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PIENINIA OBLONGA — SKELETAL PARTS OR ENDOPARASITES OF KERATOSA SPONGES ?

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Abstract: The problematic bodies *Pieninia oblonga* Borza & Mišík common in Barremian to Upper Eocene shallow-water sediments were considered as algae, rudist fragments, echinoderm remains, or sclerites of Gorgonaceae. They were recently found inside the skeleton of sponges, probably Keratosa. The growth stages of these bodies are described. The question remains whether they are unusual sclerites or parasites. The way of their loosening from the skeletons was not observed.

Key words: Western Carpathians, Paleocene, biohermal limestones, *Pieninia* problematic bodies, Octocorallia, Keratosida, parasites.

Introduction

Problematic bodies named *Pieninia oblonga* were described by Borza & Mišík (1976) and considered to be of algal origin. Later they were found in many countries and various opinions concerning their systematic position were advanced (see in the following chapters). Surprising occurrences of *Pieninia oblonga* in skeletal parts of presumed sponges or hydrozoans (I received from E. Köhler the first thin sections of them) initiated this new study.

Pieninia oblonga Borza & Mišík 1976 (Pl. I–III)

+ 1976 *Pieninia oblonga* n.sp. Borza & Mišík: p. 65–77, Pl. 1–4
1976 "Forma indeterminata", Luperto Sinni: Pl. 58, Figs. 4–5.
1978 *Pieninia oblonga*, Knauer & Gellai: Pl. 4, Figs. 1–2.
1979 *Pieninia oblonga*, Mišík: p. 708, Pl. 8, Figs. 1–6.
1984 *Pieninia oblonga*, Bignot, Haas & Poignant: p. 437–438, Pl. I, Figs. 2–4.
1986 *Pieninia oblonga*, Granier: p. 103–108, Pl. I, Figs. a–t.
1986 *Pieninia oblonga*, Császár: p. 165, Pl. XX, Fig. 1.
1987 *Pieninia oblonga*, Granier: p. 51, Pl. 43, Figs. d–o.
1988 *Pieninia oblonga*, Granier: p. 61, Pl. 12, Figs. d–o.
1988 *Pieninia oblonga,* Řehánek: p. 255, Fig. 4.
1991 *Pieninia oblonga*, Mišík, Sýkora, Mock & Jablonský: p. 64, Pl. XVIII, Fig. 3.
1991 *Pieninia oblonga*, Schlagintweit: p. 28–29, Pl. 8, Figs. 1–5.

The bodies have the form of a biaxial ellipsoid with radial-fibrous structure consisting of calcite fibres diverging from a small central "canal". The surface is sometimes covered with small protuberances. According to the original description the length ranges from 0.100 mm to 0.450 mm.

Geographical distribution

Pieninia oblonga was quoted from Slovakia, Italy, Hungary, Croatia, Spain and Austria (that is from the Carpathian Mts., Dinaric Mts., Appenines, Betics and Eastern Alps). We also found it in Urgonian facies of Algeria, Constantine (Tellian Atlas).

Stratigraphical range

The stratigraphical range known up to now is: Barremian–Upper Eocene (Priabonian).

In the first paper (Borza & Mišík 1976) a Barremian–Thanetian range was supposed. Later, we found *Pieninia oblonga* in Ilerdian limestone containing *Discocyclina seunessi* and *Nummulites exilis*, as well as in Lower Eocene limestone with *Cuvillierina vallensis* (Mišík et al. 1991, p. 50, 64). Recently I observed it in Upper Eocene (Priabonian) limestone with *Chapmannina gassinesis,* locality Podbánske (Pl. I: Fig. D). Řehánek (1987) mentioned it without details from the Upper Jurassic; verification is needed.

In the Western Carpathians, it is most common in Barremian-Aptian, Senonian and Paleocene limestones.

Opinions about taxonomical appurtenance

The affinity of *Pieninia oblonga* to algae (probably Codiacae) was suggested in the first paper (Borza & Mišík 1976, p. 65). Mamet & Roux (1982, p. 962) stated that its kind of growth is strongly reminiscent of the genus *Nuia* (alga of uncertain taxonomic position). Bignot et al. (1984, p. 138) presumed that *P. oblonga* could correspond to cylindrical foliated

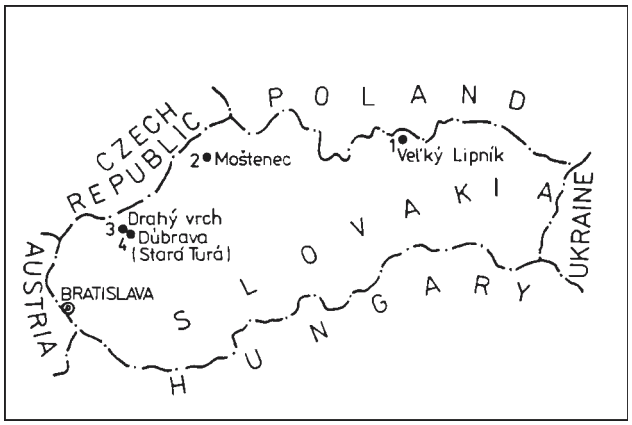


Fig. 1. Localities with *Pieninia oblonga* in sponge- or coelenterate skeletons.

expansions of Mollusca, more precisely of rudists; they considered that our occurrences in Paleocene limestones were redeposited. Schlagintweit (1991, p. 28) suggested they could pertain to echinoderms ("Echinodermnatur"). Radoičić (1983, p. 80) interpreted them as sclerites derived from Octocorallia, most probably Gorgonaceae. Granier (1986, p. 105) argued that *P. oblonga* belonged to calcareous skeleton particles (sclerites) of Alcyonaria, close to the recent genus *Eunice* (Gorgonaceae, Holaxonia).

Environment

P. oblonga occurs mainly in bioherms, in reefal and parareefal facies (Mišík 1979). According to Schlagintweit (1991, p. 28), it is typical of the reef or platform margin (facial zone 5 of Wilson). According to Granier (1986, p. 105), it is the most characteristic for the outer part of carbonate platforms, from the barrier to the talus where it can be redeposited into calciturbidites.

Frequency in the Western Carpathians

Barremian–Aptian. In limestones of Urgonian facies s.l. (Pl. I: Figs. A–C, I), usually only 1–2 specimens (maximum 6 specimens) in thin section (20×20 mm) can be found. The frequency of the *P. oblonga* in sets of thin sections was as follows: (a) In the pebbles of Urgonian limestones from the Albian conglomerates, Central Western Carpathians (Mišík et al. 1981, p. 32–33), it occurred in four thin sections from 53 (about 8 %). (b) In pebbles of Urgonian limestones from the Peri-Klippen zone (Mišík & Sýkora 1981, p. 37–44), it was found in 18 from 143 thin sections (about 13 %); it is most frequently found in limestones with orbitolinas — 12/83, with fragments of rudists 5/13. It was totally absent in the microfacies with miliolids — 0/9 which indicates that *Pieninia* belongs to the bioconstructing organisms. (c) In the pebbles of Urgonian limestones from the Strihovce conglomerates of Eocene age (Mišík et al. 1991, p. 30–33), it was present in two thin sections from 18 (about 10 %). (d) In the pebbles of Urgonian limestones from Proč conglomerates of Paleocene–Lower Eocene age (Mišík et al. 1991, p. 34–35), *P. oblonga* occurred in 5 thin sections from 42 (about 12 %). (e) From the outcrops of Urgonian Nižná limestone (Pieniny Klippen Belt, Mišík 1990, p. 44), it was found in two from 12 thin sections (about 17 %). It can be summarized that *P. oblonga* occurs in approximately 12 % of thin sections (with the surface about 400 mm^2) from the limestones with Urgonian facies.

Senonian. The frequency in sandy limestones from outcrops in the Brezovské Karpaty Mts. was 6/23, or nearly 26 %. *P. oblonga* was associated with fragments of bivalves (mostly rudists), orbitoids, coralline algae, echinoderm articles and bryozoans. In pebbles of Senonian limestones with rudists, its frequency from Eocene Strihovce conglomerates was 3/9 (about 33 %), but it was absent in limestones with *Pseudosiderolites vidali* 0/6 (Mišík et al. 1991, p. 35, 37).

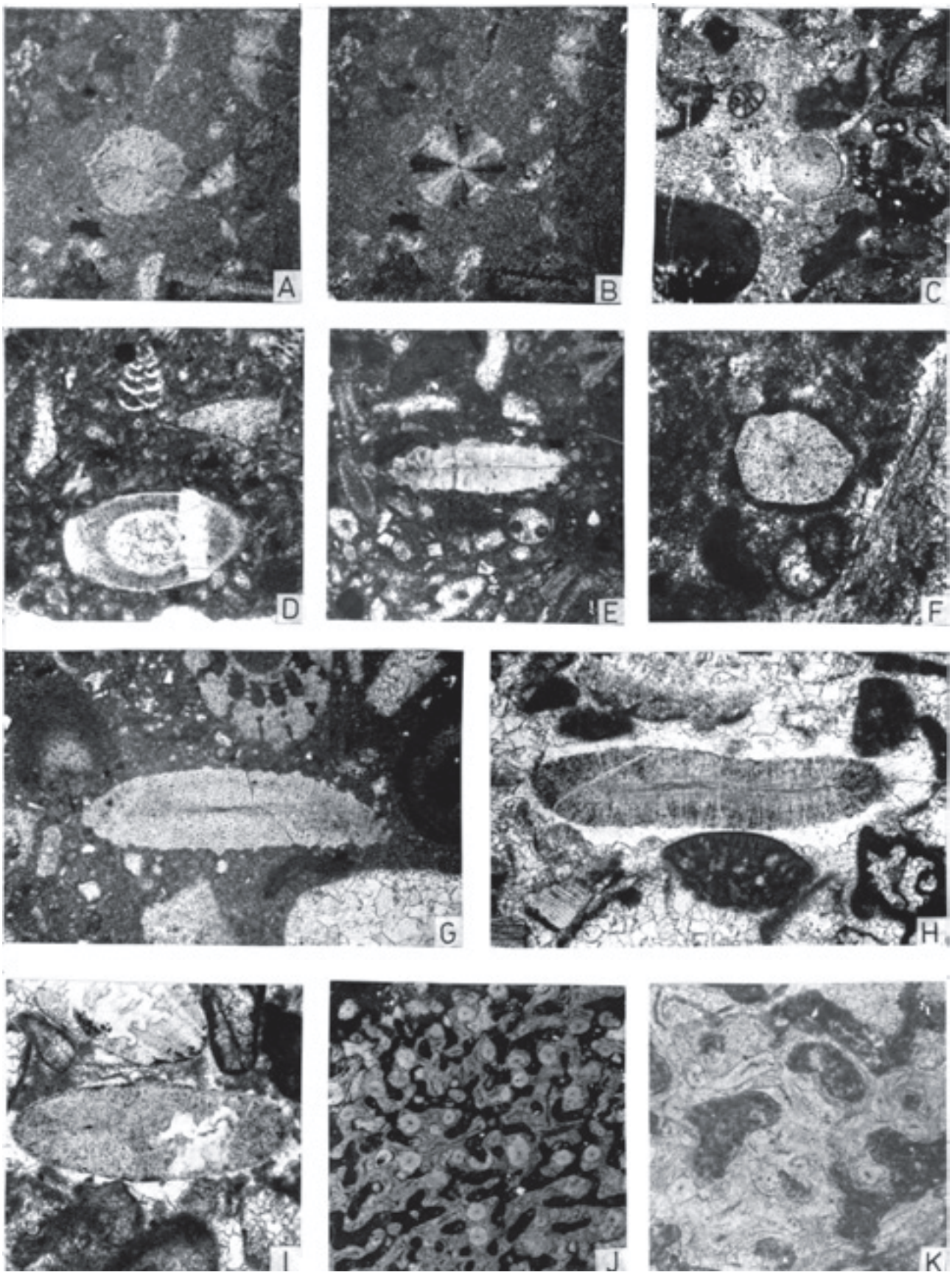
Paleocene. The frequency in the pebbles of Montian-Thanetian bioherm limestones (Kambühel Limestone) from Eocene Strihovce conglomerates (l.c., p. 30–40) was 1/13 (about 8 %); in the limestone pebbles of the same age from Paleocene–Lower Eocene Proč conglomerates, it was 2/12 (about 17 %) (Mišík et al. 1991, p. 48).

Single occurrences in the Ilerdian, Lutetian, Priabonian could not be quantified.

Paleocene limestones with *Pieninia oblonga* inside the bioclasts of probable Keratosa sponges

Formerly only loose specimens of *Pieninia oblonga* were known. We illustrate some of them in the Pl. I: Figs. A–I. In the 1992 we succeeded in finding *P. oblonga* inside fragments of supposed Coelenterata or Porifera (Pl. I: Figs. J, K; Pl. II: Figs. A–D; Pl. III: Figs. A–E) and asked several experts about their opinion. Helena Eliášová (State Geological Institute, Prague) supposed from the microphotographs that the fragments could

Plate I: *Pieninia oblonga* Borza & Mišík, occurrences of the isolated bodies in limestones. Fig. A — In the Urgonian facies (Upper Barremian–Lower Aptian), associated with corals and algae. Pebble from the Cenomanian conglomerates of the Manín Unit, Ovčiarsko near Žilina. Thin section No. 5150, ×55. **Fig. B** — The same in cross-polarized light. **Fig. C** — The same locality, thin section No. 6149, ×43. **Fig. D** — In the Upper Eocene (Priabonian) biohermal limestone. Podbánske. Thin section No. 14970, ×60. **Fig. E** — In the Paleocene Kambühel Limestone, Veľký Lipník. ×40. **Fig. F** — In the Aptian limestone. Pebble from the Paleocene Proč Conglomerate of the Pieniny Klippen Belt, Proč-d. Thin section No. 1110, ×136. **Fig. G** — In the *Orbitolina*-bearing limestone (Upper Barremian–Lower Aptian), cobble from the Cenomanian conglomerates, Manín Unit, Malé Hradisko pri Žiline. Thin section No. 6151, ×43. **Fig. H** — The same locality. Thin section No. 6154, ×43. **Fig. I** — Partly silicified specimen in the Urgonian facies with *Palorbitolina lenticularis* (Upper Barremian–Lower Aptian). Pebble from the Cenomanian conglomerates, Manín Unit, Hradná-JRD-d. Thin section No. 7116, ×43. **Fig. J** — *Pieninia oblonga* within the skeleton of Keratosa sponge or of Coelenterata. Paleocene biohermal Kambühel Limestone. Veľký Lipník, ×12. **Fig. K** — Juvenile stage of *Pieninia oblonga*, not well differentiated from the skeletal mass. The same locality, ×40.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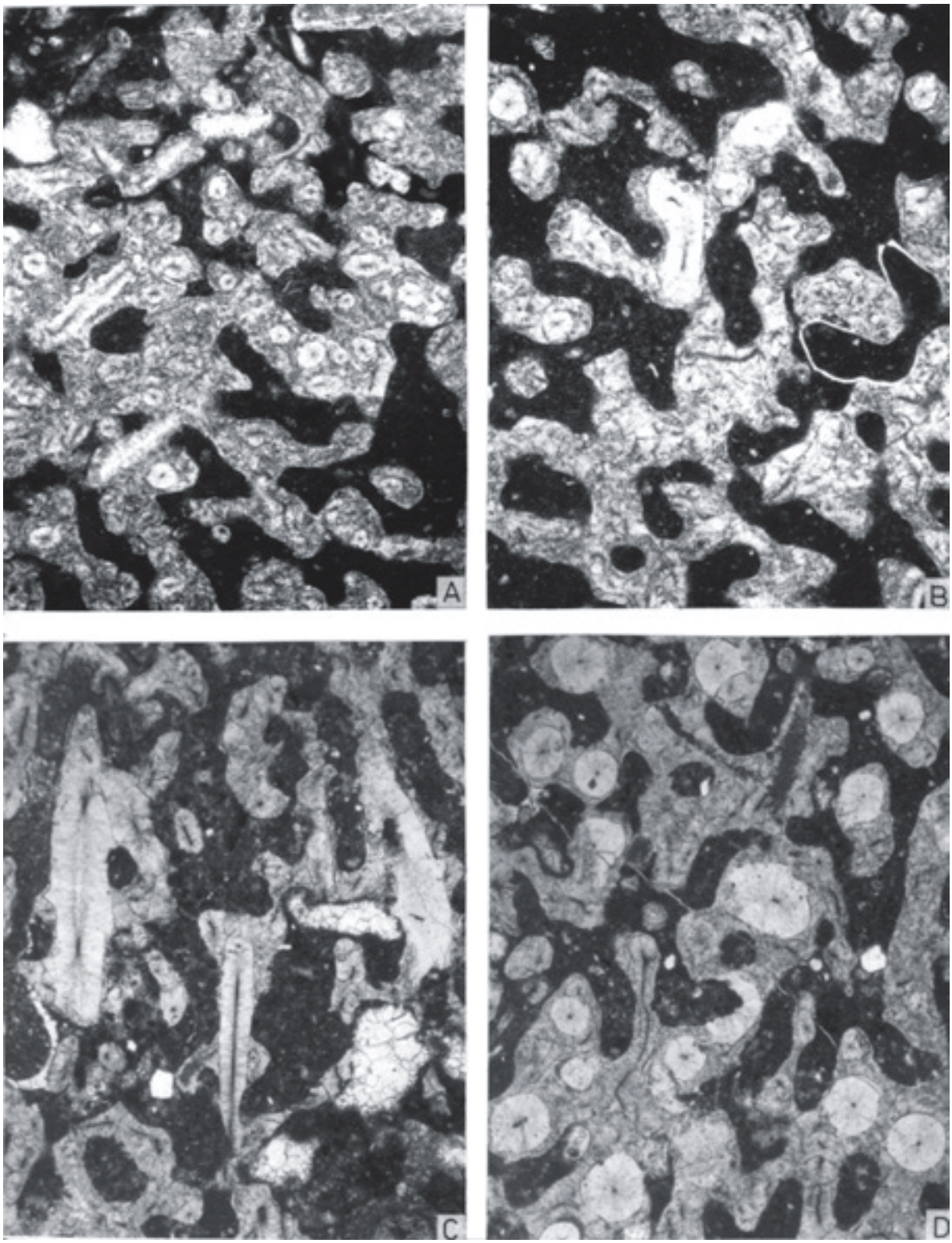

Plate II: ***Pieninia oblonga*** **Borza & Mišík in the skeleton of the sponge Keratosa or of a Coelenterata fragment.** Paleocene Kambühel biohermal limestone, Peri-Klippen zone. **Fig. A** — Settlement Dúbrava near Stará Turá. Thin section No. 22706, ×40. **Fig. B** — The same. **Fig. C** — Veľký Lipník, ×40. **Fig. D** — The same.

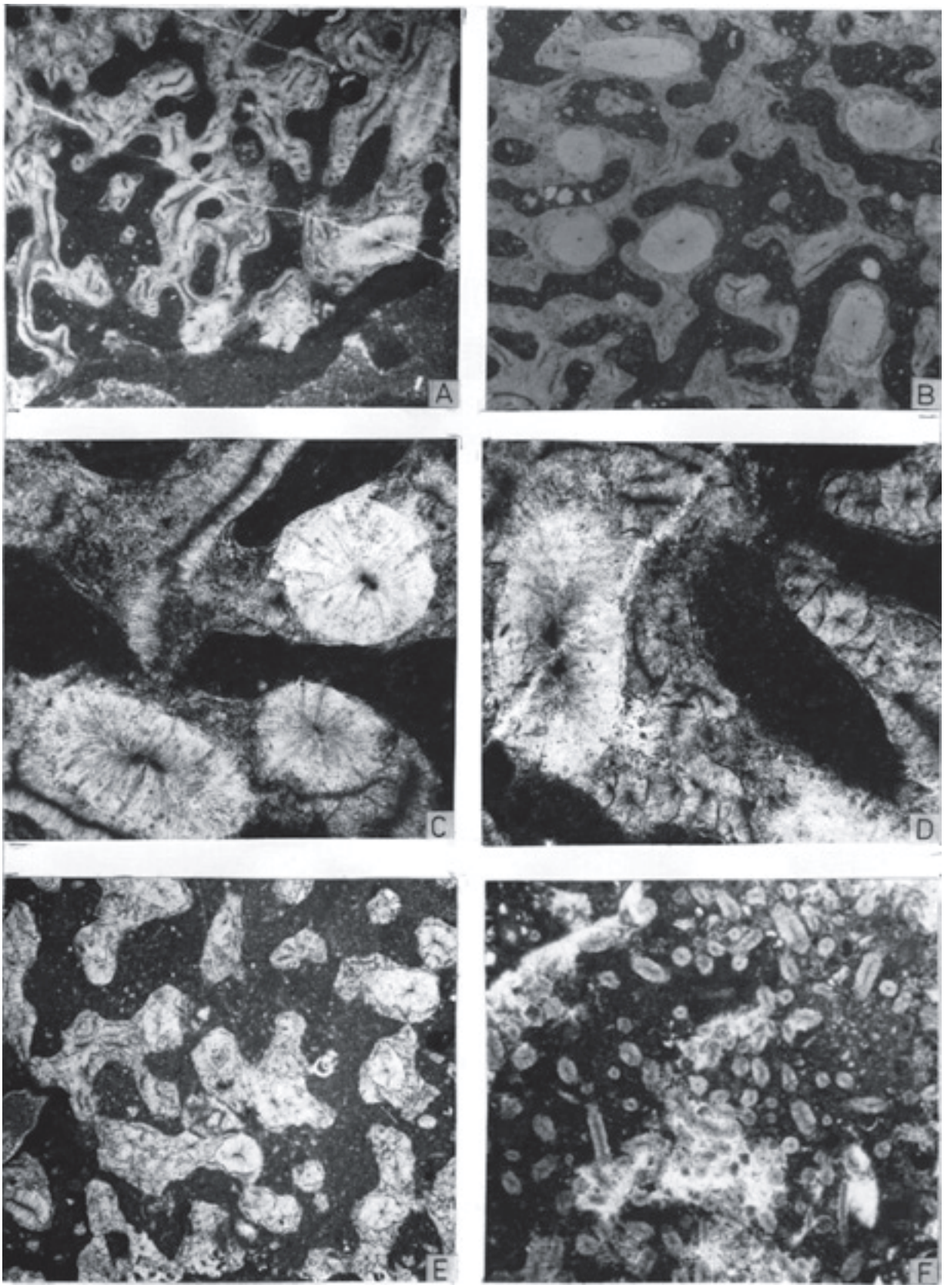

Plate III: ***Pieninia oblonga*** **Borza & Mišík in the skeleton of the sponge Keratosa of the Coelenterata bioclast.** Paleocene Kambühel biohermal limestone, Peri-Klippen zone. **Fig. A** — Moštenec, ×27. **Fig. B** — Veľký Lipník, ×30. **Fig. C** — Moštenec, ×86. **Fig. D** — The same.

belong to the corals Poritidae Gray or Actinacidae Vaughan et Wells, but their hydrozoan nature could not be excluded (letter 1992). Dragica Turnšek (Centre of Scientific Research of the Slovenian Academy of Sciences and Arts, Ljubljana) in the letter from 31. 3. 1992 deduced from the microphotographs that the fragments with *P. oblonga* could belong to some sponges; but parasites or algae are not excluded. Elzbieta Morycowa (Jagellonian University, Cracow) also did not exclude their parasitical nature (letter 1992). Joachim Reitner (Geol. Paleont. Institute, University Göttingen) considered the bioclasts with *Pieninia* as calcitized Keratosa which seems to be most likely.

The microfacies of these samples are as follow:

Boundstones to floatstones (wackestones) of cream colour; Paleocene age. Localities:

1. Veľký Lipník (Pl. II: Figs. C, D; Pl. III: Fig. B). Algae are dominating: *Lithophyllum* sp., *Lithothamnium* sp., *Amphiroa propria* (Lemoine), *Elianella elegans* (Pfender & Basse) = *Parachaetetes asvapatii* Pia, *Ethelia alba* (Pfender) = *Polystrata,* rare Dasycladales including *Acicularia* sp. Abundant sessile foraminifers: nubecularids, *Haddonia heissigi* Hagn, *Miniacina multicamerata* Scheibner, *Bullopora* sp., *Thurammina* sp., also rotalids, miliolids and *Anomalina* sp. Rarely echinoid spines, fragments of bivalves with prismatic structure, gastropods, serpulids, corals; some fragment of Porifera (?) containing *Pieninia oblonga* Borza & Mišík; also loose specimens of *P. oblonga* are present. Sandy admixture of scattered quartz, single grains of plagioclase and zircon.

2. Moštenec (Pl. III: Figs. A, C, D). Algae especially Corallinaceae are dominant: *Lithothamnium* sp., *Lithophyllum* sp., *Amphiroa propria* (Lemoine), *Distichoplax biserialis* (Dietrich), *Elianella elegans* (Pfender & Basse), *Ethelia alba* (Pfender), *Acicularia* sp. Among the foraminifers the encrusting forms prevail: nubecularids, *Bullopora* cf. *tuberculata* Sollas, *Planorbulina cretae* (Marsson), *Miniacina ? multiformis* Scheibner, also miliolids, *Alveolina (Glomalveolina) primaeva* Reichel, *Anomalina* sp. Rare fragments of bryozoans, echinoderm spines and plates, tubes of serpulid worms, ostracods, fragments of corals. *Pieninia oblonga* Borza & Mišík is present inside the fragments of Porifera (?) and loose specimens are also present. Rare admixture of quartz grains (max. 0.55 mm). Mud matrix is dominant, sometimes with small agglutinated pellets. Rare voids are rimmed with pigmented radiaxial cement, while a clear isometric mosaic occupies the central parts.

3. Stará Turá-Drahý vrch-II. Fragments of Hydrozoa, corals, Bryozoa and bivalves are dominant. Algae are rare in comparison with the previous localities: *Lithophyllum* sp., *Mesophyllum* sp., *Elianella elegans* (Pfender & Basse), *Aciculella* sp. Foraminifers are surprisingly rare: *Haddonia heissigi* Hagn, *Miniacina* sp.: further some serpulids, echinoid spines, ostracods and gastropods. One fragment of Porifera (?) with "immature" *Pieninia oblonga*; loose specimens are absent. The limestone contains a considerable amount of clastic quartz (silt), single grains of chromspinelids and tourmaline, tiny fragments of dolomites and volcanites. Small pellets are frequent.

4. Dúbrava near Stará Turá (Pl. II: Figs. A, B; Pl. III: Fig. E). Coralline algae overgrown with encrusting foraminifers: *Haddonia heissigi* Hagn, *Thurammina* sp. and nubecularids; abundant *Elianella elegans* Pfender & Basse, rare ostracods and corals. Sponge fragment probably of Keratosa filled by small yellowish and larger white *Pieninia oblonga.*

The distance between the first and the last localities is about 250 km (Fig. 1). Localities 1 and 2 were found by E. Köhler, loc. 3 by S. Buček, and loc. 4 by myself (M. Mišík).

Paleocene biohermal Kambühel limestones occur only as blocks and pebbles derived from a ridge which bordered the Pieniny Klippen Belt on its inner side. A map of all known localities has been published by Mišík (1996, Fig. 1).

Discussion

The bodies of *Pieninia oblonga* are irregularly distributed within the branches of bioclasts belonging to Porifera or Coelenterata. The process of their growth can be described as follows. The bodies are at first very small and not well differentiated from the surrounding framework (Pl. I: Fig. K). When they acquire larger dimensions, their radial-fibrous structure becomes distinct but the colour in thin sections still remains yellowish. During the further growth they accomodated to the form of the branches: some of them are strongly elongated or bent (Pl. II: Figs. A–C), while others are almost isometric (Pl. II: Fig. D). Large individuals from the final stage are already well differentiated from the skeletal framework and acquire a white colour (e.g. Pl. I: Fig. 1; Pl. II: Fig. C; Pl. III: Fig. D). The hypothesis about the calcite composition of *Pieninia* and aragonite of *Pieninia*-bearing skeleton was not checked; the probability that aragonite could be preserved in these Paleocene limestones is almost zero.

The attribution of the *Pieninia*-bearing bioclasts to Gorgonaceae or to Keratosa sponges bears some difficulties. Recent Gorgonaceae possess a horny organic skeleton and spicules of high Mg-calcite, recent Keratosidae display a skeleton consisting of spongine. The structure of the *Pieninia*-bearing bioclasts is well preserved and excludes a postmortal calcitization. It may be only accepted that the ancestors of these groups possessed a calcitic skeleton.

The loose bodies of *Pieninia oblonga* occur with *Pieninia*-bearing bioclasts in the same thin sections (Pl. I: Fig. E; Pl. II: Fig. F). We do not know the process involved in the loosening of the bodies of *Pieninia* from the skeleton. If the skeletons were from other material than low Mg-calcite, their postmortal dissolution could have taken place. No sign of such a dissolution (corrosion) on the skeletons was observed. If the *Pieninia* was an endoparasite, the loosening could be mediated by its dissolution activity. No such dissolution from inside was observed. There is hope that new, more favorable occurrences from other localities will solve the question.

The *Pieninia*-bearing skeletal fragments were found only in the Paleocene limestones. In the Barremian-Aptian limestones (Urgonian facies) where *Pieninia* is much more frequent and fragments of Coelenterata currently occur in the same thin sections, no analogic *Pieninia*-bearing skeletons were found. Perhaps *Pieninia oblonga* represents objects of different origin but we consider this probability to be very low.

Summary

The problematic bodies *Pieninia oblonga* Borza & Mišík (1976) occur in shallow-water limestones ranging from Barremian to Late Eocene. They were found up to now in Slovakia, Italy, Hungary, Austria, Croatia, Spain and Algeria. They were considered to be algae, expansions of rudists, echinoderm fragments and mostly sclerites of Gorgoniaceae. *Pieninia* occurs most frequently in Barremian-Aptian limestones of the Western Carpathians — from 268 thin sections 31 contained *Pieninia* (frequency about 12 %). In 1992, *Pieninia* was found in the fragments of Coelenterata or sponge skeletons in Paleocene biohermal limestones. Skeletal fragments were not definitely determined. After J. Reitner's opinion they belong to Keratosida sponges. Recent Keratosa as well as Gorgoniaceae possess a skeleton consisting of organic matter and spicules of Gorgoniaceae of unstable high-Mg calcite. Perhaps their ancestors might had a low-Mg calcite skeleton. The possibility *Pieninia* is an endoparasite was discussed. The process by which *Pieninia* was loosened from the skeleton is not clear. We call attention to this interesting phenomenon with the hope that some better findings will resolve the problem.

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