

Sponge borings in stromatoporoids and tabulate corals from the Devonian of Moravia (Czech Republic)

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Abstract. Borings in stromatoporoids and tabulate corals, found in the Middle to Late Devonian of Moravia (Czech Republic), correspond to the diagnosis of *Entobia* Bronn, 1837, or of the similar ichnogenus *Topsentopsis* de Laubenfels, 1955. The reconstructed morphology of the described borings is conformable to *Entobia magna* Bromley and D'Alessandro, 1989; thus they are probably the oldest representatives of this significant ichnogenus of sponge borings.

Abstrakt. Stopy vrtavých organismů ve stromatoporách a tabulárních korálech nalezené v moravském středním a svrchním devonu v podloží Vnějších Karpat, odpovídají diagnóze význačného ichnorodu *Entobia* Bronn, 1837, příp. podobného ichnorodu *Topsentopsis* de Laubenfels, 1955. Rekonstruovaná morfologie popsanych vrteb je blízká ichnodruhu *E. magna* Bromley and D'Alessandro, 1989; patří tedy patrně k nejstarším zástupcům ichnorodu *Entobia*, jehož původci jsou živočišné houby.

Key words: Sponge borings, Devonian, Bohemian Massif

Introduction

The ichnogenus *Entobia* Bronn, 1837 (sponge borings) is one of the most common ichnofossils in carbonate rock substrates and bioclasts in the Mesozoic and Cenozoic (Bromley - D'Alessandro 1984, 1987, 1989, etc.). The Palaeozoic borings of presumed sponge origin are less frequent and usually different from *Entobia* in morphology and smaller dimensions. They are the representatives of the ichnogenera *Clionolithes* Clarke 1908, *Topsentopsis* de Laubenfels 1955, *Clionolithes* Fenton and Fenton 1932, *Filuroda* Solle 1938, *Runia* Marek 1982, and the finds described by Clarke (1921), Elias (1957). Bromley (1970) and Bromley & D'Alessandro (1984) commented the relations of these borings to *Entobia*; according to them, only *Cliona cretacea* Fenton and Fenton, 1932 (Devonian, Iowa) is a Palaeozoic representative of *Entobia* (probably *E. megastoma*).

Bromley and D'Alessandro (1984) stated, that the morphology and diagnosis of *Topsentopsis* de Laubenfels, 1955, is poorly understood, and thus they could not relate this ichnogenus to *Entobia*. This must await a detailed re-examination of the type material.

Topsentopsis shows a relatively simple morphology; the boring is of quite variable size, consisting of cavities and tubes of channels. The cavity is central, irregularly spheroidal or ovoid, tubes radiating from it are simple or branching, sometimes enlarging distally. Diameter of the cavity 1 to 10 mm, of tubes 0.5 to 3 mm. *T. devonica* Clarke, 1921 is described from the Devonian of the USA (Häntzschel 1975).

Very frequent borings (probably sponge borings) come from the Frasnian stromatoporoids from western Canada. Borings from this area have not been extensively described but a few authors have noted their presence and influence

on diagenesis (Leavitt 1968, Kobluk et al. 1978). These borings are referred to *Topsentopsis* de Laubenfels and now they are the subject of research and evaluation (C.W. Stearn, *personal communication*).

The specimens from the Middle to the Upper Devonian of Moravia (Czech Republic) correspond, in my opinion, to the diagnosis of *Entobia* and are the oldest representatives of this significant ichnogenus. They were obtained in the course of the study of tabulate corals and stromatoporoids by Dr. J. Hladil (Czech Geological Survey, Prague), to whom I am indebted for the acquaintance with the material, for valuable comments, and for giving me the photographs of thin sections. The finds are documented by thin sections housed in the Czech Geological Survey, Prague and Brno, and by photographs. In all the cases, borings were made in tabulate corals and stromatoporoids. The authors studying the corals and stromatoporoids of the Devonian of Moravia, have already figured the borings several times, whether intentionally or incidentally, and sometimes they have commented briefly on these borings (see the systematic part of the paper).

All the finds (studied in this paper or figured in the papers of other authors) come from deep boreholes in the foreland or basement of the Outer Carpathians on the south-eastern slopes of the Bohemian Massif. These boreholes have been situated both in Southern Moravia (see Zukalová et al. 1981; boreholes Němčíčky 1, Uhřice 1 and 2, and others, SW of Brno) and in Northern Moravia (among others, boreholes NP-824 Ostravice - see Friáková - Zukalová 1986, Galle 1984, Hladil 1984, Zukalová 1984; NP-828 Morávka - see Hladil, Kalvoda and Galle 1985,



Hladil 1986). Concerning the sector "North" of the SE slopes of the Bohemian Massif, Hladil (1986) stated, that there are two most conspicuous peaks of the carbonate buildup: in the Late Givetian and in the Early Frasnian. The landlocked embayment setting is presumed.

Among the studied material, four specimens show "entobian" morphology. All of them come from the NP-828 Morávka borehole (Northern Moravia), depth interval 1391-1484 m (upper Givetian to lower Frasnian). Figures published by Zukalová et al. (1981) and Hladil (1986) can be added to this material. The aim of this paper is the description of the finds, the reconstruction of their morphology and their systematic evaluation.

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Systematic ichnology

Entobia Bronn, 1837

Diagnosis: Borings in carbonate substrates consisting of single chambers or of a network, more often a boxwork of chambers and galleries connected to the surface by several or numerous apertures. Morphology changes markedly with ontogeny. During the growth the galleries gradually increase their diameter; in other (camerate) forms inflation produces closely interconnected chambers at regular distances. In other forms the chamber development is restricted to an early ontogenetic stage. There are also forms with nondeveloped chambers. The surface of the borings is covered with cusped microsculpture, which may be absent in gerontic specimens. Fine apophyses (initial form of exploratory threads) arise from all or most surfaces in the system (after Bromley - D'Alessandro 1984).

? *Entobia* cf. *E. magna* Bromley and D'Alessandro, 1989

Pl. I, figs. 1-4; text-figs. 1, 2

? 1981 a cavity in *Syringostroma* cf. *capitatum*; Zukalová et al., Pl. XVIII, fig. 1 (Frasnian, Uhřice-2 borehole)

1981 trace of boring activity; Zukalová et al., Pl. XXIV, fig. 1 (Frasnian, Němčíčky-1 borehole)

1981 (figured and not commented) Zukalová et al., Pl. XXVI, fig. 1 (Frasnian, Němčíčky-2 borehole)

1986 ball-shaped boring with club-like apophyses; Hladil, Pl. 57 (Upper Givetian, Kozlovice - SV 1 borehole)

1986 ball-like feeding trace filled with fecal pellets; Hladil, Pl. 58 (Upper Givetian, Kozlovice - SV 1 borehole)

1986 ball-like cavity (?fodinichnion of gastropods); Hladil, Pl. 59 (Upper Givetian, NP-828 Morávka borehole)

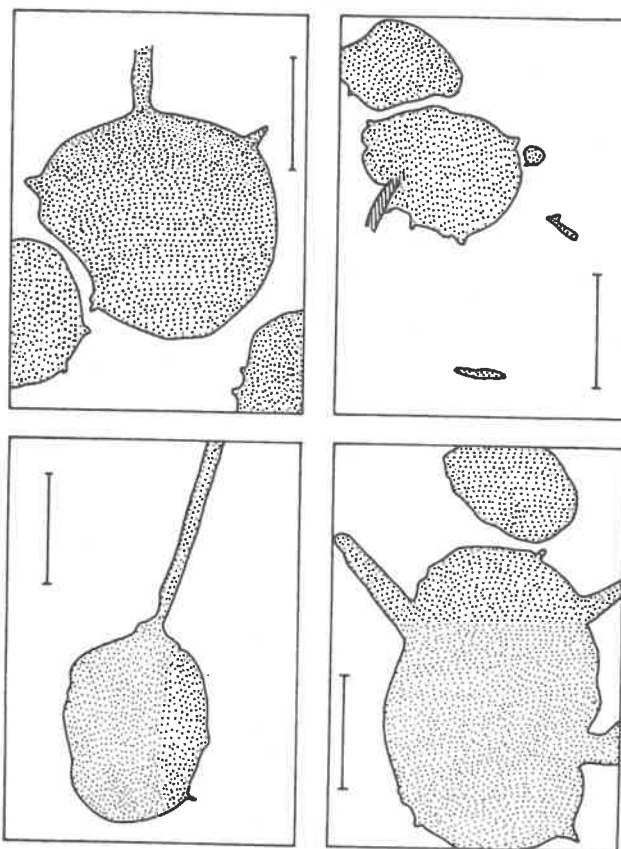


Fig. 1. Schematic sections of the borings (the same specimens as figured on Pl. I).

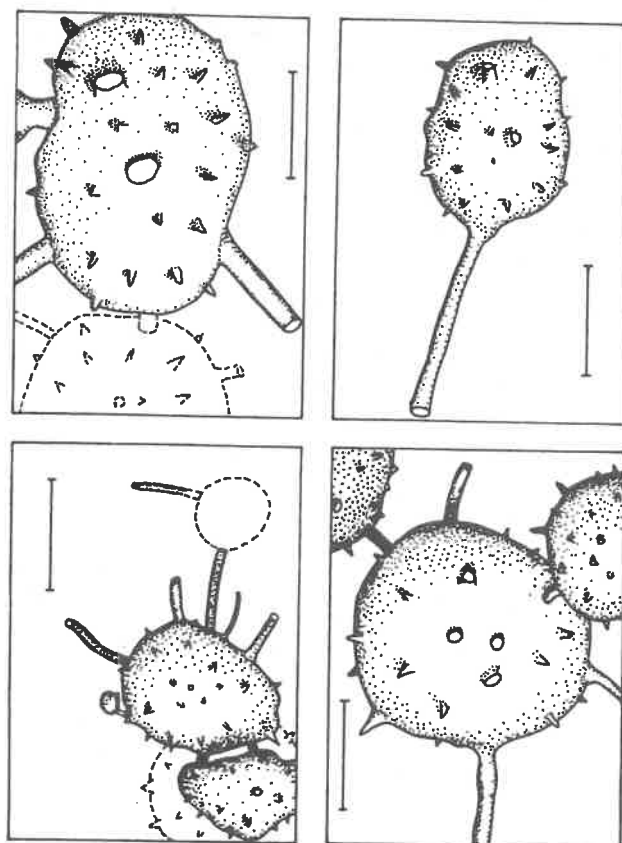


Fig. 2. Reconstruction of the original morphology of the borings (the same specimens as figured on Pl. I).

Material: In addition to the above-mentioned literary data, four finds from NP-828 Morávka borehole, depth 1391-1484 m (Upper Givetian - Lower Frasnian) - thin sections of filled cavities, bored in *Hermatostroma* sp., *?Plectostroma* sp., and *Trupetostroma mailleuxi* Lecompte.

Description: Oval to almost circular cross-sections of secondary cavities in stromatoporoids, secondarily filled with homogeneous or heterogeneous carbonate material - micrite, sparite, or minute bioclasts (shells of ostracods) and pellets, that concentrated in the lower part of the cavity and now they document the original orientation of borings. Diameter of cross-sections ranges from 4 to 11 mm; finer cross-sections are also present, but they are likely to represent sections of canals. Thin sections were oriented with no respect to the borings (they were made for study of corals and stromatoporoids). But in the case of specimens figured on Pl. I, figs. 1, 3, and 4, a proximity of the sections to the symmetry plane of cavities can be assumed, because the tunnels outing roughly perpendicularly from the surface of the cavities are intersected longitudinally. On the contrary, the specimen figured on Pl. I, fig. 2, was probably cut out of the plane of symmetry.

On the periphery of the cross-sections there are two kinds of projections: rare short, pointed (=apophyses), and long, of constant width, originally probably of cylindrical shape (=apertural or intercamerate canals). The short projections are 0.5 to 1.5 mm long, up to 0.7 mm wide at the base, the long ones are about 1.0 mm (minimum 0.5 mm) wide and up to 8 mm long. Both the short and long projections are mostly perpendicular to circumference of sections of chambers, thus they were also perpendicular to the chamber surface.

In three cases the thin section intersects only one chamber, while in other cases two or three chambers were intersected.

Thin sections available for study do not reveal the original morphology completely. Serial sections would be a more suitable technique; however, at the present, no further material is at my disposal. Nevertheless, the sections described and figured here (Pl. I, Text-fig. 1) enable a sufficiently credible reconstruction of morphology (Text-fig. 2). The borings were chambers of ellipsoidal to sphaeroidal shape, in the final growth phase 5 to 12 mm in diameter, with a few thin pointed apophyses and smooth, straight tunnels, probably connecting the chambers with the surface of the coral or stromatoporoid (apertural canals), or with neighbouring chambers (intercameral canals). Some of the conical terminated cavities may be the canals cut obliquely to the plane of the thin section, but this explanation is not probable in the case of several very thin and pointed terminations. The chambers occur both solitary and in small clusters.

Remarks: The reconstructed morphology of the described borings is conformable to that of *E. magna*

Bromley and D'Alessandro, 1989, known from the Pliocene and Pleistocene of Southern Italy. According to Bromley - D'Alessandro (1990), *E. magna* occurs abundantly in infralittoral, sporadically in bathyal settings. Because of the imperfect knowledge of the morphology of the described finds, they are ascribed to *E. magna* with some doubt.

The study of the relations between the ichnogenera *Entobia* and *Topsentopsis* seems to be necessary for the final systematic classification of the described borings. The ichnogenera are similar in many aspects and the finds of new, unicamrate entobians (*E. magna*, *E. solaris* Mikuláš, 1993, *E. astrologica* Mikuláš, 1993) make the diagnoses even more similar.

Besides the described finds, there are other borings found in the Devonian corals and stromatoporoids of Moravia. These finds, stated in synonymy with a question mark, are mostly irregular hollows of dimensions comparable with entobian chambers. Their assignment to the ichnological system seems to be uncertain.

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Explanation of Plate I



- 1-4: ? *Entobia* cf. *E. magna* Bromley and D'Alessandro, 1989; 1 - boring in *Hermatostroma* sp., x 7.0, NP-828 Morávka borehole, 1391.1 m. 2 - boring in *Trupetostroma mailleuxi*, x 4.4, NP-828 Morávka borehole, 1477.0 m. 3 - boring in *Plectostroma*? sp., x 7.0, NP-828 Morávka borehole, 1484.0 m. 4 - boring in *Trupetostroma mailleuxi*, x 7.0., NP-828 Morávka borehole, 1477.0 m. Late Givetian to Early Frasnian.

Photos by J. Navrátilová and J. Hladil.

