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ENVIRONMENT, FAUNA AND PALEOGEOGRAPHIC IMPORTANCE OF THE BERRIASIAN LIMESTONES FROM THE VIGANTICE TECTONIC SLICE IN THE OUTER WESTERN CARPATHIANS

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Abstract: The limestones of the Vigantice tectonic slice represent one of the few preserved remnants of the sedimentary record of Mesozoic sedimentation in the Cetechovice Basin of the Outer Carpathians. The sequence of pelagic limestones contain calciturbidite intercalations with clastic material originating from the Silesian cordillera. The fauna of aptychi (*Punctaptychus punctatus punctatus, P. p. rectecostatus, P.* sp., *Lamellaptychus beyrichi beyrichi, L. submortilleti*) indicates a Berriasian age of the limestones. The association of calpionellids is typical of the *Calpionella* Zone.

Key words: Berriasian, Lower Cretaceous, Outer Carpathians, pelagic limestones, calciturbidites, calpionellids, calcareous dinoflagellates, aptychi.

Introduction

The Western Carpathians, which are part of the Alpine mountain zone, form the western section of the Carpathian mountain range, shifted far to the north between the Czech Massif and the Eastern European Platform. Tectonic shortening of the area between the Mediterranean Micro-continent and the Paleo-European Craton brought the products of sedimentary basins, originally separated by hundreds of kilometres into contact. The complex nappe structure of the resulting orogene, influenced and created by successive orogenic deformations, is the cause of a series of discussions about the mutual position of the nappe units, paleo-geographical zones and palinspastic reconstructions.

Maheľ (1986) divided the Outer Carpathians into the Beskydicum, Oravicum and Vahicum. These areas represented basin areas mutually separated by wide thresholds. Soták (1990) assumed that the Silesian "cordillera" dividing the Godula Basin of the Silesian area from the Magura (Cetechovice) Basin, was really a micro-continent about 100 km wide.

Olistolites and tectonic slices of Mesozoic sequences outcrop along the front of the flysch nappes. They are most frequently formed by Jurassic and Lower Cretaceous limestones, investigated and exploited in the past. These bodies, exposed today in already abandoned quarries, represent a precious source of information about the history of the development of the given area before the beginning of neo-Alpine flysch sedimentation.

Setting

A stripe of olistolites and tectonic slices (in older literature called the "Outer Klippen Belt") crops out in the area between Kyjov, Koryčany, Fryšták, and Valašské Meziříčí in Moravia. The locality of Vigantice is found on the left bank of the Měřístek Brook (a left tributary of the Hažovice Brook, 1000 m southwest of the village, cf. Fig. 1).

Thinly bedded grey-white, significantly tectonized marly limestone with occasional cherts occurs in two small abandoned quarries. The sequence of pelagic limestones contains sporadic intercalations of clastic limestones with a content of quartz grains (up to 2 mm in size), fragments of limestones (from 2 to 15 mm), scales to large slices some cm long of chlorites, sericites and graphite shale. The base of the more significantly turbiditic beds has the character of limestone breccia to conglomerate (size of clasts: up to 15 cm). Blocks of such rocks occur in the scree at the bottom of the quarry. Fragments of aptychi valves are concentrated at the base of the more distal turbidite layers. Occasionally they are also accompanied by fragments of belemnite rostra.

Several dozen incomplete valves of aptychi with the corroded most curved top parts of the valves, some fragments of belemnite rostra and one small rhyncholite were found, mostly in the scree at the main locality. At the second locality, only a single incomplete valve of an aptychus could be found.

In May 1993, samples for thin sections were collected from both localities. Samples Nos. 1 to 7 were collected from the southern wall of the first locality (proceeding from west to east), and samples Nos. 10 to 12 were from the west wall. Samples Nos. 8 and 9 were collected from erosive groove of the western outcrop. Thin sections were studied by Mrs. D. Reháková.

Previous research

Zahálka (1927) assumed that the limestones, then exploited for road gravel, form the base of the "Vigantice Nappe". Koutek (in Zahálka l.c.) supposed a Tithonian age for the locality, on the basis

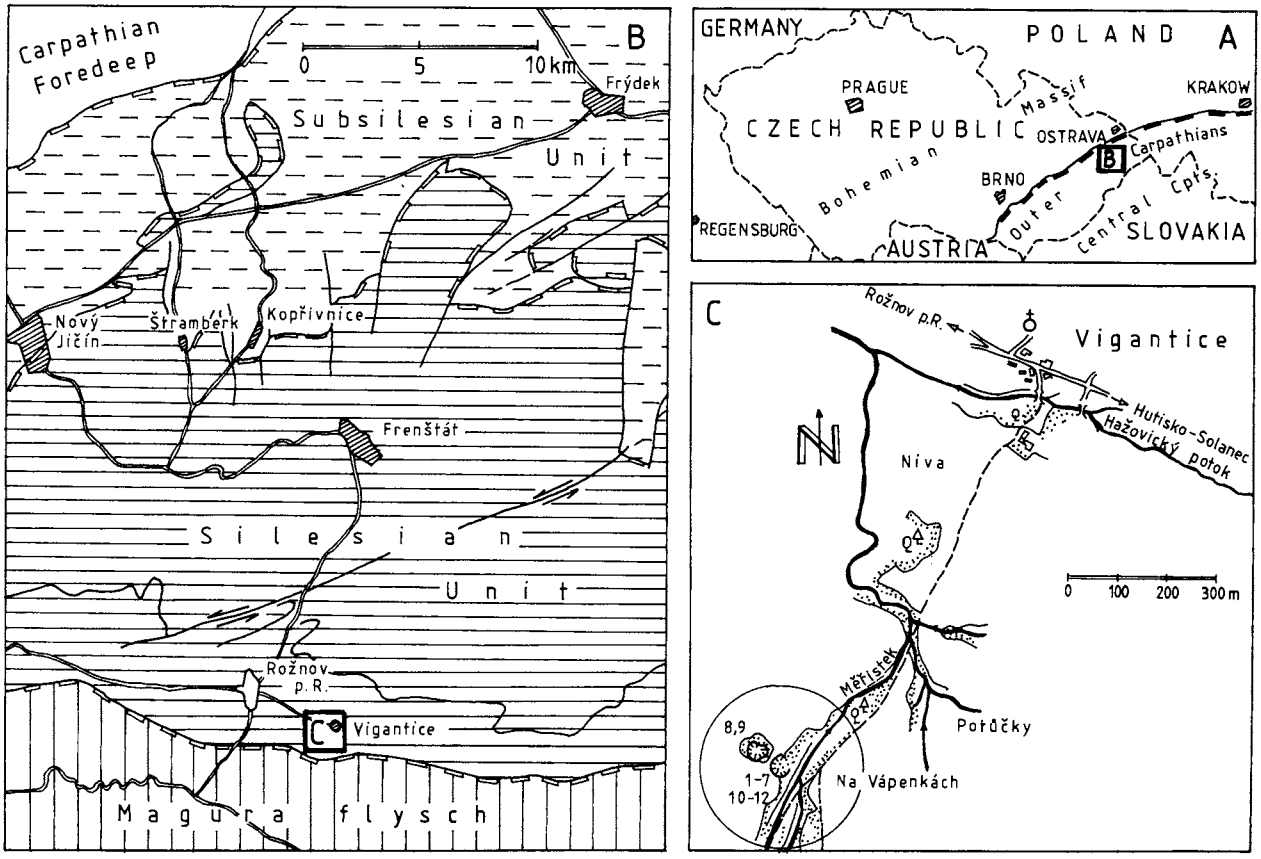


Fig. 1. A - Situation of the studied area within the Czech Republic; **B** - Geological sketch of the area of the Moravian- Silesian Beskydy Mts.; **C** - Topographic situation of the locality of Vigantice. The outline curve along the Měřístek stream indicates the wooded area, the numbers on the outcrops show the position of the samples collected for thin sections.

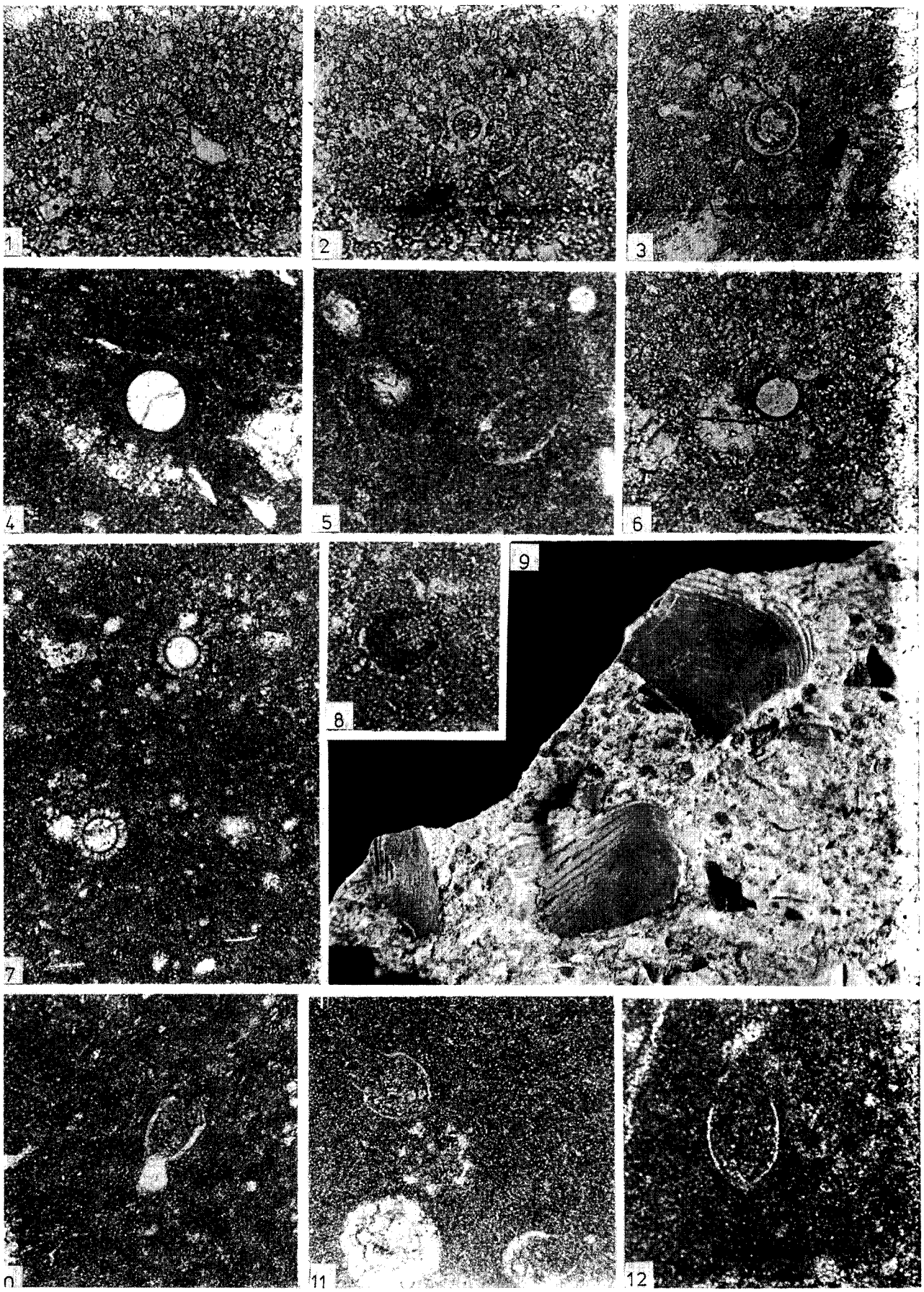
of the micro-fauna, represented by the species *Calpionella alpina*, and calcified radiolarians. Oppel (1930) mentioned the occurrence of *Lamellaptychus beyrichi* (Oppel), *Punctaptychus punctatus* (Voltz), belemnites and problematic sea urchin spines. In the context of later geological mapping, Matějka & Roth (1948) mentioned the locality. Andrusov (1959) and Roth et al. (1962) considered the body of limestone to be a tectonic slice at the base of the Magura Nappe. However, according to Pesl et al. (1972) and Menčík et al. (1983), it is an olistolite body on the boundary of the "sub-menilite" and Krosno Beds in the Silesian Nappe. Řehoř et al. (1978) concerned themselves with the fauna of the locality.

Microfacies

Six thin section (samples Nos. 1-5 and 10) from the main locality came from biomicritic and nannocone mudstones and biomicritic wackestones, usually penetrated by calcite veins. Rhombohedra of newly forming carbonate, fine scales of muscovite and silt quartz grains are present in the matrix. Calcified radiolarians (especially unclearly defined tests - "ghosts") are abundant, with numerous cross sections of *Nannoconus* sp. in places. Fragments of valves of ostracods, aptychi etc. also occur. They are accompanied the following association of microorganisms (Pl. I): *Calpionella alpina* Lorenz, *Calpionella minuta* Houša, *Tintinopsella carpathica* (Murgeanu & Filipescu), *Lorenziella hungarica* Knauer, *Remaniella ferasini* Catallano, *Cadosina fusca fusca* Wanner, *Crassicollaria parvula* Remane, *Colomisphaera vogleri* (Borza), *Stomiosphaera echinata* Nowak, *St. wanneri* Borza, *Schizosphaerella minutissima* (Colom) and *Globochaete alpina* Lombard.

The micro-breccia and breccia limestones (samples Nos. 6 and 11 from the easternmost outcrop) contain clasts of Tithonian-Berriasian sediments. Among them, it is possible to distinguish lower Tithonian biomicritic wackestone with *Parastomiosphaera malmica* (Borza), upper Tithonian wackestone with *Crassicollaria colomi* Doben and isolated individuals of elongated *Calpionella alpina*, as well as Berriasian calpionellid-radiolarian packstone with numerous and well preserved tests of radiolarians, with *Calpionella alpina*, *Tintinnopsella carpathica* and *Crassicollaria parvula* (Pl. I).

Plate I: Microfossils of the Vigantice Limestone. **Fig. 1** - *Colomisphaera carpathica* (Borza), thin section 8; ×265. **Fig. 2** - *Stomiosphaera wanneri* Borza, thin section 8; ×265. **Fig. 3** - *Parastomiosphaera malmica* (Borza), thin section 6; ×265. **Fig. 4** - *Cadosina fusca fusca* Wanner, thin section 8; ×265. **Fig. 5** - *Tintinnopsella carpathica* (Murg. & Filip) and *Cadosina semiradiata olzae* Nowak, thin section 10; ×265. **Fig. 6** - *Colomisphaera vogleri* (Borza), thin section 5; ×265. **Fig. 7** - *Schizosphaerella minutissima* (Colom), thin section 11; ×265. **Fig. 8** - *Cadosina semiradiata olzae* Nowak, thin section 10; ×265. **Fig. 9** - Brecciated limestone with fragments of valves of *Punctaptychus* sp. sample 11; ×1.8. **Fig. 10** - *Crassicollaria parvula* Remane, thin section 1; ×265. **Fig. 11** - *Calpionella alpina* Lorenz and calcified tests of radiolarians, thin section 4; ×265. **Fig. 12** - *Tintinnopsella carpathica* (Murgeanu & Filipescu), thin section 10; ×265.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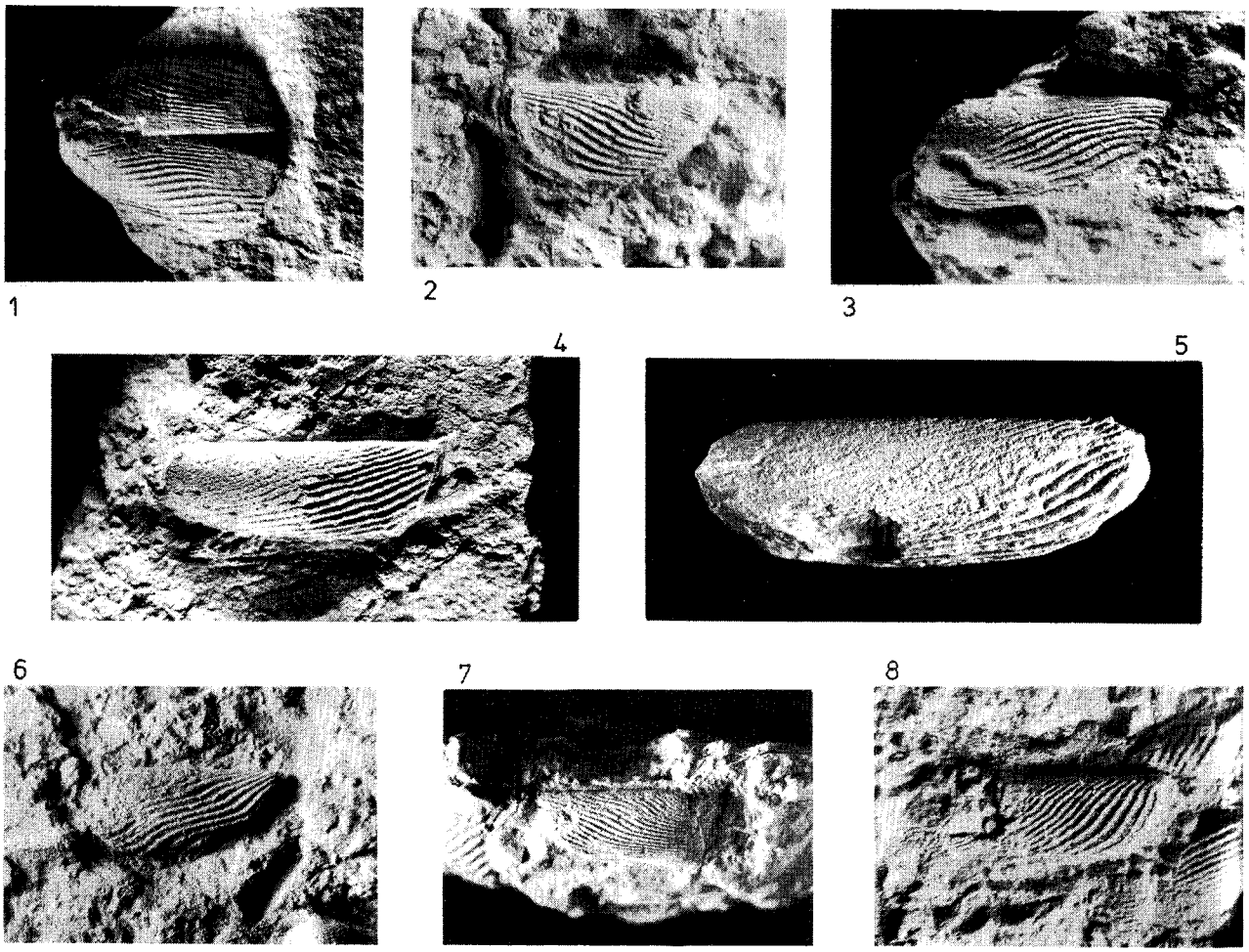

Plate II: Macrofauna of the Vigantice Limestone. **Figs. 1–3** - *Punctaptychus punctatus punctatus* (Voltz). 1 - example of an exceptional l_4 preserved complete pair of valves. The left valve has a corroded punctated layer, below it distinct lamellate ribs appear. Spec. Vig-2, ×2. 2 - valve with relict of a punctated layer, completely corroded in the umbonal area. Spec. Vig-3, ×3. 3 - usual type of corrosion of the punctated layer at the Vigantice locality. Spec. Vig-4, ×2. **Figs. 4, 5** - *Punctaptychus punctatus rectecostatus* Cuzzi. 4 - valve with beginnings of corrosion of the punctated layer. Spec. Vig-6, ×1.5. 5 - valve with moderately atypical movement of the end of the ribs close to the terminal edge. Spec. Vig-5, ×1.5. **Fig. 6** - *Punctaptychus* sp. Juvenile valve with remnants of the punctated surface on corroded top part. Spec. Vig-7, ×3. **Fig. 7** - *Lamellaptychus beyrichi beyrichi* (Oppel) Juvenile valve. Spec. Vig-9, ×3. **Fig. 8** - *Lamellaptychus submortilleti* Trauth. Incomplete juvenile valve. Spec. Vig-1, ×3. Photography: K. Mezihoráková, Ostrava University, All the valves were whitened with ammonium chloride before photography. The collected material will be deposited in the collections of the Administration of the Protected Landscape Area of the Beskydy at Rožnov pod Radhoštěm.

Samples Nos. 8 and 9 (collected in the western outcrop) are radiolarian wackestone with calcified cross sections of radiolarians, sponge spicules, fragments of ostracods, ophiuroids, etc. The matrix contains silt grains of quartz and scales of muscovite. The samples contain *Calpionella alpina*, *Tintinnopsella carpathica*, *Colomisphaera carpathica* (Borza), *Stomiosphaera wanneri*, *Cadosina fusca fusca* and *Nannoconus* sp.

Aptychi

Genus *Punctaptychus* Trauth 1927

Punctaptychus punctatus punctatus (Voltz 1837)
Pl. II, Figs. 1-3

1990 *Punctaptychus punctatus punctatus* (Voltz); Michalík et al., p. 77, Tab. 5, Fig. 1 (cum syn.)

Material: More than 30 valves of the most varied sizes, usually incomplete and isolated; only two of the valves are preserved in complete pairs.

Description: Thick-shalled valves with characteristic punctated sculpture in the area around the top. Lamellate ribs occur on the edge of the valves, where the punctated layer does not reach. The ribs are mainly simple and weakly bent. In the terminal (back) part of the valves, the ribs are joined into thicker bundles, and clearly run along the direct or so-called symphysal margin.

Distribution: According to our data from the Outer and Central Western Carpathians, supported by the joint occurrences with calpionellid microfauna (locality Strážovce: Michalík et al. 1990, Zrázy: Michalík et al. 1993, Kurovice etc.), *P. punctatus punctatus* occurs in a wide stratigraphic range from lower Tithonian to the boundary between the lower and middle Berriasian.

Punctaptychus punctatus rectecostatus Cuzzi 1962
Pl. II., Figs. 4, 5.

1990 *Punctaptychus rectecostatus* Cuzzi; Michalík et al., p. 78, Pl. 5, Fig. 2 (cum syn.)

Material: Five complete or almost complete valves and ten fragments.

Description: Valves with a fully developed punctated layer. The ribs have a straight course and are not gathered into bundles close to the symphysal margin.

Comments: A transitional continuum exists between the distinctly curved ribs of the typical subspecies *P. punctatus punctatus* and the straight ribs of the subspecies described here. It is therefore appropriate to consider the morphotype with straight ribs, as only a part of the species *P. punctatus* and not as an independent species, as Cuzzi (1962) did.

Distribution: According to the author, the subspecies started to occure around the boundary between the Middle and Late Jurassic. According to Michalík et al. (1990) *P. p. rectecostatus* may have exceptionally survived up to the middle of the Valanginian. However its occurrence usually ends in Lower Berriasian deposits. In the Western Carpathians, this subspecies is so far known only from the localities of Strážovce and Kurovice.

Punctaptychus sp. ind.
Pl. II, Fig. 6

Material: One incomplete valve partially flattened to the level of a bedding plane.

Description: Arched valve with shallow lateral depression emphasized by the curve of the ribs. The punctated layer is badly corroded in the not fully preserved area around the top. The lamellate ribs in the juvenile area go towards the symphysal margin under a sharp angle (around 30°), in further development, they gradually copy the outline of the valve.

Comments: No other form of the genus *Punctaptychus* which could have ribs with a similar course, is known to us. It could be a new morphotype, but to determine this, it is necessary to have further, better preserved specimens.

Genus *Lamellaptychus* Trauth 1927

Lamellaptychus beyrichi beyrichi (Oppel 1865)
Pl. II, Fig. 7

1990 *Lamellaptychus beyrichi beyrichi* (Oppel); Michalík et al. p. 80, Pl. 5, Fig. 8 (cum syn.)
1990 *Lamellaptychus submortilleti submortilleti* Trauth; Michalík et al. p. 88 Pl. 5, Fig. 9

Material: Five more complete valves usually not exceeding 7 mm in size.

Description: Plates moderately arched without distinct keel and lateral depression. The ribs are weakly curved, moderately gathering along the symphysal margin, as with *P. punctatus punctatus*.

Comments: The arched plates of *L. beyrichi* represent a transitional type to the species *L. studeri* (Ooster), which is identified by the presence of a keel and lateral depression.

Distribution: *L. beyrichi beyrichi* is known from the Kimmeridgian to lower Berriasian inclusive. In the Western Carpathians, it is especially abundant at the locality of Kurovice.

Lamellaptychus submortilleti Trauth 1938
Pl. II, Fig. 8

1938 *Lamellaptychus submortilleti* n. n. f.; Trauth p. 143, Pl. 10, Figs. 23-25.
1979 *Lamellaptychus submortilleti* Trauth; Kälin et al. p. 755, Fig. 11f, h, l, m, q-s.
1993 *Lamellaptychus submortilleti* Trauth; Michalík et al. Pl. 21, Fig. 5.

Material: A single small incomplete valve.

Description: A flat valve. Ribs, which continue subparallelly with the outline, change direction in the terminal part close to the symphysal margin, and run along it in a very short section before they cut it.

Distribution: In the Western Carpathians, the species was mentioned around the Tithonian-Berriasian boundary and in the Lower Berriasian part of the sequence at the localities of Zrázy, Nozdrovice and Kurovice. An occurrence at the locality of Strážovce is mentioned by mistake (see the synonymous *L. beyrichi beyrichi*).

Conclusion

Micro- and macro-biostratigraphy research on the locality, contributed to analogous stratigraphic conclusions. The associations of identified microfossils indicate the lower Berriasian *Calpionella* Zone, and the subzones "alpina" and "*Remaniella*". The uncertain occurrence of a single cross section of ?*Calpionella elliptica* in the micro-brecciated limestone of thin section No. 6, could point to a middle Berriasian age. The presence of *Stomiosphaera echinata* and *Cadosina semiradiata olzae* is perhaps a little unusual. They are more usual in associations of the higher - up lying *Calpionella (Calpionellopsis- Calpionellites- and Tintinnopsella-)* Zones.

The abundance of aptychi enables the identification of these rocks as aptychus limestone. The determined aptychus association, in which representatives of *Punctaptychus* dominate by 10 : 1 over the simple ribbed valves of *Lamellaptychus*, indicates only the Early Berriasian: while the first of the genus crosses over the Lower Berriasian boundary only exceptionally, the determined species of the second mentioned genus was not identified in the Upper as in the Lower Berriasian deposits of the Carpathians. Together with the aptychi, a juvenile rostrum of the belemnite *Pseudobelus* sp. juv. (Berriasian to Hauterivian) was also successfully determined. With regard to this fact, and moreover to the possibility of partial redeposition of the already fossilized aptychus associations, the age of the Vigantice limestones is therefore Early Cretaceous and not Late Jurassic as was thought (see the literature cited in the introduction).

The micro- and macro-fauna from the Vigantice limestones recall to a significant degree, the associations from the upper part of the Kurovice limestones at the locality of Kurovice near Otrokovice (front of the Rača Nappe, Vašíček & Reháková in press). Both lithotypes are also lithologically similar, in the colour and character of the limestones, and the occurrence of badly sorted detrital-conglomerate layers with abundant redeposited valves of aptychi. However the Vigantice limestones are distinguished by the presence of clasts of epizonal metamorphic crystalline rocks and quartz grains in psephite layers. These show that an actively uplifting ridge must have already existed, in the period around the Jurassic - Cretaceous boundary, close to the basin, and most probably in the area of the Silesian cordillera. This elevation, at least partly eroded down

to the crystalline basement, was the source area for the turbiditic layers in the pelagic limestones.

The present state of exposure and knowledge of the depositional relations of the Vigantice limestone body does not allow us to finally decide whether it is a tectonic slice from the thrust zone of the Rača Unit of the Magura Nappe or an olistolith in the Krosno Beds in the highest part of the stratigraphic sequence of the Silesian Unit. Although the occurrence of similar bodies of Mesozoic rocks in the Magura group of nappes is quite obvious the olistoliths in the Krosno Beds are a rather exceptional phenomenon. In either case, the Vigantice limestones are a foreign body in the Paleogene flysch complexes of the Outer Carpathians.

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