

The first partially articulated amphibian (Temnospondyli: Disorophoidea) from the Líně Formation (Stephanian C, central Bohemia)

(4 text-figs., 2 pls.)

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Abstract. The first record of a partially articulated amphibian (*Branchierpeton* cf. *B. saalensis*) from the Líně Formation is described. It is also the first amphibian from the Stephanian C of Czechoslovakia. The relationships of the specimen and the stratigraphy are discussed. The "tetrapod" claystone layer within the Zdětín Horizon is described and its possible stratigraphic use is outlined.

Abstrakt. Z líňského souvrství je popsán první nález částečně artikulovaného obojživelníka (*Branchierpeton* cf. *B. saalensis*), který je zároveň prvním, takto zachovalým, obojživelníkem československého stefanu C. Je diskutována stratigrafie a příbuzenské vztahy jedince. V rámci zdětínského obzoru je popsána poloha „tetrapodového“ jílovce a je nastíněno její možné stratigrafické využití.

Geology and stratigraphy

Between 1983 and 1986, one of the authors (J. Z.) had studied the fauna from boreholes made by the Geological Survey, Prague. These boreholes were situated in the Bohemian Permo-Carboniferous basins (one in the Kladno Basin, two in the Roudnice Basin, two in the Mnichovo Hradiště Basin, and one in the Krkonoše-piedmont Basin). These basins are, in fact, sections of a larger sedimentary area and their mutual boundaries have been determined by convention (Holub and Tásler 1978, fig. 1). The new fossiliferous layer was found in three of the four boreholes made in the region between the northeastern border of the Kladno Basin and the southwestern border of the Mnichovo Hradiště Basin. It was identified in the boreholes at Martiněves (Mt-1), Liběchov (Lib-1), and Semčice (Sč-1), but not in the borehole Strachaly (Str-1). The layer is a blackish-grey claystone which is rich in isolated bones, almost entirely attributable to amphibians. The fossiliferous con-

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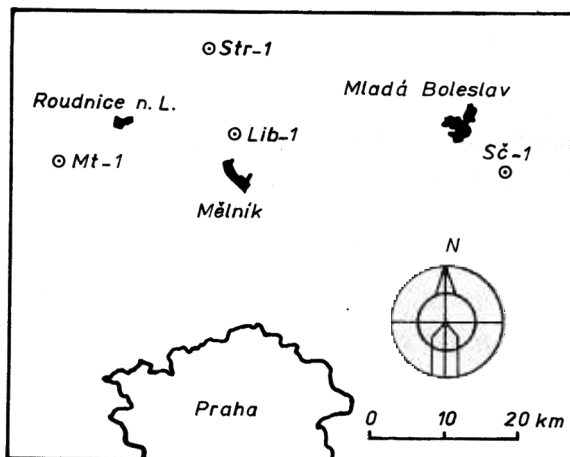


Fig. 1 The distribution of the boreholes mentioned in the text

tent of this layer contrasts strikingly with the content of other sediments within the Zdětín Horizon which bear local concentrations of fish remains, mostly scales of *Sphaerolepis kounoviensis*. This “tetrapod” claystone clearly corresponds to some specific environment, and must have occupied a relatively considerable area, the distance between the furthest recorded occurrences (Mt-1 and Sč-1) being 60 km. The thickness of the claystone is 70 cm in the borehole Lib-1 (eastern part of the Roudnice Basin). In the borehole Sč-1 (southwestern border of the Mnichovo Hradiště Basin), the layer bifurcates and the thicknesses are 75 cm (upper part) and 110 cm (lower part). Text-fig. 2 shows that, from west to east, the base of the Zdětín Horizon approaches the base of the Líně Formation, and that there is a simultaneous increase in thickness of the Zdětín Horizon and, generally, the “tetrapod” claystone. It may prove possible to utilize the “tetrapod” claystone layer to differentiate the Zdětín Horizon from the Klobuky Horizon (which belongs to the same biozone but has not yet been distinguished from the Zdětín Horizon on faunal grounds), and from prospective younger horizons. It is unfortunate that such an important fossiliferous layer is known from boreholes only.

The borehole Lib-1 passes through Quaternary sediments (0.0–2.5 m), Upper Cretaceous sediments (2.5–235.7 m), the Líně Formation (235.7–977.1 m), the Slaný Formation (977.1–1113.3 m), the Týnec Formation (1113.3–1260.5 m), the Kladno Formation (1260.5–1319.1 m), and Upper Proterozoic sediments (1319.1–1344.4 m). The amphibian described below comes from the “tetrapod” claystone of the Zdětín Horizon (Líně Formation, Stephanian C) from a depth of 736.3 m. The Zdětín Horizon is known only from boreholes but is well correlatable with the Ploužnice Horizon of the Semily Formation in the Krkonoše piedmont Basin (Tásler, Havlena, and Prouza 1981). Frič (1912) mentioned vertebrae and small bones of *Branchiosaurus* sp. from the Ploužnice Horizon at a railway cutting near Ploužnice. However this material was not described or figured, and its present location is unknown. Both the Zdětín and Ploužnice Horizons pertain to the *Sphaerolepis acme*-zone (see Zajíc, in press).

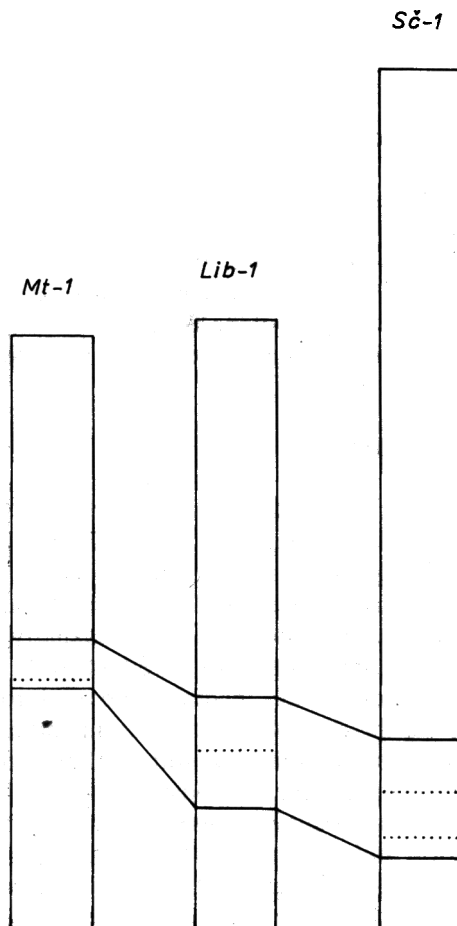


Fig. 2 Comparison of the generalized sections of the Líně Formation in boreholes Mt-1 (Kladno Basin), Lib-1 (Roudnice Basin), Str-1 (Roudnice Basin), and Sč-1 (Mnichovo Hradiště Basin), at a scale of 1:10,000. The Zdětín Horizon is identified, and is correlated within the Líně Formation. The "tetrapod" claystone is marked by dotted lines. The overlying sediments are Upper Cretaceous, and immediately underlying is the Slaný Formation. Compiled by Klener et al. (1985), Prouza et al. (1986), and Tásler et al. (1986)

Systematic paleontology

Order: *Temnospondyli*

Superfamily: *Dissorophoidea*

Family: *Micromelerpetontidae* Boy, 1972

Genus: *Branchierpeton* Boy, 1972

Type species: *Branchierpeton amblystomus* (Credner, 1881) Boy, 1972

Branchierpeton cf. *B. saalensis* Werneburg, in press a.

Synonymy: 1988 *Branchiosaurus* sp., Roček, p. 520.

Materia YA 1250, Geological Survey of Prague specimen

Locality: Borehole (Lib-1) near Liběchov, Roudnice Basin, Central Bohemia.
Horizon: Líně Formation, Zdětín Horizon, Stephanian C.

Description

The specimen is preserved in counterpart in a split core. It comprises a crushed disarticulated skull and articulated anterior postcranial skeleton. Most of the skeleton lies on one counterpart which has been partly prepared by one of the authors (J. Z.). This positive counterpart forms the basis of much of the description. The posterior region of the skeleton was missed by the core. The size of isolated elements suggests a skull length of 18–20 mm. No dermal scales are visible.

Skull roof

Only a few elements of the dermal skull roof can be identified with certainty, namely a left maxillary, the right postfrontal, both postorbitals, a supratemporal, both squamosals and quadratojugals. The anterior and posterior regions of the maxillary are preserved on different counterparts. The back of the maxillary terminates in an acute point. The maxillary bears a number of tiny teeth with conical crowns and appears to have had space for at least 28 such teeth. There appear to be some denticles medial to the tooth row. The postfrontal bears a thickened ridge along the concave orbital margin and narrows to a point anteriorly indicating that there was no common suture with the prefrontal, and hence that the frontal entered the orbit margin. The postorbitals have a more shallowly concave orbit margin and are broad shallow bones which could not have penetrated far between the supratemporal and squamosal. The supratemporal is an ovoid bone with an indentation in one long edge, giving it a kidney-like outline. It is present as a mould on the main slab and appears to have had a fine pitted ornament all over its outer surface. Each squamosal has a large semicircular concavity in its posterior edge which can only be a large otic notch. The squamosal extends laterally behind the level of the otic notch suggesting the presence of a jaw suspensorium at least as far back as the occiput. An elongate rectangular bone associated with the right squamosal may be the right quadratojugal. Other less certainly identifiable elements include a possible frontal.

Palate

The only palatal elements which can be identified with any confidence are a left palatine and the parasphenoid, both at the anterior end of the specimen. The palatine is an elongate curved triangular bone with a semicircular concavity at one end representing the margin of the choana. It is the left palatine visible in dorsal aspect and no dentition can be seen. The parasphenoid is situated on the counterpart (text-fig. 4; pl. II) and consists of a broad straight cultriform process and a widely

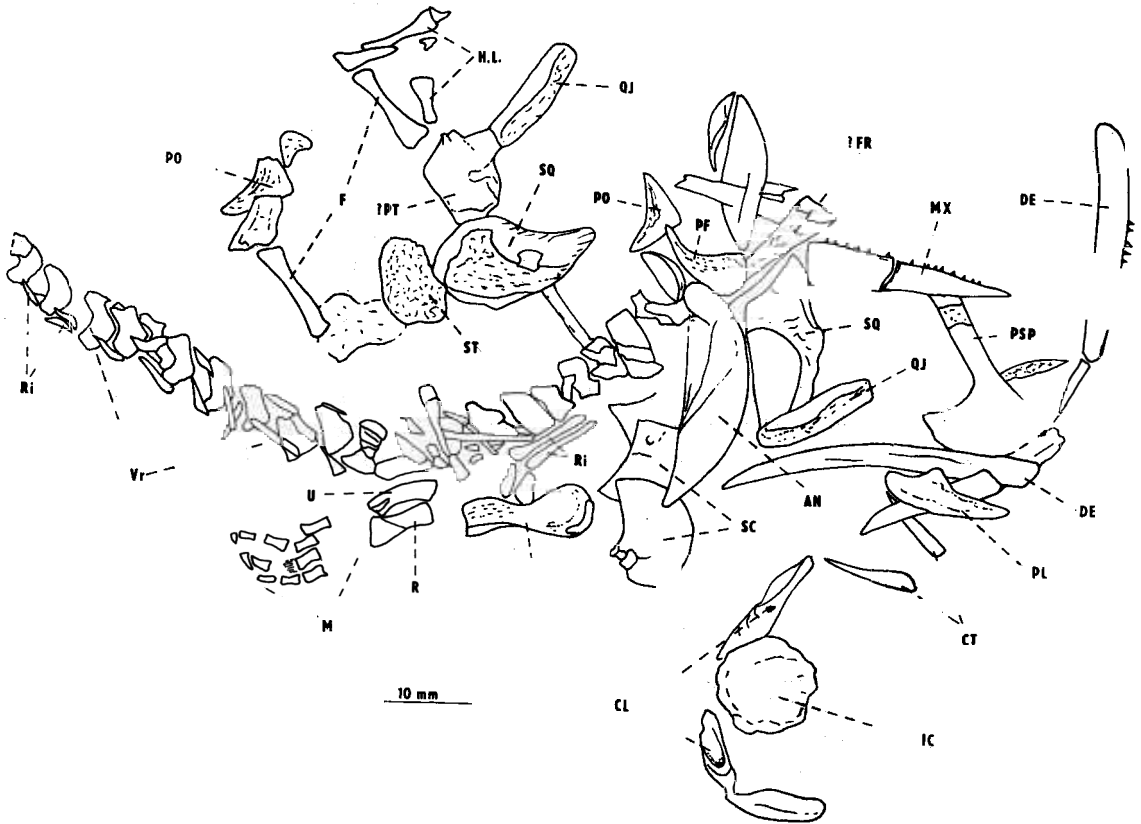


Fig. 3 Drawing of disarticulated skeleton of animal on core surface A. AN - angular; CL - clavicles; CT - cleithra; DE - dentary; F - femora; ?FR - frontal; H - humerus; H. L. - bones of hind limb; IC - interclavicle; M - part of manus; MX - maxillary; PF - postfrontal; PL - palatine, PO - postorbital; PSP - parasphenoid; ?PT - pterygoid; Qj - quadratojugal; R - radius; Ri - ribs; SC - scapulocoracoids; SQ - squamosal; ST - supratemporal; U - ulna; Vr - vertebrae

flaring basal plate. The entire structure resembles an inverted T in shape. The leading edges of the lateral processes of the basal plate are slightly concave and forward-directed. There are denticles covering the area at the base of the cultriform process. The mould of the cultriform process shows a pair of grooves at its base which were probably the carotid grooves. A disarticulated element near the left squamosal may be the left pterygoid in dorsal aspect.

Mandible

Anterior to the rest of the specimen is a long tooth-bearing element which appears to be the left dentary seen in lateral aspect. About six very tiny conical teeth are

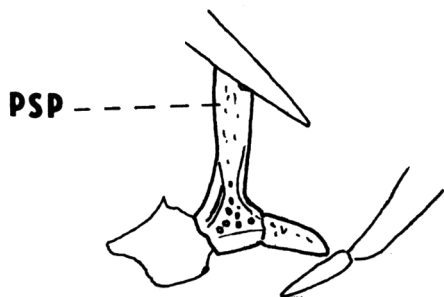


Fig. 4 Parasphenoid drawn after latex cast of core surface B (cf-plates I, II). PSP - parasphenoid

visible. Between 30 and 40 such teeth could have been present on the dentary. A long curved element between parasphenoid and palatine is probably the right dentary. A bone resembling an angular is also superimposed on other skull elements.

Axial skeleton

The anterior presacral column is made up of at least 18 vertebrae in articulation. The anterior nine trunk vertebrae are crushed together and partly obscured by ribs, but the following vertebrae are clearly seen in lateral aspect. The neural spines are very low and the posterior trunk vertebrae can be seen to be made up of paired neural arches only. There is no evidence of ossified centra. Straight ribs with slightly expanded ends are present and are elongate on several of the anterior trunk vertebrae becoming much shorter further back along the trunk.

Appendicular skeleton

The dermal pectoral girdle is preserved on one side of the skeleton. The interclavicle is an almost circular bone with radiating striae on all sides and some concentric ring-like marks. It is not longer than wide and has no posterior extension of any type. The interclavicle does not appear to be as heavily ossified as some other pectoral elements. The clavicles have narrow oar-like blades and must have only slightly overlapped the interclavicle. The cleithra are also present and have slender stems and oval caps. The right scapulocoracoid is preserved next to the right fore limb. It has a typical temnospondyl crescent-shape and the glenoid process is visible. The left scapulocoracoid is partly visible below the dorsal edge of the right scapulocoracoid.

The right forelimb is preserved in articulation. The humerus is slightly elongate and broad-ended with a distinct "waist". The ends are poorly ossified and there is no evidence of a supinator process. The radius and ulna are present and are incompletely ossified too. The carpals are not preserved and must have been unossified. The metacarpals and phalanges are present and show that the manus had four digits

with a phalangeal formula of 2.2.3.?. The phalanges are not elongate or slender. On the other side of the specimen are series of poorly preserved disarticulated elements, mostly phalanges, which may represent the left forelimb.

Systematic position

Despite the poor preservation of the skull, the specimen has sufficient morphological characteristics to permit its systematic position to be determined. It may be recognized as a temnospondyl amphibian by the combination of the following seven characteristics.

- 1.1. A large semi-circular embayment in the squamosal for an otic notch.
- 1.2. A parasphenoid with a broad cultriform process and a wide basal plate, associated with large interpterygoid vacuities.
- 1.3. Vertebrae of a small specimen (less than 300 mm long) with low neural spines and no ossified centra.
- 1.4. Trunk ribs straight and most relatively short.
- 1.5. Interclavicle bearing no posterior extension.
- 1.6. Humerus broad-ended but with a distinct "waist".
- 1.7. Manus with four digits.

The specimen may be recognized as a member of the Superfamily *Dissorophoidea* by the following characteristics.

- 2.1. The otic notch is extremely large and semi-circular and occupies the entire back of the squamosal. This is found only in the Superfamily *Dissorophoidea*, including the families *Dissorophidae*, *Branchiosauridae* and *Micromelerpetontidae*. The trimerorhachoids have a shallow otic notch or none at all and the eryopoids have a proportionately smaller otic notch.
- 2.2. The interclavicle is a short square-shaped bone and the clavicles have narrow blades. Most temnospondyls have large diamond-shaped, rhomboidal interclavicles and broad-bladed clavicles. Only the *Dissorophoidea* and the families *Zatrachydidae* and *Eryopidae* have the type of pectoral girdle found in this specimen (Milner, in press).
- 2.3. The humerus is slightly more elongate than is typical in temnospondyls and lacks a supinator process. These are characters of the humeri of most dissorophoid families, apart from the *Trematopidae* which have shorter humeri and retain a supinator process.

The second conclusion is that the specimen belongs to the temnospondyl superfamily *Dissorophoidea*, a group commonly represented in the Stephano-Permian of Europe by the *Branchiosauridae* and *Micromelerpetontidae*, and occasionally by the *Dissorophidae*. This specimen appears to be a small aquatic dissorophoid, either a larva or a neotenuous adult, probably the latter, as it is too large to be a larva. The unossified centra and carpals indicate an aquatic animal. Furthermore, there seem to be no dermal scales present, but this may be due to poor preservation. This suggests that it is either a micromelerpetontid or a branchiosaurid. The specimen may be recognized as a member of the *Micromelerpetontidae* by the following features.

3.1. The palatine is about twice as long as wide. That of branchiosaurids is much more abbreviated posteriorly, with similar length and width.

3.2. The parasphenoid bears denticles at the base of the cultriform process and along the posterior shaft of the cultriform. Only a few species of branchiosaurids bear denticles at the base of the cultriform, and none are known which have denticles both on the shaft and at the base.

3.3. The anterior trunk ribs are elongate and straight. This closely resembles the condition in *Micromelerpeton* (Boy 1972, Abb. 2). In branchiosaurids, the corresponding ribs are much shorter and stouter.

3.4. The interclavicle is round but larger than the clavicle blades and sufficiently well ossified to have surface features. In all branchiosaurids the interclavicle is small, poorly ossified and wider than it is long.

3.5. The specimen has none of the features to be expected in a dissorophid. It is not likely to be the larva of an armoured dissorophid as these have tall neural spines and dermal scutes even when they are small (Blot, 1974). It is not attributable to *Amphibamus* which has very long phalanges on the manus, and a very long humerus. Small *Amphibamus* with 20 mm skulls do have ossified carpals and centra.

The *Micromelerpetontidae* are a group of small temnospondyls known only from limnic deposits from the Westphalian to the Artinskian (= Upper Rotliegendes) of Europe. There are three genera, *Limnogyrinus* (2 species), *Branchierpeton* (3 species) and *Micromelerpeton* (1 species). The Liběchov specimen is most similar to *Branchierpeton saalensis*, recently described by Werneburg (in press a, b) because of the following characteristics.

4.1. The postfrontal appears to terminate in an anterior point, implying that there is no prefrontal-postfrontal suture. The specimen is thus more derived than *Limnogyrinus* and more closely related to *Branchierpeton* and *Micromelerpeton* (Werneburg in press b; Bild 8).

4.2. The elongate palatine is closest in shape to that of *Branchierpeton* species (e.g. *B. reinholdi*, Werneburg 1988; Abb. 12) although that of *B. saalensis* is not known. Those of *Limnogyrinus* and *Micromelerpeton* are shorter (Werneburg in press b, Bild 11).

4.3. On the counterpart, the anterior edge of the basal plate of parasphenoid flares forwards on either side of the point of insertion of the cultriform process. This occurs in *B. saalensis* but not in other micromelerpetontids (Werneburg in press b; Bild 11).

4.4 The interclavicle bears a close resemblance to that of *B. saalensis* (Werneburg in press b; Bild 11). It is almost circular with radiating striae all round, but with little evidence of central pitting. Other micromelerpetontids either have square interclavicles (*Micromelerpeton*), slightly elongate interclavicles (*Limnogyrinus*), or a concentration of anterior striae only (other *Branchierpeton* species).

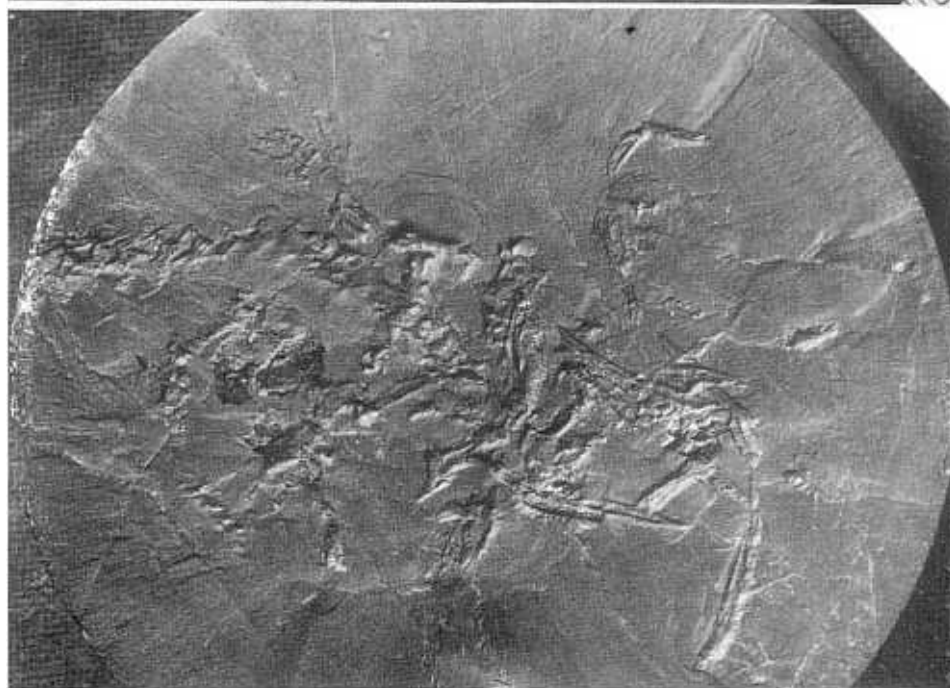
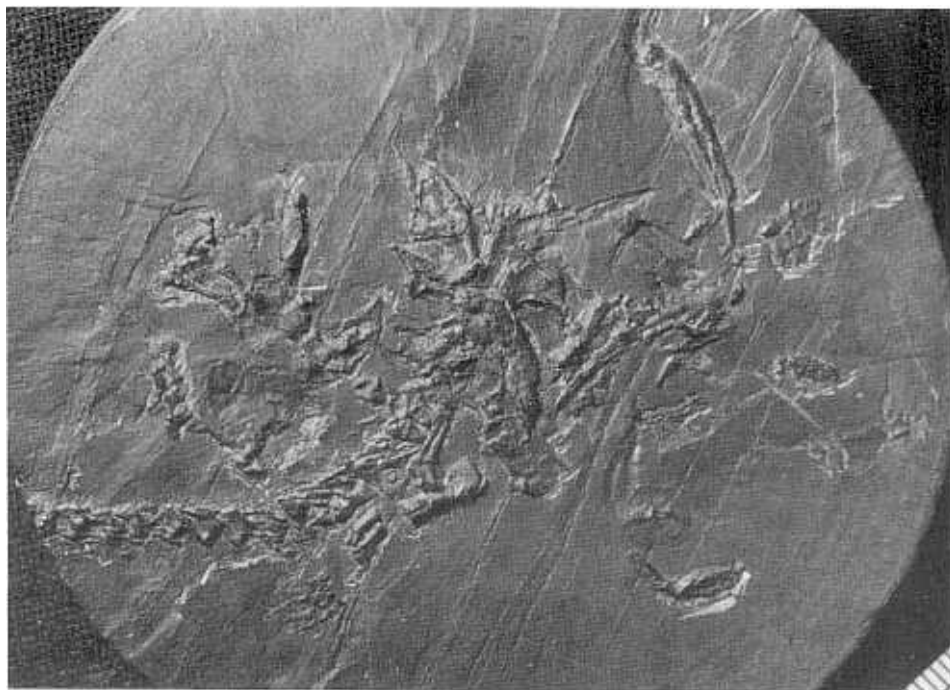
Discussion

The specimen bears a closer morphological resemblance to *Branchierpeton saalensis* than to any other micromelerpetontid. Because the skull is only visible as scattered elements, it cannot be positively assigned to that species and is simply re-

ferred to it as *Branchierpeton* cf. *B. saalensis*. The type specimen of *B. saalensis* was recently described and named by Werneburg (in press a). It came from the Wettin Beds at Petersberg near Halle (DDR) in the Saale Basin, and is of Stephanian C age. Another specimen referred here by Werneburg (op. cit.) comes from either the Wettin or Halle Beds at Lobejun near Halle and was originally described by Chryploff and Kampe (1958) as a specimen of *Branchiosaurus* cf. *amblystomus*. This specimen is of either Stephanian C or basal Autunian age. Werneburg (in press b) suggested that *B. saalensis* could be used as a zone-fossil to characterize Stephanian C/basal Autunian horizons in the European limnic basins and this is consistent with such an age for the Zdětín Horizon at the Liběchov borehole.

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Branchierpeton cf. *B. saalensis* (YA 1250), total view, 1 - the core surface A, $\times 1.5$; 2 - the core surface B, $\times 1.5$.

Photos by J. Zajíc



Branchierpeton cf. *B. saalensis* (YA 1250), detail of part of core surface B, $\times 3,3$. DE - dentary; MX - maxillary; PL - palatine; PSP - parasphenoid; QJ - quadratojugal; SQ - squamosal.
Photos by J. Zajíč