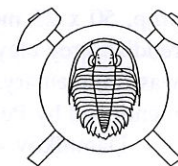


## Borings in the oyster shells from the Badenian at Česká Třebová and its neighbourhood (Eastern Bohemia, Czech Republic)



Vyvrtné otvory - doupata ve schránkách ústřic badenského stáří z České Třebové a jejího okolí (východní Čechy) (Czech summary)

(4 plates)

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Lower Badenian sediments in the town Česká Třebová and its close vicinity yielded the trace fossils (borings) *Maeandropolydora* cf. *elegans* Bromley and D'Alessandro, *M. sulcans* Voigt, *M. decipiens* Voigt, *Entobia* ichnosp., „circular“ and „parabolic“ borings. They were formed in shells of oysters *Ostrea gingensis* Schlotheim and *Ostrea* sp.

**Key words:** Ichnofossils, Borings, Oysters, Badenian, Czech Republic

### Introduction

Little attention has been paid to trace fossils from the Miocene (Badenian) sediments of the Eastern Bohemian region so far. Michalski, Panoš and Pek (1988) figured one specimen of the oyster *Ostrea* sp. with borings (Pl. XI, fig. 1, and Pl. XII, fig. 1) only, but without description. Recently Pek and Mikuláš (1996) described the ichnogenus *Oichnus* Bromley, 1981 formed by carnivorous gastropods in conchs of various gastropod taxa.

The aim of this paper is to describe a boring assemblage in shells of oysters. Our material (about 500 specimens of oysters, one hundred of them with borings) were mostly collected by I. Pek in 1960-1994 and by M. Michalski in 1958-1975. Minor part of the collections is housed in the Museum of the Town Česká Třebová.

### Geological settings

The Lower Badenian sediments at the Česká Třebová region form denudation relics lying on the Upper Cretaceous sedimentary rocks, less frequently on the Permian ones. The relics are situated between the towns Moravská Třebová, Lanškroun, Česká Třebová and Choceň, in the geomorphological units Česká Třebová Upland, Třebovice Col, and Moravská Třebová Benchland. The thickness of the Lower Badenian sediments ranges locally (at Třebovice Col, or N of the Česká Třebová Brickyard) more than 100 m. They are composed of bluish-grey, green-grey, yellowish-grey to grey calcareous clays, containing in places relatively rich plant detritus and coal substance. Facially, the oligohaline or brachyhaline sediments are concerned.

Further data on the geological and paleontological

settings of the Miocene of the given area were published esp. by Procházka (1895, 1900), Zázvorka (1940a,b), Cícha - Dornič (1959, 1962), Michalski - Panoš - Pek (1988), Hamerník (1989), Pek - Mikuláš (1995, 1996), Fencel - Schütznerová - Havelková (1971), Pek - Bičík (1995).

### Localities

Česká Třebová - brickyard: Large outcrop at the western margin of the town. Here, the greyish-blue to grey, plastic clays with weak sandy admixture are exposed; the idiomorphic crystals of gypsum, pyrite hexaeders, concretions of Fe-oxides and hydroxides, minute spheroidal to anisometric carbonate concretions, irregular clusters of coal substance, and fragments of fossil wood occur rarely. In upper layers, the oyster banks up to 20 cm thick (and variable in their length) were exposed (Pl. IV). Here the taxa *Ostrea* sp., *Ostrea* sp. (juv.) and *O. gingensis* Schlotheim were found.

For further details on this locality see Vavřínová (1952), Štenglová (1955), Hamerník (1989), Pek - Mikuláš (1995, 1996)

Česká Třebová - „Suez“: The locality is situated in the western part of the town, between the guard stones No. 246.9 and 247.1 left of the railway from Česká Třebová to Ústí nad Orlicí. In 1961-1963, grey clays containing oyster associations in upper layers were exposed. The locality does not exist at present. The species *Ostrea ?boblayi* (one juv. specimen without borings), *O. ?digitalina* Dubois (three fragmentary preserved shells without traces), *O. cf. plicatula* (one valve without traces) and *O. sp.* were ascertained.

Česká Třebová - Ústřední kotelná ČD (Central boiler-room of Czech Railways): The site was located in SW margin of the town, nearly at the southern margin of the boiler-room. In 1971-1972, a planary out-



crop, 50 x 25 metres in dimensions, exposed grey to reddish-grey clays. The oyster fauna (*Ostrea* sp. only) was fragmentary. The locality does not exist now. It is mentioned by Pek and Mikuláš (1996).

Damník - U trati (At the railway): The extinct locality was situated NW of Damník, at the railway from Třebovice to Rudoltice, between guard stones No. 10,2 and 10,4, near the so-called „pile stone“. In 1970-1972, grey clays with weak sandy admixture, in places with clusters of organic substance, were exposed. Finds of oysters are mostly fragmentary, with exception of rare juvenile specimens. The taxa *Ostrea gingensis* Schlotheim and *O. sp.* were found. The locality is extinct; for further data see Pek - Bičík (1995), Pek - Mikuláš (1996).

### Systematic ichnology

*Maeandropolydora* Voigt, 1965

Type ichnospecies: *M. decipiens* Voigt, 1965

*Maeandropolydora sulcans* Voigt, 1965

Pl. I, figs. 3, 5-8; Pl. II, fig. 9; ?Pl. III, fig. 2

Addition to the synonymy of the ichnospecies: 1976  
*Polydora hoplura* (Claparède); Švagrovský, p. 150; text-figs. IV-3, IV-5.

Material: Several tens of fragments of oysters with borings.

Description: Borings in a form of cylindrical galleries constant in diameter (0.3-0.5 mm) usually forming long meanders, either symmetrical or irregular, rarely branching. In some cases, the meanders are isolated, more usually they are densely crowded. Width of meanders 2-5 (10) mm, length up to 50 mm.

As it can be judged from the fragments of oysters, the borings originated most frequently nearly under the inner surface of shells. At the upper surface (and also in muscle scars area) they are less frequent. They were found also in a calcitostracum. The galleries tend to follow the surface of shells, i.e. the tracemaker used a primary inhomogeneity of shell caused by a presence of „increment lamellae“ for his orientation inside the substrate and for an easier boring.

Fragmentary preservation of oyster shells enables us to study the galleries exposed; many of them, however, remain covered by non-destructed parts of the shell. They can be discovered by X-ray investigation (Pl. II, fig. 9).

Remarks: The ichnogenetic and ichnospecific apurtenance of these borings follow the papers of Voigt (1965) and Bromley - D'Alessandro (1983). The polychaete worms (as *Polydora hoplura* /Claparède/) are presumed tracemakers.

Because of fragmentary preservation, some speci-

mens cannot be distinguished at an ichnogenetic level - they can be considered both as representatives of *Maeandropolydora*, and *Caulostrepsis* Clarke, 1908. The last-named ichnogenus shows unbranched, more-or-less U-shaped galleries possibly with „pouches“ and „vanes“ of the same character as in *Maeandropolydora* (see Bromley and D'Alessandro 1983). Because of branching of galleries sometimes visible in our material, we range all our specimens to *Maeandropolydora*, but in fragmentary specimens with some doubts. After all, both the ichnogenes are very similar by morphology, ethological sense and taxonomic position of presumed tracemakers.

Occurrence: In the studied area, *M. sulcans* was found at Česká Třebová - brickyard, Česká Třebová - „Suez“ and Damník localities. Newly (in summer 1995) we found oyster fragments (*O. sp.*) with *M. sulcans* at the locality Semanín-skládka (Semanín dump, see Pek - Mikuláš 1996).

*Maeandropolydora decipiens* Voigt, 1965

Pl. II, figs. 1-6

Material: About 20 oyster fragments with the trace.

Description: Cylindrical galleries forming usually narrow asymmetrical meanders. Inner sides of them are usually connected by a „vane“ with characteristic spreiten-like sculpture. Less frequently, characteristic enlargements („pouches“) are present (Pl. II, figs. 3, 6). Other morphological features, dimensions and distribution on shells are analogical to *M. sulcans*.

Remarks: For literary sources and for presumed tracemaker see the remarks to *M. sulcans*.

Occurrence: In the studied area, Česká Třebová - brickyard and Damník localities.

*Maeandropolydora* cf. *elegans* Bromley & D'Alessandro, 1983

Pl. I, figs. 1, 2, 4, 7

Material: About 15 specimens of oyster fragments with the trace.

Description: Cylindrical galleries densely spaced to pairs. They do not bear either pouches or vanes. Other morphological features, dimensions and distribution on shells are analogical to *M. sulcans*.

Remarks: The described specimens resemble *M. elegans* B. & D'A. by a paired fashion of galleries. Other characteristic features of this ichnospecies, e.g. numerous apertures, are not well-visible in our material. Therefore, we range them to this ichnospecies with the reserve.

Occurrence: In the studied area, Česká Třebová - brickyard and Damník localities.



*Entobia* Bronn, 1837

*Entobia* ichnosp.

Pl. II, fig. 8; ?Pl. III, figs. 1, 2

1976 Cliona; Švagrovský, p. 150, text-fig. IV-3.

Material: Seven fragments of oyster shells, one almost complete shell with the trace.

Description: Ellipsoidal to spheroidal chambers several mm in diameter, joined by thin canals and forming clusters or networks. They are in all the cases preserved in weathered parts of shells and do not show details of shape and surfaces of chambers.

Remarks: Characteristic morphology of these borings enables us to place them to the ichnogenus *Entobia* Bronn, 1837; the sponge borings are concerned. For detailed information on the ichnogenus and their representatives see Bromley - D'Alessandro (1984, 1987).

Occurrence: In the studied area, Česká Třebová - brickyard and Česká Třebová - „Suez“ localities.

Circular borings

Pl. II, fig. 7; Pl. III, figs. 1, 2

Material: Six fragments of oysters with borings.

Description: Pits or cylindrical borings, solitary or in clusters, circular to slightly oval in cross-section, perpendicular (exceptionally oblique) to surfaces of shells. They can be developed both on the upper, and on the inner surface. Diameter of them 1.5 to 2.5 mm, usual depth 2.0 mm. Base of the borings, if visible, is moderately concave to flat. On the inner surface of shells, the borings can be cased by convex bodies (?pearl-like tumors). It points to the fact that some of these borings originated during the life of oysters.

Remarks: A heterogeneous origin of these traces cannot be excluded. Some of them may represent weathered chambers of entobians, the cylindrical ones are related to *Trypanites* Magdefrau. We suspect that most of them are domichnia of unknown tracemakers analogical, e.g., to the ichnogenus *Gastrochaenolites* Leymerie. For description of the two last-named ichnogenes see, e.g., Mikuláš - Pek (1995).

Occurrence: In the studied area, Česká Třebová - brickyard and Česká Třebová - „Suez“ localities.

Parabolic borings

Pl. II, fig. 3

Material: Six fragments of oyster shells with borings.

Description: Short galleries bent parabolically, parallel with the surface of shells. They were probably

open by two very short perpendicular or oblique „shafts“. Diameter of galleries 1-2 mm, length of all the bent gallery up to 12 mm.

Remarks: These borings may represent domichnia analogical to burrowing ichnogenes *Arenicolites* resp. *Rhizocorallium*.

They can be considered also to be initial forms of *Maeandropolydora* or, more probably, *Caulostrepsis* Clarke, 1908 (for description see Bromley and D'Alessandro 1983).

Occurrence: Česká Třebová - brickyard and Česká Třebová - Central boiler-room localities.

## Conclusions

In the Badenian at Česká Třebová, strong oyster shells served both *in vivo* and postmortally as a substrate suitable for colonisation of boring organisms, probably polychaetes and clionid sponges. The described ichnofossils represent a sole evidence of this interesting interaction between organisms and they are an example of the Trypanites Ichnofacies (in detail characterized, e.g., by Frey and Pemberton 1984) in the sequence with prevailing sedimentation of clay material.

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Translated by the authors

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### Vyvrtné otvory - doupata ve schránkách ústřic badenského stáří z České Třebové a jejího okolí (východní Čechy)

Ze spodnobadenských usazenin v České Třebové a jejím blízkém okolí jsou popsány ichnofosilie („vrtby“) *Maeandropolydora cf. elegans* Bromley and D'Alessandro, *M. sulcans* Voigt a *M. decipiens* Voigt, dále *Entobia* ichnosp. a „kruhové“, resp. „parabolické“ dutiny. Vyskytují se na schránkách ústřic *Ostrea gingsensis* Schlotheim a *Ostrea* sp.

Silné schránky ústřic sloužily jak postmortálně, tak *in vivo* jako substrát vhodný ke kolonizaci polychétními červy a v menší míře clionidními houbami; popsané ichnofosilie jsou ve fosilním záznamu jediným dokladem této interakce mezi organismy. Jednotlivé schránky i ústřicové lavice představují zajímavý příklad trypanitové ichnofacie v sekvenci s převahou jílové sedimentace.

#### Explanation of plates

Material prefixed by F-(inv. No.) comes from the personal collection of I. Pek and partly of M. Michalski. It is housed in the collection of the Department of Geology, Palacký University, Olomouc.

Photos by I. Pek and M. Michalski. Pl. II, fig. 5 made by J. Šebela, Pl. II, fig. 9 by R. Mikuláš



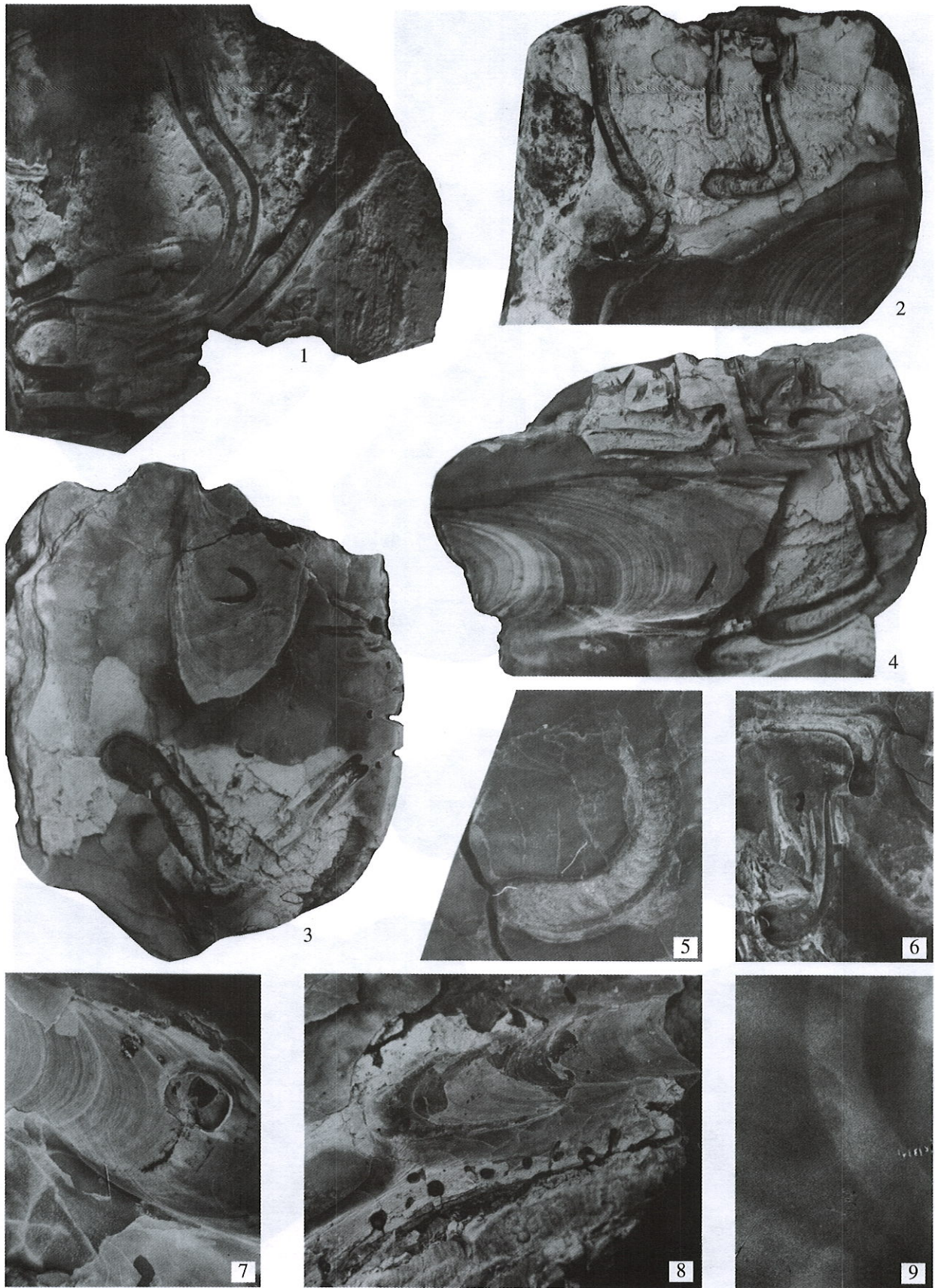
R. Mikuláš - I. Pek: Borings in the oyster shells from the Badenian at Česká Třebová and its neighbourhood (Pl. I)



Fragments of oysters *Ostrea* sp. with borings. Badenian, Česká Třebová - brickyard locality. 1, 2 - *Maeandropolydora* cf. *elegans* Bromley and D'Alessandro, 1983; F-760 and F-761, x1.2. 3 - *Maeandropolydora sulcans* Voigt, 1965; F-762, x1.2. 4 - *M.* cf. *elegans*; F-763, x1.5. 5, 6, 8: *M. sulcans*; F-764, F-765, and F-767, all x1.5. 7 - *M.* cf. *elegans* (left) and *M. sulcans* (right); F-766, x1.5.

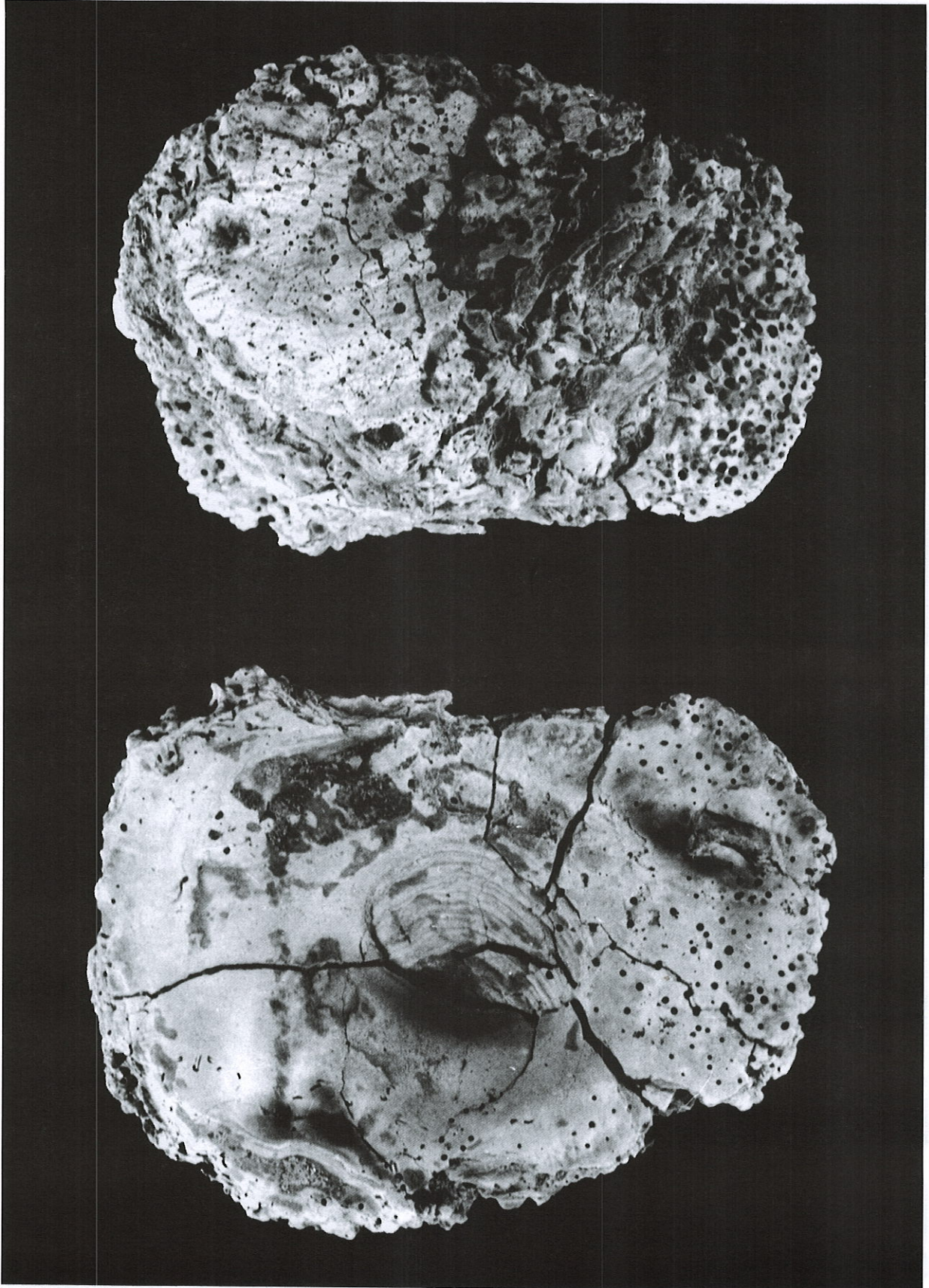


R. Mikuláš - I. Pek: Borings in the oyster shells from the Badenian at Česká Třebová and its neighbourhood (Pl. II)



Fragments of oysters *Ostrea* sp. with borings. Badenian, Česká Třebová - brickyard locality. 1 - *Maeandropolydora* aff. *decepiens* Voigt, 1965; F-768, x2.0. 2 - *M.* aff. *decepiens*; F-769, x1.5. 3 - *Maeandropolydora decepiens* Voigt, 1965 (lower part of the figure) and „parabolic boring“ (upper part); F-770, x1.2. 4 - *M.* aff. *decepiens*; F-771, x1.7. 5 - *M. decepiens*; coll. Městské Muzeum v České Třebové No. 1-C-118, x2.2. 6 - *M. decepiens*; F-772, x1.7. 7 - „circular boring“, F-773, x1.5. 8 - *Entobia* ichnosp.; F-774, x2.0. 9 - X-ray diagram of *M. sulcans*; F-775, x10.





Shell of *Ostrea* sp. with borings. Badenian, Česká Třebová - brickyard locality. Both upper and inner surfaces of the shell show „circular borings“, representing partly weathered chambers of *Entobia* ichnosp. Galleries of *Maeandropolydora* cf. *sulcans* are present at the inner surface only (lower part of the second figure); F-776, x1.0.



R. Mikuláš - I. Pek: Borings in the oyster shells from the Badenian at Česká Třebová and its neighbourhood (Pl. IV)



1 - Planar outcrop of the Badenian clays in the burckyard at Česká Třebová. 2 - Oyster bank in the clays at the Česká Třebová - brickyard locality.

