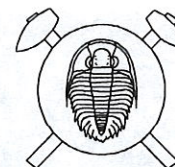


A problematic fossil from the Middle Cambrian of the Barrandian area (Czech Republic)



Problematická fosilie ze středního kambria Barrandienu (Czech summary)

(2 text-figs.)

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The locality Vinice (Příbram–Jince area of the Barrandian Middle Cambrian) yielded a sole find of fossil showing no shell material. The fossil is a straight, cudgel-shaped body with two narrowings, 65 mm long, and it can be roughly compared with an entoproct-like organism *Dinomischus* Conway Morris, 1977. It is unlike that the find represents an ichnofossil.

Key words: Invertebrata, Middle Cambrian, Barrandian area, Ichnofossils, Brachiopoda.

Introduction

The aim of the present contribution is to describe and discuss a find which has been found at the locality Vinice (Middle Cambrian, Příbram–Jince area of the Barrandian Early Palaeozoic, central Bohemia). The sample was interpreted preliminarily as an ichnofossil, however, detailed comparisons with morphologically similar ichnotaxa have shown that this explanation is incredible. Therefore, a body fossil is to be concerned. The find, however, does not contain a shell material; a fossilization of soft tissues must be assumed. This way of preservation of fossils has not been reported from the Cambrian of the Barrandian area so far, but there are numerous analogies abroad, e.g. Conway Morris (1977), Jin et al. (1993).

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Geologic settings

The find comes from a flysch-like sequence, overlying the sediments of the *Eccaparadoxides pusillus* Zone (i.e. from the Interzone B according to Kordule 1996) at the locality Vinice at Jince (for description of the site, see, e.g., Fatka and Kordule 1992, Chlupáč 1993, Kordule 1996). Here, the uppermost layer of the *Eccaparadoxides pusillus* Zone is composed of very fine-grained shales rich in fossils of trilobites; some of them are supposed to indicate rather deep-water settings (Robison 1994). The interval including the layer which provided the described fossil shows a rhythmical alternation of fine-grained sandstones to greywackes with clayey and silty shales. The layers of the shales are usually rhythmical by

themselves, being composed of distinctive laminae of silty and clayey substance.

The flysch-like interval starts with two about 20 cm thick layers of sandstone separated by 1.5 m thick section of shales. Further alteration of sandy layers and shales is of decimetre scale, sometimes in centimetres. Some of the coarser layers are lenticular or wedge-shaped, often cross-bedded or showing slump structures or convolute bedding. Their bases have often tongue-like flute casts directed to SW, sometimes crossed by series of narrow flute marks perpendicular to them (?alternation of gravity flows and contour currents). Thicker layers have also load casts. There is no macroscopically visible graded bedding. One of the greywacke layers provided finds of disarticulated carapaces of trilobites *Acadoparadoxides sirokyi* Šnajdr and *Hydrocephalus minor* (Boeck) orientated the concave sides upwards, which suggests their transport by a current. Bases of several coarser layers have also frequent ichnofossils *Planolites cf. montanus* and incomplete U-structures *Diplocraterion* isp. or *Arenicolites* isp.

As a mechanism of rhythmicity of the sedimentation, either tempestites or distal turbidites may be considered. The sequence gradually loses its coarse layers upwards, passing into laminated shales and fine-grained greywackes. Overall thickness of the sequence is several tens of metres.

The described fossil comes from the lower part of the rhythmical sequence, approximately 14 metres above its base, from a layer of laminated clay shale.

The specimen

Material: Sole find, housed in the collection of the National Museum, Prague, Inv. No. L 32933 (Fig. 1).

Description: The structure is preserved as a full relief in a very fine-grained clay shale. It is a cudgel-shaped, strictly horizontal body, 65 mm long. The body is divided lengthwise into three parts. The first one, 20 mm



Fig. 1. A problematic fossil (cp. *Dinomischus* Conway Morris 1977). Middle Cambrian, Vinice at Jince, x1.4. Photos by R. Mikuláš

long, shows a constant width of 8 mm; the central part is 25 mm long and 6–6.5 mm wide, and finally, the thinnest one is 2 mm wide and 20 mm long. As the fossil is flattened horizontally by a diagenetic compaction, the original vertical dimension is difficult to estimate more exactly than to several millimetres.

Remarks and interpretation

The described find does not contain a shell material or its cast. Therefore, the shell was not present primarily, or it had been dissolved or mechanically detached prior the fossilization. All the body resembles in its shape a burrow of lingulid brachiopod or its fossil body with preserved soft parts. However, the strictly horizontal orientation makes the possibility, that the burrow is concerned, very unlikely.

Jin et al. (1993) described and figured numerous finds of lingulid brachiopods with preserved pedicles from Chengjiang (China). Most of them have no shell material, however, the pedicles are curved or twisted and possibly shortened by their post-mortem contracting. A review of finds of fossilized brachiopod pedicles was given by Südkamp (1997). In addition to the material from Chengjiang, the author mentioned one specimen of

Lingulella sp. from the Burgess Shale (Cambrian), one find of *Lingula aequalis* from the Trenton Group in Canada (Middle Ordovician) and one find of *?Lingula leseuri* from Devonshire (England; Devonian). In addition, he described two new specimens of *Orbiculoidea mediorhena* from the Lower Devonian Hunsrück Slate.

The described fossil shows numerous features which doubt its relevance with brachiopods. The phosphatic material of lingulid shells is chemically very stable, and its dissolution prior the diagenesis (coupled with a good preservation of soft parts) is unlikely. If the shells were separated mechanically before fossilization, it is not probable that the soft tissues would keep a relatively smooth surface as visible on the widest part of the specimen. Also the double narrowing of the „cudgel“ has no analogy among brachiopods. Moreover, the only representative of lingulid brachiopods known from the stratigraphical level of the described find is *Westonia bohémica* (Koliha, 1921) (see Mergl and Šlehoferová 1991). The outline of this brachiopod (roughly triangular, relatively low shell) differs from the widest part of the described fossil.

Fossilization of soft parts is enabled most often by a low oxygen level in the sediment, and Kukal (1992) places the Jince Formation sedimentologically to the neighbourhood of black shales. Also the lack of subsurface bioturbation in the above-described laminated shales points to the low oxygenation of the sediment.

The question important for a systematic appurtenance of the find is to consider a possible secondary changes of the shape of the specimen. Particularly, a pyrite crystallization might enlarge certain parts of the fossil. However, the described specimen shows no traces of pyritization (i.e., the pyrite itself, its pseudomorphoses, or products of its weathering). Therefore, we assume that the double narrowing of the fossil is a primary feature of its morphology.

In our opinion, a straight course of the „cudgel“ shows that the tissue was not easily flexible; particularly, the narrow edge suggests more persistent material. The analogy of the body consistence might be found, e.g., in the „ediacaran-like“ fauna from the Upper Cambrian of Ireland (Crimes et al. 1995).

Other animal groups known from the Middle Cambrian do not provide reasonable possibilities for a comparison to the described find. Cephalopods are known till the Late Cambrian, and their oldest representatives have different shapes of conchs. General coincidence in dimensions and outline can be found in some eocrinoids (e.g., *Acanthocystites briareus* Barrande – see Turek 1986). However, we do not know examples of such a preservation of similar echinoderms (i.e. a dissolution of strong calcite plates and a good preservation of soft tissues).

Among the non-shelly fossils of uncertain systematic appurtenance, an entoproct-like organism *Dinomischus* Conway Morris 1977, known from the Burgess Shale and from the Chengjiang locality, shows some resemblance in its morphology. Our specimen, however, lacks a cir-

plet of bracts typical for *Dinomischus*. We consider this genus to be a possible analogy of our specimen, but only subsequent finds from the Bohemian Cambrian might enlighten the relations.

As the comparison to ichnofossils is concerned, there are analogical features in the ichnogenus *Lingulichnus* Hakes, 1976. This ichnofossil is a vertical to subvertical burrow, oval in cross-section, and it represents a lingulid dwelling burrow known from the Uppermost Cambrian (e.g., Hakes 1976, Szmuc et al. 1977, Over 1988, Fillion

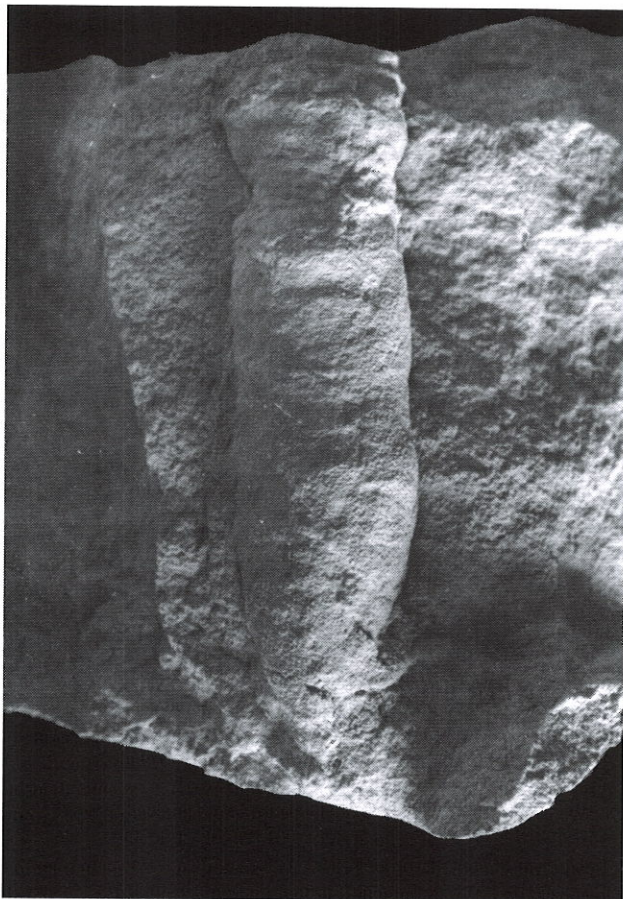


Fig. 2. Trace fossil *Skolithos* isp. Middle Cambrian, right bank of the Litavka Brook at Rejkovice, x2.0. Photos by R. Mikuláš

– Pickerill 1990). *Lingulichnus* has not been reported from the Cambrian of Barrandian area but relatively shallow cylindrical burrows are common in places (Šnajdr – Havlíček 1951, Mikuláš *in press*). Some of them are sharply extended (Fig. 2); exceptionally, a deep, very narrow shaft continues downwards. We presume that inarticulate brachiopods might be tracemakers of some of these burrows; the shafts might represent traces of anchoring and contraction of the pedicles. A crucial difference between these traces and *Lingulichnus* consists in their circular cross-section (in contrast with the elliptical cross-section of *Lingulichnus*), therefore, they have to be classified as *Skolithos* isp.

A strictly horizontal orientation of the described structure excludes its function as a dwelling burrow, as there would be no openings to the surface. A random secondary „turning“ of the fossil by a slump may be fully excluded, e.g., because there is no record of slumps in the layer where the specimen was collected. Further, we might consider the fossil to represent an early to middle phase of the process of forming a typical vertical lingulid burrow (see examples in Thayer and Steele-Petrovic 1975). However, even in this case, the resulting structure would not be strictly horizontal; moreover, there are no vertical or U-shaped burrows of the corresponding size at the locality.

Some other possibilities could also be discussed (e.g., the trace as a result of atypical behaviour of the animal buried in the sediment). However, none of them provided us an acceptable explanation of the origin of the specimen.

Conclusions

The described specimen from the Middle Cambrian of the Barrandian area is, in our opinion, most probably a fossil of the unknown invertebrate having no rigid shell but rather tough „soft“ tissues. It shows a certain resemblance to *Dinomischus* Conway Morris 1977 from the Cambrian Burgess Shales. It is the first non-shelly fossil reported from the Bohemian Cambrian.

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Problematická fosilie ze středního kambria Barrandienu

Na lokalitě Vinice (přibramsko-jinecká oblast středního kambria Barrandienu) byla nalezena fosilie, která neobsahuje pevnou schránku a která svým kyjovitým obrysem se dvěma zúženými a značnými rozměry (délka 65 mm) poněkud připomíná problematickou fosilii *Dinomischus* Conway Morris, 1977 z burgeských břidlic. Eventualitu, že se jedná o ichnofosilii, lze téměř vyloučit.