiguity in counting the primary ribs. Although the present specimen displays the important characters of this genus, the really poor preservation did not allow a definite generic assignment.

?*Orthosphinctes* sp. B
(Pl. 5: 3, 4)

Material. One fragmented, worn whorl fragment from limestone bed (specimen no. J 2020.29.1; Wh = 31 mm). Due to the fragmentary status, dimensions are not given.

Description. Half of an whorl fragment eroded that represents a body chamber. Umbilical wall short, corroded, umbilical shoulder rounded. At umbilical shoulder, strong prorsiradiate primary ribs rise and travel toward midflank, where trifurcate. There are 12 secondaries per 4 primary ribs. Venter not preserved. Cross section seems to be high oval. Ribs cross the venter continuously and perpendicularly to the midsiphonal line as seen on the imprint of the earlier whorl.

Remarks. It is difficult to recognize the species of this highly variable genus even having complete specimens. The present specimen shows also similarities toward *Ardescia* (*cf.* specimen 000305-7/1 of Schairer *et al*., 2003, fig. 10.9).

Stratigraphic and geographic distribution. *Orthosphinctes* is known from the Lower Kimmeridgian in the Tethys.

Family uncertain

Perisphinctoid ammonite sp. A
(Pl. 5: 7–9)

Material. One fragmented, disarticulated and partly dissolved, poorly preserved specimen.

Dimensions.

Specimen	D	Wb	Wh	U	Wb/Wh	Wh/D	U/D
J 2020.733.1	96.6	21.0	(27)	49.1	0.778	0.279	0.508

Description. Medium sized, compressed phragmocone conch without the inner whorls. Conch evolute, serpenticone, two whorls seen, other inner whorls lost. Umbilicus extremely wide, shallow. Cross section is high oval, flanks convex. No umbilical wall, umbilical shoulder rounded. Strong, radially placed primaries rise from the umbilical shoulder and travel toward midflank, where slightly above the midflank, bifurcate. Ribs cross the midsiphonal line continuously with a very gentle sinus. On inner whorl the outer whorl covers the bifurcation, only strong primaries are seen. On the last whorl, close to the apertural end, a strong triplicate rib appears on the umbilical shoulder. On the last half whorl 15 primaries and on the half penultimate half whorl 22 primaries are present. No constrictions. Aperture, suture not seen.

Remarks. Although the inner whorls are lost, there is internal evidence of many early whorls, a feature that is not frequently present in perisphinctids from this period. The strong evoluteness (U/D > 0,5) may also refer to certain genera of Passendorferiinae.

Perisphinctoid ammonite sp. B
(Pl. 5: 10–12)

Material. One poorly preserved internal mould from ammonitico rosso-type limestone bed.

Dimensions.

Specimen	D	Wb	Wh	U	Wb/Wh	Wh/D	U/D	N/2
J 2020.634.1	78.4	(23)	(22)	(36)	1.045	0.281	0.459	11

Description. Medium-sized phragmocone conch. Umbilicus wide, shallow. Cross section high oval. One and a half whorl seen. Umbilical wall short, oblique. From the umbilical wall, strong, high, radially placed primaries rise having triangular shape in cross section. Primaries bifurcate or sometimes trifurcate above the mid flank bending slightly forward. Ribs cross the venter continuously being perpendicular to the midsiphonal line. Primaries become less numerous on the last half whorl (11). There are around 25 primaries on the last whorl. Except for the ribbing no sculpture seen. Aperture, suture not seen.

Remarks. Unfortunately, the preservation of this exceedingly interesting specimen is very poor. The ventral area is dissolved or worn; therefore, strong ambiguity arises around its assignment. The strong, simple ribbing may refer to the transitional forms between *Passendorferia* and early *Praesi-*

moceras as Wierzbowski and Matyja (2014, pl. 6: 1) demonstrated on a specimen of the same age from Central Poland.

Superfamily **Aspidoceratoidea** Zittel, 1895

Recently Parent *et al.* (2020) proposed the raising of aspidoceratid ammonites to superfamily level. Their proposal is followed here.

Family **Aspidoceratidae** Zittel, 1895

Subfamily **Euaspidoceratinae** Spath, 1931

Genus *Euaspidoceras* Spath, 1931 [= *Neaspidoceras* Spath, 1931; *Arcaspidoceras* Jeannet, 1951; *Mirosphinctes* Schindewolf, 1926]

Type species. *Ammonites perarmatus* J. Sowerby, 1822.

Euaspidoceras cf. *radisense* (d'Orbigny, 1850) (Pl. 6: 1)

1850. *Ammonites Radisensis* – d'Orbigny, p. 536, pl. 203: 2, 3.

1981. *Ammonites radisense* d'Orbigny – Myczyński and Brochwicz-Lewiński, pl. 4: 2.

1994. *Euaspidoceras radisense* (d'Orbigny) – Hantzpergue in Fischer, p. 175, pl. 75: 8A, B.

2007. *Euaspidoceras* cf. *radisense* (d'Orbigny) – Cecca and Savary, p. 536: 12C.

2009. *Euaspidoceras radisense* (d'Orbigny) – Bonnot *et al.*, p. 406, pl. 7: 12.

2014. *Neaspidoceras radisense* (d'Orbigny) – Wierzbowski and Matyja, pl. 8: 1, 2.

Material. One poorly preserved, fragmented and distorted and partly dissolved specimen.

Dimensions.

Specimen	D	Wb	Wh	U	Wb/Wh	Wh/D	U/D
J 2020.78.1	(82)	(15)	(29)	(32)	0.517	0.354	0.390

Description. Midsized phragmocone conch of aspidoceratid coiling. Umbilicus wide, shallow. Cross section compressed, high oval. Umbilical shoulder rounded, low. At the umbilical shoulder fine, radially elongated fine tubercles rise. From tubercles fine, radially placed ribs rise. These fine ribs disappear on the upper flank. Flanks convex. Venter unsculptured, rounded, smooth. No midsiphonal line. Aperture, suture, constrictions not seen.

Remarks. The lectotype (MNHN.F.R03201) of d'Orbigny's species has 7 tubercles on the last quarter whorl and its U/D ratio is 0.392. The present specimen has also 7 tubercles on the last quarter whorl and its U/D ratio is practically the same (0.390). The poor preservation justifies the doubts in assignment; however, the present specimen shows faint, radial ribs rising from the periumbilical tubercles. *E. radisense* is very similar to *Pseudowaagenia tietzei* (Neumayr, 1873), but the latter has distinct tubercles on the umbilical shoulder, while the periumbilical tubercles of *E. radisense* are always elongated, as they are in the present case and its cross section is compressed. First record from Hungary.

Stratigraphic and geographic distribution. *E. radisense* was reported from the Upper Oxfordian of the Czorsztyn Formation (Pieniny Klippen Belt, Slovakia) by Aubrecht and Jamrichová (2009). It was also reported from the Bimammatum Zone of Poitou, and Île de Ré (France) (Bonnot *et al.*, 2009). Wierzbowski and Matyja (2014) reported it from the Hypselum Zone (former Bimammatum Zone [pars]) of Central Poland.

Subfamily **Aspidoceratinae** Zittel, 1895

Genus *Aspidoceras* Zittel, 1868

Type species. *Ammonites Rogoznicensis* Zejszner, 1846.

Aspidoceras div. sp. (Pl. 6: 4, 5, 8)

Material. 15 poorly preserved, corroded, dissolved, sometimes deformed specimens (J 2020.31.1, 36.1, 39.1, 48–50.1, 72.1, 640.1, 641.1, 653.1, 662.1, 665.1, 680.1, 682.1, 725.1).

Description. These heavily dissolved, corroded and sometimes distorted specimens demonstrate aspidoceratid coiling and compressed to depressed cross sections. Aperture, suture not seen, dimensions not acquired.

Remarks. These poorly preserved, various sized specimens represent different developmental phases of aspidoceratids, however only the aspidoceratid coiling and cross sections are the indication of this genus. All the other important features such as ribbing, umbilical region, and number of rows of tubercles are not seen, therefore specific assignments are not possible, but these specimens definitely represent different aspidoceratid taxa.

Aspidoceras cf. *binodum* (Oppel, 1863) (Pl. 6: 2, 3)

1863. *Ammonites binodus* Opp. – Oppel, p. 217.

1929. *Physodoceras binodum* Oppel – Wegele, p. 89 (183), pl. 11: 3.

1931. *Aspidoceras* cf. *binodum* (Oppel) – Spath, p. 637, pl. 119: 2a, b.

1962. *Aspidoceras binodum* (Oppel) – Wilczyński, p. 90, pl. 8: 3.

1966. *Physodoceras binodum* (Oppel) – Anđelković, p. 86, pl. 25: 1.

1973. *Aspidoceras binodum* Oppel – Preda, pl. 18: 3–5.

1985. *Aspidoceras binodum* (Oppel) – Checa, p. 54, pl. 1: 1. pl. 2: 2–5. text-fig. II.3.1. II.3.6.

1994. *Aspidoceras* cf. *binodum* (Oppel) – Wierzbowski, pl. 4: 10, 11.

1999. *Aspidoceras (Aspidoceras)* aff. *binodum* (Oppel) – Fatmi and Zeiss, p. 76, pl. 26: 2.

2010. *Aspidoceras binodum* (Oppel) – Wierzbowski *et al*., pl. 12: 3.

Material. Two poorly preserved, dissolved specimens.

Dimensions.

Specimen	D	Wb	Wh	U	Wb/Wh	Wh/D	U/D
J 2020.16.1	45.9	21.6	(18)	(11)	1.200	0.392	0.240
J 2020.15.1	53.1	(32)	(31)	(10)	1.032	0.584	0.188

Description. Compressed, small-sized phragmocone conch. Cross section depressed, wider than tall. Umbilicus small, shallow. Umbilical wall vertical, umbilical shoulder rounded. Flanks convex, venter rounded, flat. No sculpture preserved. Aperture, suture not seen.

Remarks. *Aspidoceras binodum* has a compressed cross section. Although the characteristic periumbilical and lateral rows of tubercles are not or only partly seen, this is possibly due to the poor preservation. However, based on the cross section and coiling the specimens are assigned to this species, but lack or poor presence of tubercles justifies the open assignment, however certain forms of this species do show weakly tuberculated stages. The present specimens are similar to the specimen ZI/50/46 of Wierzbowski *et al.* (2010) representing the poorly sculptured morphs of the species.

Stratigraphic and geographic distribution. *A. binodum* is known from the Kimmeridgian (from the Bimammatum Zone to the Acanthicum Zone). Geographically it has wide distribution in the western Tethys and adjacent territories in the Submediterranean Province, northern (Baluchistan), and southern Tethys (Madagascar).

Subfamily **Physodoceratinae** Schindewolf, 1925

Genus *Physodoceras* Hyatt, 1900

Type species. *Ammonites circumspinosus* Quenstedt, 1849.

Physodoceras sp. ex gr. *altenense–wolfi* (Pl. 6: 6, 7)

Material. Five poorly preserved, partly dissolved and fragmentary internal moulds (J 2020.13.1, 30.1, 43.1, 56.1, 77.1)

Description. Compressed phragmocone conchs. Umbilicus comparatively wide, deep. Umbilical wall high, vertical, smooth; umbilical shoulder gently rounded. One and a half whorl seen. Flanks parallel or slightly convex; inflated on early and parallel on later stage. Venter rounded, smooth. Cross section compressed to depressed, high oval. No sculpture preserved. Aperture, suture not seen, dimensions not acquired.

Remarks. *Ph. altenense* (d'Orbigny, 1850) and *Ph. wolfi* (Neumayr, 1873) are closely related species as discussed by Sarti (1993, p. 120). *Ph. altenense* has a narrower umbilicus and its U/D ratio varies between 0.19–0.23 while this is between 0.25–0.37 in *Ph. wolfi*. The U/D ratio of the present specimens varies between 0.17–0.25 overlapping the U/D ranges of both species partly due to the deformation and corrosion, therefore specific assignment to either of these species is dubious. Both species represent smooth, non-tuberculated morphs of the genus. The fine differences between these practically synchronous species are only observable on finely preserved material therefore specific assignment is not possible.

Stratigraphic and geographic distribution. Both species are reported from the Bimammatum Zone to the Herbichi Zone (*Ph. altenense*) or the Acanthicum Zone (*Ph. wolfi*) of the Lower Kimmeridgian. Both species are Tethyan taxa with wide distributions.

Aspidoceratoid ammonite sp. (Pl. 6: 9, 10)

Material. 29 poorly preserved, corroded and dissolved internal moulds (J 2020.3.1, 9–11.1, 14.1, 19.1, 22.1, 23.1, 25.1, 53–55.1, 625.1, 626.1, 630.1, 644.1, 648.1, 651.1/A, 664.1, 668.1, 671.1, 674.1, 675.1, 685.1, 688.1, 689.1, 706.1, 709.1, 717.1).

Description. Medium to large sized phragmocone conchs or partial body chambers. Cross section much inflated, globulous. Umbilicus small, deep, one whorl seen. Umbilical wall vertical, high. Umbilical shoulder rounded. Flanks convex, inflated. Cross section depressed oval. No ventral shoulder. Venter smooth, rounded. Aperture, suture not seen, dimensions not acquired.

Remarks. These specimens show certain similarities toward *Benetticeras benettii* Checa, 1985. The cross sections are similar; however, the latter is more evolute. Other similar species are *Ph. altenense* and *Ph. wolfi*, however these species have more compressed shells, and a shallower umbilicus with more whorls visible. Their stratigraphic distributions partly overlap each other, however *B. benettii* has a more limited stratigraphic distribution that is restricted to the Lower Kimmeridgian Planula and Platynota Zones (Checa, 1985, p. 133).

APTYCHI

Family **Lamellaptychidae** Měchová, Houša and Vašíček, 2008

Genus *Lamellaptychus* Trauth, 1927

Type species. *Trigonellites lamellosus* Parkinson, 1811.

Lamellaptychus sp. ind.
(Pl. 2: 3, 4)

Material. Nine variously preserved, partly fragmentary specimens (J 2020.20.1, 21.1, 690.1, 693.1–695.1, 697.1, 700.1, 736.1).

Description. Medium to large-sized valves of both sides in various preservations but all in fragmentary condition; only convex sides seen. Valves gently arched without distinct keel and without lateral depression. Ribs simple, weakly curved, gently packed along the symphysial margin or slightly converging longitudinally along the symphysial margin. Ribs in terminal area form a bundle of thin, closely spaced ribs placed along symphysial margin. No refraction or sigmoidal bending of ribs occurs.

Remarks. Width index (L_{at}/L) of the present specimens varies between 0.56 and 0.58, however the collected limited, fragmentary and poorly preserved material did not allow the differentiation of any species.

Stratigraphic and geographic distribution. *Lamellaptychus* has been reported from the Oxfordian to the Berriasian. Initially it was considered to be restricted to the Tithonian, later to the Kimmeridgian and Tithonian and considered to belong to the genus *Haploceras* (Renz, 1972, p. 614). The co-occurrence of haploceratid ammonites (*Lissoceratoides erato*) with specimens of this genus in our material confirms the observation that this genus should be associated with haploceratid ammonites. It had already been reported from the Tithonian of the Mecsek Mountains by Vadász (1935).

Family uncertain

Genus *Laevaptychus* Trauth, 1927

Type species. *Aptychus meneghinii* de Zigno, 1870.

Laevaptychus sp. ex gr. *hoplisus–obliquus*
(Pl. 2: 5–8)

Material. Seven variously preserved, sometimes dissolved and fragmentary left and right convex valves (J 2020.691.1, 699.1 and below).

Dimensions.

Specimen number	L	S	L_{at}	l	G	S/L
J 2020.692.1	48.6	38.2	38.9	(30)	(6)	0.79
J 2020.696.1	(47)	36.8	38.3	(31)	(7)	0.78
J 2020.698.1	(52)	45.0	44.7	(29)	7.2	0.86
J 2020.701.1	52.0	38.3	38.8	34.1	3.4	0.74
J 2020.702.1	45.9	38.6	36.7	28.2	4.0	0.84

Description. Small to medium sized, thick, robust, massive and large-sized valves. Only external (=convex) surfaces present that are wide, large and smooth with wide lateral-external edges. Ornamentation consists of fine constriction lines and pores that are settled according to the growth lines. Pores are settled closer to the ventral edge. Lateral-external surface high, smooth and inclined. Morphometric data of the specimens fall in the range indicated by Trauth (1931, p. 92) indicative to *L. hoplisus* (Spath, 1925). They show, therefore, similarities toward *L. hoplisus* (Spath, 1925) and *L. obliquus* (Quenstedt, 1849) however because the concave parts of the valves cannot be seen and the surfaces of the convex valves are corroded, specific determination is obscure.

Remarks. These species of *Laevaptychus* are associated with *Aspidoceras*. The assemblage contains a rich assemblage of aspidoceratid ammonites of various sizes, and this assemblage corresponds well to the recorded presence and sizes of laevaptychi (*cf.* Trauth, 1931, fig. B.9; Turculet; Grigore, 2006, pl. 2. fig. 5).

Stratigraphic and geographic distribution. The stratigraphic and geographic distribution of these aptychus form-species (*L. hoplisus* and *L. obliquus*) follow well the distribution of its supposed host animal, the aspidoceratid species. It is reported from the Kimmeridgian and Tithonian of the Tethys.

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- study conception and design, drafting of manuscript and critical revision: LB,
- acquisition, analysis and interpretation of data: LB, RA.

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PLATE 1

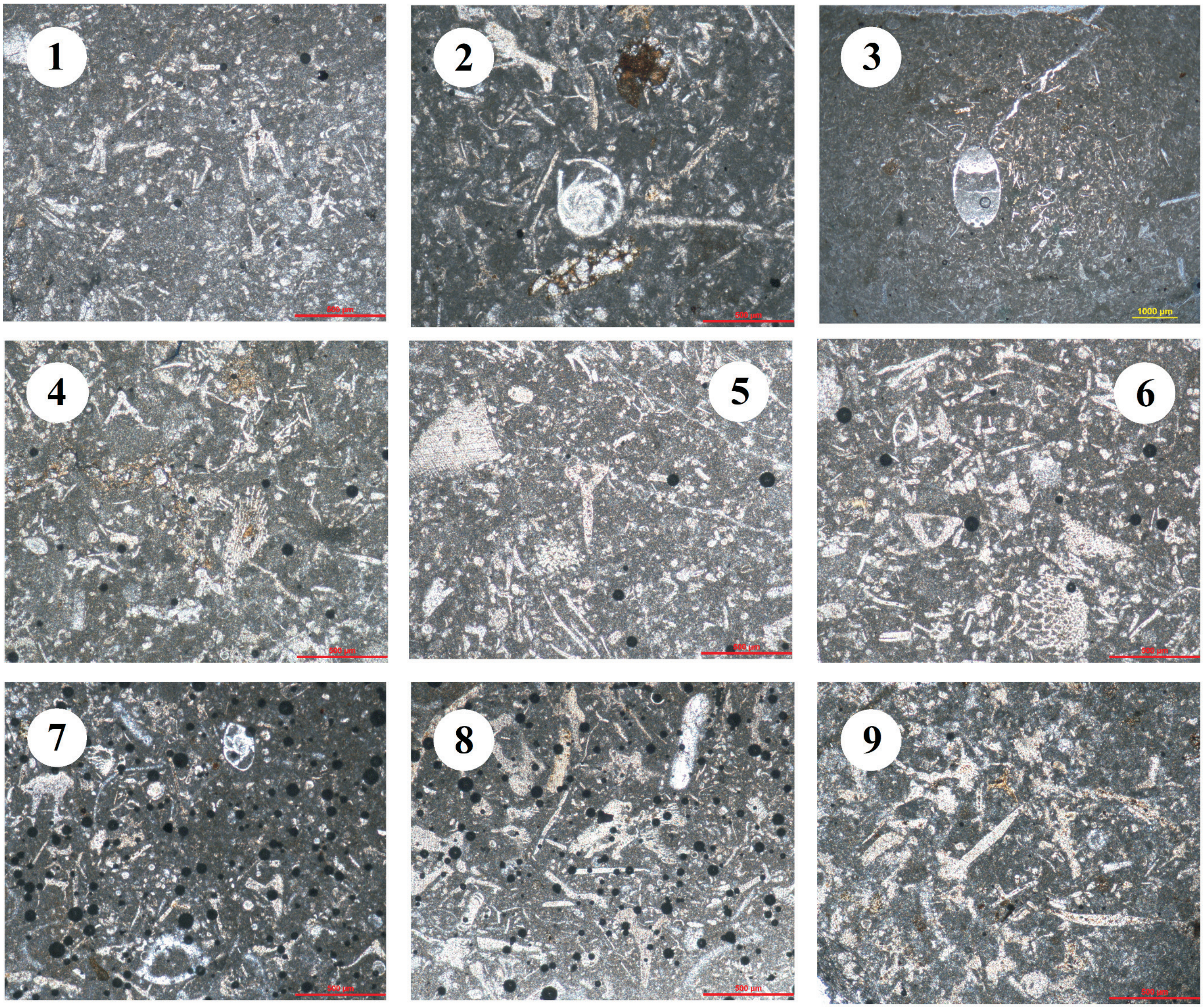
Microfacies and microfauna from the ammonitico rosso-type uppermost Oxfordian – lowermost Kimmeridgian red limestone bed at Zengővárkony (Mecsek Mountains, Hungary)

Figs. 1–3. Sampling point C (see text-Fig. 4), finely bedded red coloured ammonitico ross type limestone.
1. *Saccocoma* wackestone; 2. *Lenticulina* sp. in *Saccocoma* wackestone; 3. Section of small ammonite in *Saccocoma* wackestone with protoglobigerinid test fragment (*Globuligerina* sp.) and single bivalve valves

Figs. 4–6. Sampling point B (see text-Fig. 4), massive limestone bed.
4. *Saccocoma* wackestone; 5. *Saccocoma* wackestone with echinoderm particle; 6. *Saccocoma* packstone with foraminifera test fragment

Figs. 7–9. Sampling point A (see text-Fig. 4), massive limestone bed.
7.) *Saccocoma* wackestone with horizontal and vertical sections of *Lenticulina* sp.; 8. *Saccocoma* packstone with microsphaeric *Spirillina* sp.; 9. *Saccocoma* packstone

Scale bars indicate 0.5 mm except for Fig. 3, where it refers to 1 mm



László BUJTOR, Richárd ALBRECHT – Latest Oxfordian – earliest Kimmeridgian ammonite dominated fauna and microfacies from the ammonitico rosso-type Fonyászó Limestone Formation at Zengővárkony (Mecsek Mountains, Hungary)

PLATE 2

Annelids and aptychi from the ammonitico rosso-type uppermost Oxfordian – lowermost Kimmeridgian red limestone bed at Zengővárkony (Mecsek Mountains, Hungary)

Figs. 1, 2. *Spiraserpula spirolinites* Münster in Goldfuss, 1830.
1. Specimen J 2020.651.2; 2. Specimen J 2020.651.3

Figs. 3, 4. *Lamellaptychus* sp.
3. Left valve, convex side; specimen J 2020.690.1; 4. Left valve, convex side; specimen J 2020.690.1

Figs. 5–8. *Laevaptychus* sp. ex gr. *hoplisus-obliquus*.
5. Left valve, convex side; fossilized in the inner whorls of a *Lytoceras* sp.; specimen J 2020.700.1; 6. Left valve, convex side; specimen J 2020.701.1; 7. Left valve, convex side; specimen J 2020.702.1; 8. Left valve, convex side; specimen J 2020.692.1

Scale bars indicate 1 cm

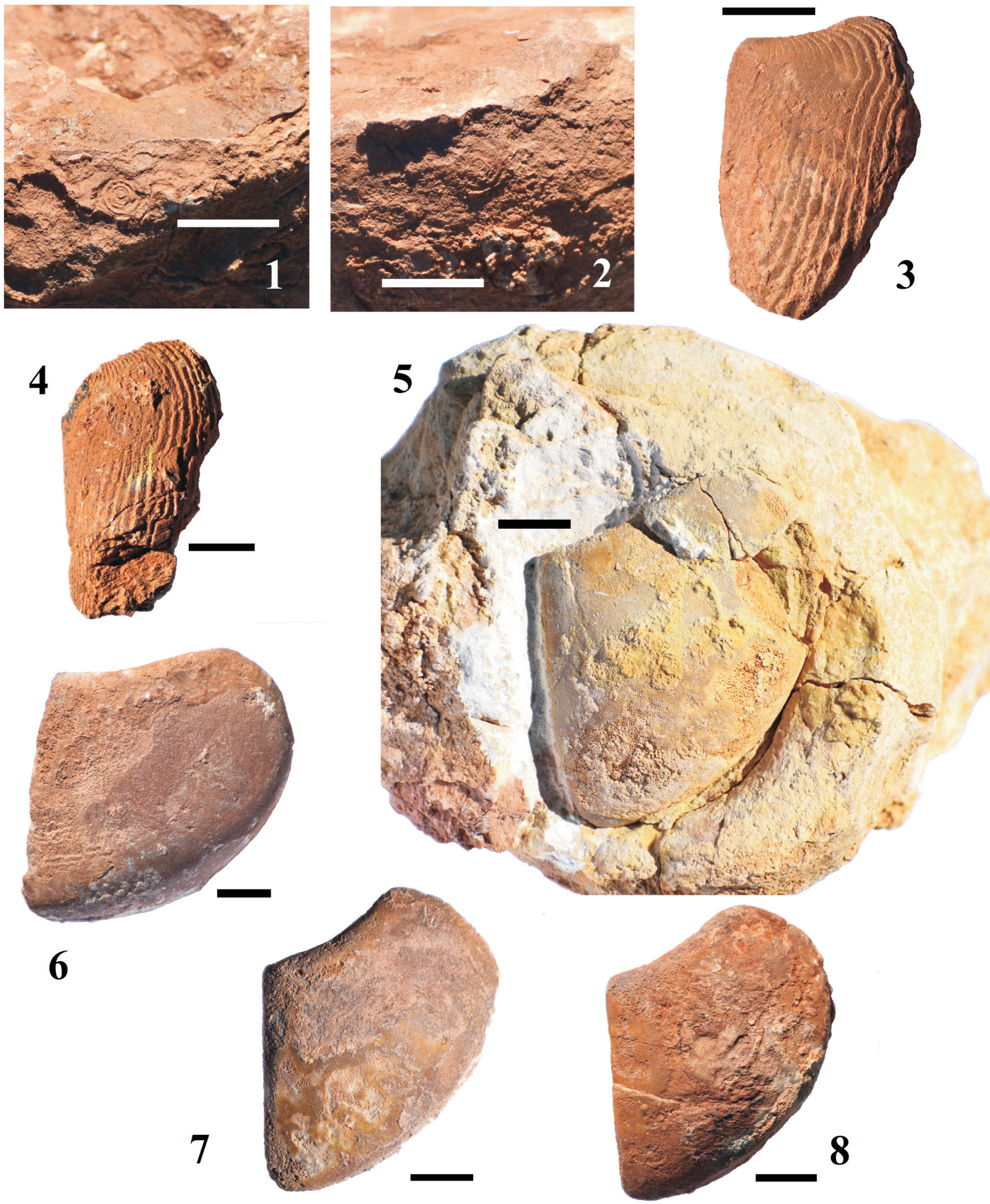

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PLATE 3

Phylloceratid and lytoceratid ammonites from the ammonitico rosso-type uppermost Oxfordian – lowermost Kimmeridgian red limestone bed at Zengővárkony (Mecsek Mountains, Hungary)

Figs. 1, 2. *Phylloceras* div. sp.
1. Specimen J 2020.8.1, lateral view; 2. Specimen J 2020.734.1, lateral view

Figs. 3, 4. *Holcophylloceras* div. sp.
3. Specimen J 2020.2.1, lateral view; 4. Specimen J 2020.52.1, lateral view

Figs. 5, 6. *Sowerbyceras* sp. specimen J 2020.6.1.
5. Lateral view; 6. Ventral view

Figs. 7–9. *Lytoceras* div. sp.
7. Specimen J 2020.612.1, lateral view; 8. Specimen J 2020.28.1, lateral view; 9. Specimen J 2020.74.1, apertural view

Scale bars indicate 1 cm

László BUJTOR, Richárd ALBRECHT – Latest Oxfordian – earliest Kimmeridgian ammonite dominated fauna and microfacies from the ammonitico rosso-type Fonyászó Limestone Formation at Zengővárkony (Mecsek Mountains, Hungary)

PLATE 4

Haploceratid, oppeliid and perisphinctid ammonites from the ammonitico rosso-type uppermost Oxfordian – lowermost Kimmeridgian red limestone bed at Zengővárkony (Mecsek Mountains, Hungary)

Figs. 1, 2. *Lissoceras* (*Lissoceratoides*) *erato* (d'Orbigny, 1850).
1. Lateral view; specimen J 2020.1.1; 2. Lateral view; specimen J 2020.45.1

Figs. 3, 4. *Glochiceras* (*Coryceras*) cf. *microdomum* (Oppel, 1863), specimen J 2020.735.1.
3. Lateral view; 4. Ventral view

Figs. 5, 6. *Trimarginites* cf. *trimarginatus* (Oppel, 1862), specimen J 2020.670.1.
5. Lateral view; 6. Ventral view

Figs. 7, 8. *Subdiscosphinctes* sp., specimen J 2020.17.1.
7. Lateral view; 8. Ventral view

Figs. 9, 10. Passendorferiinae sp. (?*Geyssantia*), specimen J 2020.8.1.
9. Lateral view; 10. Ventral view

Scale bars indicate 1 cm

László BUJTOR, Richárd ALBRECHT – Latest Oxfordian – earliest Kimmeridgian ammonite dominated fauna and microfacies from the ammonitico rosso-type Fonyászó Limestone Formation at Zengővárkony (Mecsek Mountains, Hungary)

PLATE 5

Ataxioceratid and perisphinctoid ammonites from the ammonitico rosso-type uppermost Oxfordian – lowermost Kimmeridgian red limestone bed at Zengővárkony (Mecsek Mountains, Hungary)

Fig. 1, 2. ?*Orthosphinctes* sp. A, specimen J 2020.57.1.
1. Lateral view; 2. Ventral view

Fig. 3, 4. ?*Orthosphinctes* sp. B, specimen J 2020.29.1.
3. Lateral view; 4. Cross section

Fig. 5, 6. ?*Wegelea* sp., specimen J 2020.632.1.
5. Lateral view; 6. Ventral view

Fig. 7–9. Perisphinctoid ammonite sp. A, specimen J 2020.733.1.
7. Apertural view; 8. Lateral view; 9. Ventral view

Fig. 10–12. Perisphinctoid ammonite sp. B, specimen J 2020.634.1.
10. Lateral view; 11. Ventral view; 12. Lateral view

Scale bars indicate 1 cm

László BUJTOR, Richárd ALBRECHT – Latest Oxfordian – earliest Kimmeridgian ammonite dominated fauna and microfacies from the ammonitico rosso-type Fonyászó Limestone Formation at Zengővárkony (Mecsek Mountains, Hungary)

PLATE 6

Aspidoceratoid ammonites from the ammonitico rosso-type uppermost Oxfordian – lowermost Kimmeridgian red limestone bed at Zengővárkony (Mecsek Mountains, Hungary)

Fig. 1. *Euaspidoceras* cf. *radisense* (d'Orbigny, 1850), specimen J 2020.78.1; lateral view

Fig. 2, 3. *Aspidoceras* cf. *binodum* (Oppel, 1863); specimen J 2020.16.1.
2. Lateral view; 3. Ventral view

Fig. 4, 5. *Aspidoceras* sp., specimen J 2020.72.1.
4. Lateral view; 5. Ventral view

Fig. 6, 7. *Physodoceras* sp. ex gr. *altenense-wolfi*, specimen J 2020.56.1.
6. Lateral view; 7. Apertural view

Fig. 8. *Aspidoceras* sp., specimen J 2020.30.1; lateral view

Fig. 9, 10. Aspidoceratid ammonite, specimen J 2020.706.1.
9. Lateral view; 10. Cross section

Scale bars indicate 1 cm.

László BUJTOR, Richárd ALBRECHT – Latest Oxfordian – earliest Kimmeridgian ammonite dominated fauna and microfacies from the ammonitico rosso-type Fonyászó Limestone Formation at Zengővárkony (Mecsek Mountains, Hungary)