

Sbor. geol. věd	Paleontologie 30	Pages 37–59	2 figs.	1 tab.	4 pls.	Praha 1989 ISSN 0036-5297
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## The hyoliths of the Králův Dvůr Formation (Bohemian Ordovician)

### Hyoliti královského souvrství českého ordoviku

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Received October 6, 1986

MAREK L. (1989): The hyoliths of the Králův Dvůr Formation (Bohemian Ordovician). -- Sbor. geol. Věd, Paleont., 30, 37–59. Praha.

**Abstract:** All known species of hyoliths from the Králův Dvůr Formation of the Bohemian Ordovician are described or their descriptions completed. The species are attributed to appropriate genera. In the Králův Dvůr Formation the following genera were ascertained: *Circotheca*, *Nephrotheca*, *Panitheca*, *Bactrotheca*, *Elegantilites*, *Joachimilites*, *Gompholites*, *Leolites*, *Decipilites*, *Recilites?* and probably *Sololites*. Seven new species and 2 new genera, *Mediolites* gen. n. and *Raitilites* gen. n. were established. At present, 15 species of hyoliths are known from the Kralodvor, 4 of them in the open nomenclature.

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#### Introduction

During a systematic field paleontological research in the Bohemian Ordovician a rich material of hyoliths was collected in the Králův Dvůr Formation, enabling to widen substantially our knowledge of the character of hyolith assemblages of this stratigraphical unit. It appeared that a number of significant genera known from earlier formations (Llanvirn, Dobrotiv and mainly Beroun) passed into the Kralodvor where their occurrence ends. From the overlying Kosov Formation, the youngest unit of the Bohemian Ordovician, only two indeterminable fragments of hyolithids were ascertained.

#### History of the research

The history of the research of hyoliths from the Králův Dvůr Formation is very brief and the bibliography is restricted to only three items, above all to the monographs of J. Barrande and O. Novák. BARRANDE (1867) described from the Kralodvor (the lower part of his band Dd5) two species: *Hyolithes decipiens* BARR. and

*H. indistinctus* BARR. According to BARRANDE, the occurrence of the first species mentioned is limited only to Dd5, whereas *H. indistinctus* is reported incorrectly by this author also from the Vinice and Zahořany Formations (Barrande's bands Dd3 and Dd4). BARRANDE also mentioned the occurrence of two other species in the Králův Dvůr Formation, namely *H. striatulus* BARR. and *H. undulatus* BARR. The occurrence of these species in the band Dd5 was already refuted by NOVÁK (1891).

NOVÁK (1891) added to the list of the Kralodvorian hyoliths two new valid species, *Bactrotheca deleta* Nov. and *Hyolithus sulcatulus* Nov.

MAREK (1977) established a new genus *Decipilites* based on *Hyolithes decipiens* BARR. and ranged it to the family *Pauxillitidae*.

Such was the state of knowledge of hyoliths of the Králův Dvůr Formation, when the work on this paper began. Only four species were known from which no one (with the exception of *Bactrotheca deleta*) could be used to clear up the relations of generic hyolith assemblages of the Kralodvor to those of earlier Bohemian Ordovician Formations.

### Localities and mode of preservation

There are not many localities available in the Králův Dvůr Formation and localities yielding hyoliths are scarce. It appeared that the layer richest in hyoliths lies close to the base of overlying Kosov Formation. This fossiliferous layer formed by dark grey-green clayey shales and calcareous shales crops out on several places of the Prague Basin, but the greatest part of the material derives from Mt. Kosov near Králův Dvůr. Other finds of hyoliths in the Králův Dvůr Formation were made only occasionally, partly in temporary outcrops. The list of localities yielding the material for this paper is given below.

Kosov — abandoned quarry at the NW slope of Mt. Kosov above the cement factory at Beroun-Králův Dvůr. In the SW part of this quarry the above mentioned layer with hyoliths and other fauna was exposed in the uppermost parts of the Králův Dvůr Formation about 1.6 m below the base of the Kosov Formation (MAREK 1952, 1964). This layer was known already to Barrande from some other place at the foot of Mt. Kosov. Below the shales with abundant hyoliths about 40 cm thick, lies a calcareous layer maximum 30 cm thick, containing also common hyoliths (*Bactrotheca*, *Panitheca*, *Sololites*?) besides a rich assemblage of trilobites and brachiopods: *Duftonia morrisiana*, *Cryptolithus kosoviensis*, *Stenopareia oblita*, *Zdicella sola*, *Diacalymene asperula*, *Staurocephalus clavifrons*, *Aegironetes tristis*, *Kozlowskites rangari*, etc.

The above mentioned layers were also exposed in the railroad cutting at Zadní Třeboň, in a steep hillside near the village Karlík and at Liteň. CHLUPÁČ (1951, 1952) reports some hyolith species from these localities, now practically inaccessible.

Králův Dvůr — Barrande's classic locality at the sheep farm ("U ovčína") close to the fork of roads to Suchomasty and to Karlova Huť. This locality has been inaccessible for about three decades and new material could not be therefore collected. The material housed in the collections of the National Museum and partly in the Paleontological Department of the Faculty of Natural Sciences, Charles University, Prague is mostly very poorly preserved in greenish claystones.

Lejškov — another classic, long forgotten locality of Barrande, rediscovered more than 30 years ago by the present author. This locality lies in the ravin between the western part of the hill Lejškov and Libomyšl. Fossiliferous dark gray claystones crop out in the bed of a creek NE of the former farmhouse called Vyšebohy and are hardly accessible as they lay under the water level. The claystones contained small calcareous nodules with perfectly preserved trilobites and rare hyoliths [*Elegantilites* cf. *indistinctus* (BARR.)]. A small number of compressed and deformed hyoliths was found also in the claystones.

Praha-Spořilov. Lower layers of Králův Dvůr Formation were temporarily uncovered during building of new houses SE of the tram terminal between the present (1987) streets Na Chodovci and Hrusická. Greenish claystones yielded here a fairly rich fauna with prevailing trilobites: *Amphitryon radians* (BARR.), *Raphiophorus tenellus* (BARR.), *Carmon mutillus* BARR., *Areia bohémica* BARR. etc. Common hyoliths are represented by new taxa, but the specimens are strongly compressed.

Praha-Nusle (Jezerka). A thin calcareous layer stratigraphically corresponding to the layer from Kosov is exposed in the park above the Nuselská Street. The faunistic assemblage is composed of brachiopods, trilobites etc., hyoliths are rare and poorly preserved.

Praha-Michle (Rajtknechtka). Temporary outcrops SW of Tyršův vrch hill made in early eighties. Exposed here was an oolitic layer yielding a rich and well preserved fauna showing certain affinities to the fauna of the upper Bohdalec Formation. However, this layer called the "Podolí ore horizon" is conventionally ranged to the base of the Králův Dvůr Formation. *Bactrotheca rediviva* is the most common hyolith in this locality, undeterminable species of *Elegantilites* occurs scarcely.

A great deficiency of the material studied is its strong pressure deformation in claystones and clayey shales. This mode of preservation prevents to ascertain the outline of the cross-section of conchs and their contingent curvature. The only exception is the scarce material from Lejškov, collected in the last century and represented by calcareous internal molds. Uncompressed is also the material from the oolitic rock on the base of the Králův Dvůr Formation.

Most specimens are preserved as composite molds enabling in many cases to distinguish the dorsal and ventral sculptures on the conchs and to ascertain the number and position of clavicles on the opercula. Also the position of the bases of cardinal processes can be observed but the detailed morphology of all these structures remains unknown.

**Relations of the Kralodvor hyoliths  
to the older Ordovician hyoliths in Bohemia**

Despite very unfavourable preservation of the material studied it was possible to ascertain in the Králův Dvůr Formation the occurrence of ten hyolith genera of the orders Orthothecida and Hyolithida, known from older formations: *Circotheca*, *Bactrotheca*, *Nephrotheca*, *Panitheca*, *Elegantilites*, *Joachimilites*, *Gompholites*, *Sololites*, *Cavernolites*, *Pauxillites*, *Recilites*, *Leolites*, *Decipilites*, *Mediolites*, *"Carmolites"*, *Neurolites*, *Chimerolites*, *Raitilites*.

Table 1  
Distribution of hyolith genera in the Bohemian Ordovician

Formations Genera	Klabava	Šárka	Dobrotivá	Libeň	Letná	Vínice	Zahořany	Bohdalec	Králův Dvůr
<i>Circotheca</i>			○						○
<i>Nephrotheca</i>	○?	○	○				○	○	○
<i>Panitheca</i>			○				○	○	○
<i>Bactrotheca</i>		○	○	○			○	○	○
<i>Brevitheca</i>							○		
<i>Elegantilites</i>	○	●	○	○		○	○	○	○
<i>Joachimilites</i>							○	○	○
<i>Eumorpholites</i>				○			○	○	
<i>Gamalites</i>			○						
<i>Dilytes</i>		○							
<i>Gompholites</i>		○	○			○	○	○	○
<i>Sololites</i>						○			○?
<i>Cavernolites</i>		○	○						
<i>Pauxillites</i>		○	○						
<i>Recilites</i>					○	○	○	○	○?
<i>Leolites</i>					○	○	○		○
<i>Decipilites</i>									○
<i>Mediolites</i>									○
<i>"Carmolites"</i>				○					
<i>Neurolites</i>			○						
<i>Chimerolites</i>							○		
<i>Raitilites</i>									○
Number of genera	2	7	10	4	2	5	11	8	13

*lites*, *Leolites*, *Recilites*? and probably also *Sololites*. The other characteristic Ordovician hyolith genera known from Llanvirn, Dobrotiv and Beroun have not been found in Kralodvor as they most probably became extinct. They are for instance *Cavernolites*, *Pauxillites*, *Eumorpholites*, *Gamalites* and "*Carinolites*". On the other hand, the genus *Decipilites* is known only from the Králův Dvůr Formation (see tab. 1 showing the stratigraphical range of the Bohemian Ordovician hyolith genera).

### Systematic part

Class *Hyolitha*

Order *Orthothecida* MAREK, 1966

*Circothecidae* MISSARZHEVSKI, 1969

*Circotheca* SYSSOIEV, 1958

Type species: *Hyolithes (Orthotheca) stylus* HOLM, 1893. Middle Cambrian, Sweden.

*Circotheca neptis* sp. n.

Pl. I, figs. 1, 2

Holotype: Incomplete conch, figured here on pl. I, figs. 1, 2. LM 186.

Stratum typicum: Králův Dvůr Formation.

Locus typicus: Praha-Kačerov?.

Material: Only holotype, incomplete steinkern and counterpart underformed in nodule.

**Description:** Conch of circular cross-section. The fragment does not allow to recognize, whether the conch was straight or curved. The aperture is perpendicular to the longitudinal axis of conch. Its margin is almost straight, only very slightly anteriorly arched on the ventral side and posteriorly arched on the dorsal side. The thickness of the shell-wall decreases rapidly close to the edge of the aperture. This is perceptible on the steinkern at a comparatively sharply bordered vaulting around the aperture. The angle of divergence measured on the steinkern makes 6—7 degrees.

The surface of the conch bears very obscure fine growth-lines, visible only on few places.

The operculum is unknown.

**Dimensions:** The length of the conch is estimated for only a little over 20 mm. The diameter of the aperture measured on the steinkern is 2.8 mm.

**Remarks:** The conch of the type species of *Circotheca*, *C. styla* (HOLM) from the Swedish Middle Cambrian bears longitudinal elements of the sculpture men-

tioned by HOLM (1983, p. 53) and well preserved in some specimens from Holm's collection housed in the Swedish Geological Survey in Uppsala (Paleont. Coll. SGU, No. 292). *Circotheca hofensis* (BARRANDE, 1868), *C. caperae* MAREK, 1983 b (both Tremadocian species) and few other yet undescribed Lower and Middle Cambrian and Ordovician species of this genus bear a characteristic sculpture of narrow undulating or zig-zag longitudinal lamellae. *Circotheca neptis* sp. n. is lacking in longitudinal sculpture. In this feature, *C. neptis* differs from other known Ordovician species and represents the youngest species of circothecid hyoliths yet known.

Occurrence: This species was found in one nodule coming doubtless from the Králův Dvůr Formation as proved by associated trilobite species *Lonchodomas portlocki* (BARR.) and *Carmon mutillus* (BARR.). The last mentioned species indicates the lower parts of the above formation. The nodule derives from the dump at Praha-Zbraslav. The rock material came most probably from the excavations of the Prague Metro at Praha-Kačerov.

### *Orthothecidae* SYSSOIEV, 1958

#### *Nephrotheca* MAREK, 1966

Type species: *Orthotheca sarkaensis* NOVÁK, 1891. Ordovician (Šárka Formation), Bohemia.

#### *Nephrotheca ruderalis* sp. n.

Pl. I, figs. 3, 4; text-fig. 1

Holotype: Steinkern, figured here on pl. I, fig. 3. LM 187.

Stratum typicum: Králův Dvůr Formation.

Locus typicus: Praha-Kačerov?

Material: In addition to the holotype, two more specimens undeformed by pressure.

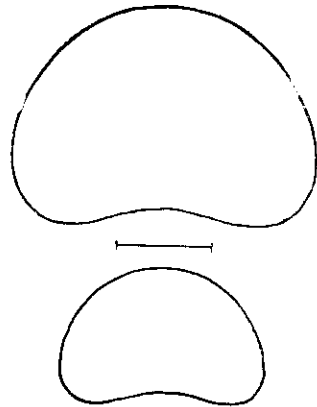
Description: The conch is dorso-ventrally curved, its posterior part bent slightly upwards. The cross-section is kidney-shaped. The angle of divergence makes about 12 degrees. W/h ratio = 1.4. The dorsal side is strongly inflated, the ventral side is concave. The lateral edges are strongly rounded and lie at about one-third height of the conch. The ventral apertural margin is straight, with its central part almost imperceptibly adapically arcuated. The dorsal apertural margin is broadly arched adapically. The aperture is oblique in lateral view, with its lateral margin inclined upwards and backwards in a very moderate arc. The depth of the ventral concavity equals approx. one-thirteenth height of conch and its width attains about three-fifths of conch's breadth. The internal surface of conch is smooth, without any trace of muscle scars.

Ventral side bears very low, comparatively broad rounded riblets. They number

6—7 per mm close to the aperture. Same riblets are developed on the dorsal side, where they are less marked.

The operculum is unknown.

**Dimensions:** Adult conch attained an estimated length minimum of 14 to 15 mm. Apertural width of the holotype amounts to 3.0 mm, height equals 2.15 mm.



1. *Nephrotheca ruderalis* sp. n., cross-sections of steinkern, LM 187 (pl. I, fig. 3). Bar = 1 mm

**Remarks:** Although the operculum of this species is unknown, the morphology of the conch witnesses its appurtenance to the genus *Nephrotheca*. It is the shape of the cross-section, which is kidney-shaped and very similar to that of the type species of *Nephrotheca*, *N. sarkaensis* (NOVÁK) and the presence of rounded longitudinal riblets. *N. ruderalis* sp. n. differs from the above mentioned species in more concave ventral side (one-thirteenth height of conch against one-fifteenth in *N. sarkaensis*) and in smaller number of riblets on ventral side (6—7 per mm in the new species, about 9 in *N. sarkaensis*).

**Occurrence:** This species was found in the same nodule as *Circotheca neptis* sp. n. and derives also most probably from the diggings in Praha-Kačerov.

*Nephrotheca?* sp. n.

Pl. I, fig. 15

**Material:** 1 compressed conch in claystone.

**Description:** Only the ventral side of this species is known, showing, despite of its unfavourable preservation, that the conch was concave in its axial part. The ventral apertural margin is straight but other details of the shape of aperture are unknown. The angle of divergence was not worth measuring due to substantial distortion.

The surface of the ventral side is smooth except for very fine transverse growth-lines close to the aperture.

Dimensions: The length of conch measures 16 mm, the width of aperture makes 4.9 mm.

Remarks: This specimen most probably represents a new orthothecid species that can be ranged tentatively and with certain doubts to the genus *Nephrotheca*, although it is lacking in longitudinal sculpture. Such a morphological type was as yet unknown among the Bohemian Ordovician representatives of the family *Orthothecidae*. Two orthothecid species without longitudinal sculpture of the conch have been described by MAREK (1983) from the Ordovician of Morocco. They are *Nephrotheca? destombesi* and *Nephrotheca? sp.*, both hardly comparable with the Bohemian species, due to different preservation. A similar morphological type can be found in the Middle Cambrian species "*Orthotheca*" *affinis* HOLM, 1893.

Occurrence: Lejškov (Barrande's collection).

### *Panitheca* MAREK, 1967

Type species: *Panitheca collector* MAREK, 1967. Ordovician (Zahořany Formation), Bohemia.

### *Panitheca* aff. *collector* MAREK, 1967

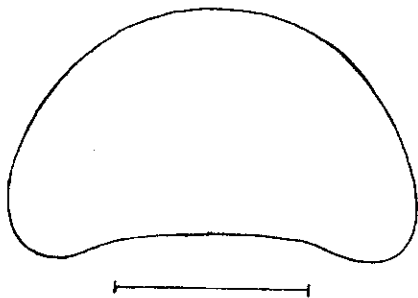
Pl. I, figs. 5–7; text-fig. 2

Material: One almost complete conch and two fragmentary conchs.

Description: Conch narrow, elongate, the angle of divergence measured on compressed specimen makes about 12 degrees. The cross-section is kidney-shaped with broadly concave ventral side and almost semicircular dorsal side. Strongly rounded lateral edges lie at about one-fifth height of the conch, w/h index = 1.65. The shape of the aperture can be reconstructed from the course of very fine growth-lines which are almost straight both on the ventral and dorsal sides.

The sculpture consists of very thin longitudinal zig-zag lamellae of unequal width, counting about 15 per mm. The growth-lines are faint.

The operculum is unknown.



2. *Panitheca* aff. *collector* MAREK, cross-section  $\frac{1}{2}$  of conch, LM 190 (pl. I, fig. 7). Bar = 1 mm



**Dimensions:** The almost complete specimen (LM 189) measures 21.0 mm in length.

**Remarks:** This species is very similar to *Panitheca collector* from the upper Zahořany and Bohdalec Formations. The only perceptible slight difference between these two species is in the outline of the cross-section. The lateral edges in *P. collector* lie at about one-seventh to one-eighth height of the conch, while in this species at about one-fifth height. This ratio was obtained from the measurement of only one specimen and is therefore not very reliable. A new, better preserved material is necessary for final decision on this question. *P. aff. collector* is the youngest representative of the genus *Panitheca* in the Ordovician as yet known.

**Occurrence:** This species was found only at Kosov.

### *Bactrotheca* NOVÁK, 1891

Type species: *Hyolithes teres* BARRANDE, 1867, Ordovician (Llanvirn), Bohemia.

### *Bactrotheca deleta* NOVÁK, 1891

Pl. I, figs. 8–10

1891 *Bactrotheca deleta* NOV.; NOVÁK, p. 35, pl. 6, figs. 17–21.

1893 *H. (O.) deletus* (NOV.); HOLM, p. 24.

1946 *H. (O.) deletus* (NOVÁK), 1891; SINCLAIR, p. 75.

1962 *O.?* *deleta* NOV.; SYSSOIEV, p. 10.

Lectotype: Specimen figured by NOVÁK (1891) on pl. 6, fig. 17. NM L 26105.

Stratum typicum: Králův Dvůr Formation.

Locus typicus: Králův Dvůr.

Material: 12 conchs and 2 opercula.

**Description:** The conch is elongated, narrow, the angle of divergence of flattened conch makes about 11–12 degrees. The cross-section of conch is unknown but from the outline of operculum it is possible to deduce that it was roundedly quadrangular. The aperture is straight but its exact shape is unknown.

The sculpture consists of sharp, comparatively sparsely spaced longitudinal lamellae (5–7 per mm at the aperture), crossed by more densely spaced and a little less distinct transverse lamellae. The crossing of the lamellae gives the sculpture a lattice-like appearance. The spaces between the longitudinal and transverse lamellae have the form of rectangles with concave planes (convex on external molds).

The operculum is subrectangular with slightly arched lateral sides, distinct broadly diverging plicae and one pair of cardinal processes of unknown shape.

**Dimensions:** The length of conch exceeded 20 mm; the conch of the lectotype is 19.5 mm long, its width at the aperture attains cca 4.5 mm.

**Remarks:** This species is similar to *B. teres* NOVÁK from the Šárka Formation

(Llanvirn) which differs in bigger size of conchs and in the sculpture that is less distinctly lattice-like. The operculum of this species has more rounded edges. Another Bohemian species, *B. rediviva* (MAREK) from the Berounian differs in closely spaced undulated lamellae which are the dominant sculpture of the conch in this species. *B. quadrangularis* (HOLM) from the Swedish lower Ordovician bears a fine longitudinal sculpture and all four sides of its conch are slightly concave. Much smaller *B. aetherica* sp. n. has more numerous riblets.

Occurrence: *B. deleta* was found at Králův Dvůr and at Kosov.

*Bactrotheca aetherica* sp. n.

Pl. I, figs. 11–14

Holotype: Conch and operculum, figured herein on. pl. 1, fig. 11. LM 192.

Stratum typicum: Králův Dvůr Formation.

Locus typicus: Praha-Spořilov.

Material: 26 conchs and 3 opercula compressed in clayey shale.

Description: Small conchs with average angle of divergence of about 13 degrees (measured on ventral sides of flattened conchs). Their cross-section was subtrapezohedral as deduced from the outline of the operculum. The aperture was straight; its exact shape is unknown, except for the ventral apertural margin, which was very moderately arched backwards. The apical part of the conch was septate, with at least 8 chambers.

The sculpture consists of very fine longitudinal riblets counting about 30 per mm for the width of conch equalling 2 mm. Less prominent are faint transverse growth-lines.

Operculum of subtrapezohedral outline has well developed folds with their lateral margins converging at the apex at about 72 to 74 degrees. The apex lies at about one-fourth length of the operculum. The lateral margins of operculum are almost straight. There are no visible traces of any sculpture on the external surface. The internal surface is practically unknown. There were two cardinal processes close to the apex of unknown shape and probably two low ridges running from the bases of cardinal processes along lateral margins of the operculum.

Dimensions: The longest, almost complete specimen known measures 14.5 mm. The dimensions of the holotype: length of the conch — 11.5 mm; width of the operculum — 2.0 mm, length of the operculum — 1.4 mm.

Remarks: This species differs from all known species of *Bactrotheca* in its small size and very fine longitudinal riblets. The riblets in *B. deleta* Nov. number only about 7 per mm at the width of conch equalling 4 mm. The operculum of *B. aetherica* sp. n. has less rounded edges than that of *B. deleta* and other species.

Occurrence: *B. aetherica* sp. n. was found only in the lower layers of the Králův Dvůr Formation at Praha-Spořilov.

*Hyolithida* SYSSOIEV, 1957

*Hyolithidae* NICHOLSON, 1872

*Elegantilites* MAREK, 1966

Type species: *Pugiunculus elegans* BARRANDE, 1847. Ordovician (Zahořany Formation), Bohemia.

*Elegantilites indistinctus* (BARRANDE, 1867)

Pl. II, figs. 1—5

1867 *Hyolithes indistinctus* BARR.; BARRANDE, p. 83, pl. 9, figs. 1—4.

1891 *Hyolithus indistinctus* BARR.; NOVÁK, p. 21, pl. 5, figs. 5—9.

1893 *Hyolithes* (*H.*) *indistinctus* BARR.; HOLM, p. 25.

1946 *H. indistinctus* BARRANDE 1867; SINCLAIR, p. 77.

1962 *Linevitus indistinctus* (BARRANDE); SYSSOIEV, p. 23.

Lectotype: Compressed composite mold of conch, figured by BARRANDE (1867) on pl. 9, fig. 4. NM L 22002.

Stratum typicum: Králův Dvůr Formation.

Locus typicus: Králův Dvůr.

Material: In addition to the lectotype, 11 conchs and 4 opercula.

Remarks: The lectotype is a strongly compressed composite mold with the ventral side up. About six septa are developed in the apical part. Ligula is asymmetric due to the deformation. The surface is practically smooth except for a few indistinct growth-lines. Only one specimen, attributed by NOVÁK (1891, pl. 5, fig. 8) to the species *indistinctus*, bears in the dorsal side a sculpture, composed of very fine, by naked eye invisible transverse and longitudinal striae, which probably represent the sculpture of the inner layer of the wall. It is difficult to confirm the specific identity of this specimen with *E. indistinctus*. The non compressed specimens from Lejškov, figured by BARRANDE (1867, pl. 9, figs. 2, 3) and by NOVÁK (1891, pl. 5, figs. 5—7) are internal molds showing indistinct transverse, irregularly spaced vaultings. The same holds for other four specimens from the same locality. The septa in the apical part of the conch are developed also in other species of *Elegantilites* (*E. benignensis*, *E. elegans*, *E. euglyphus*, *E. hejarensis*) and are not of specific importance. No traces of septa have been ascertained in undeformed internal molds from Lejškov. The cross-section of these conchs is roundedly dome-shaped, with distinctly less inflated ventral side than dorsal side. Rounded lateral edges lie approx. at two-fifths height of the conch. The shape of the cross-section is unknown in the flattened conch with septa and thus the comparison of differently preserved material is impossible. Only the smooth surface of the conch remains as specific feature of *E. indistinctus*.

The opercula belonging to the genus *Elegantilites* and most probably to this species, have distinctly narrower (sag, exsag.) cardinal shield (about one-seventh

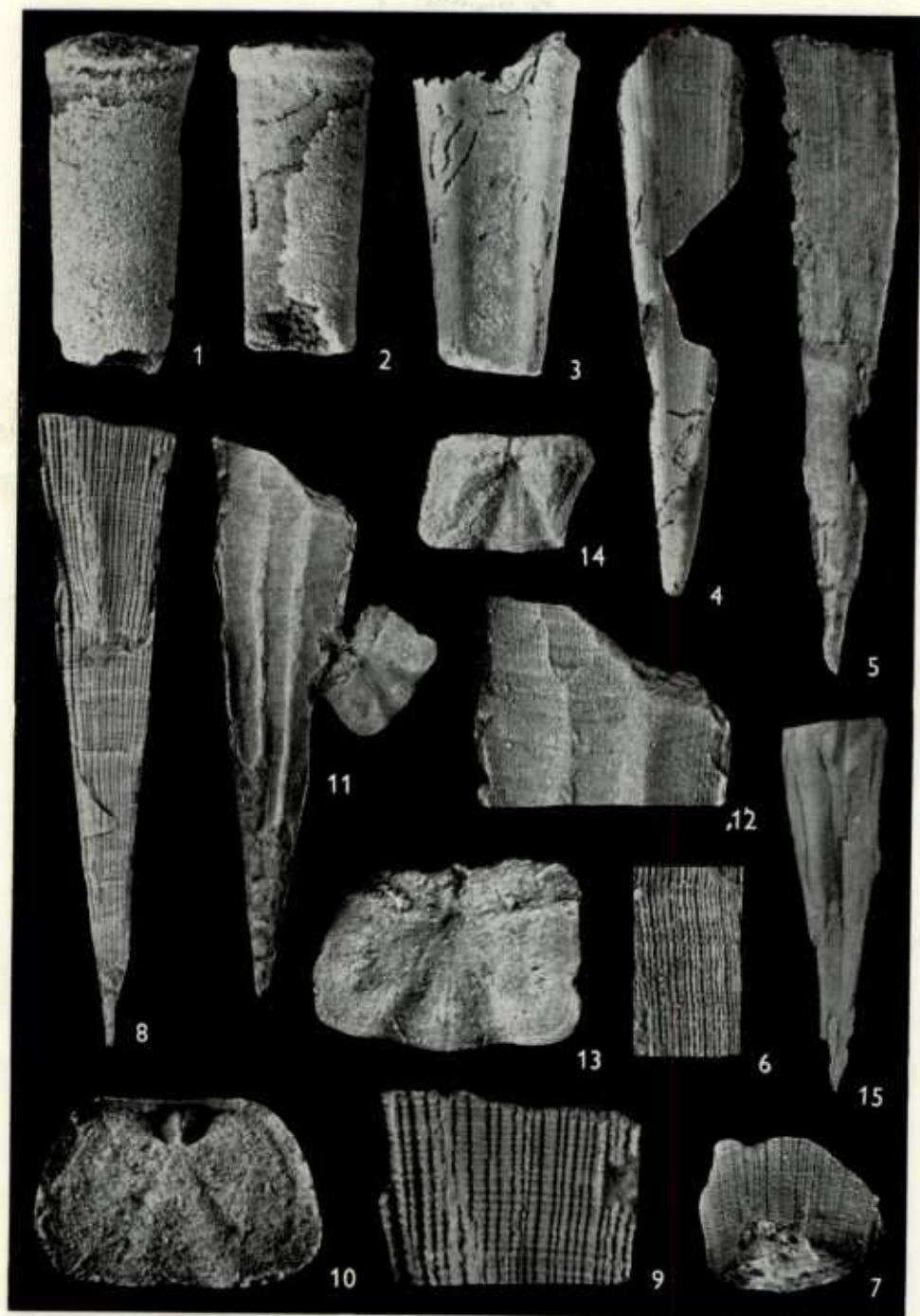
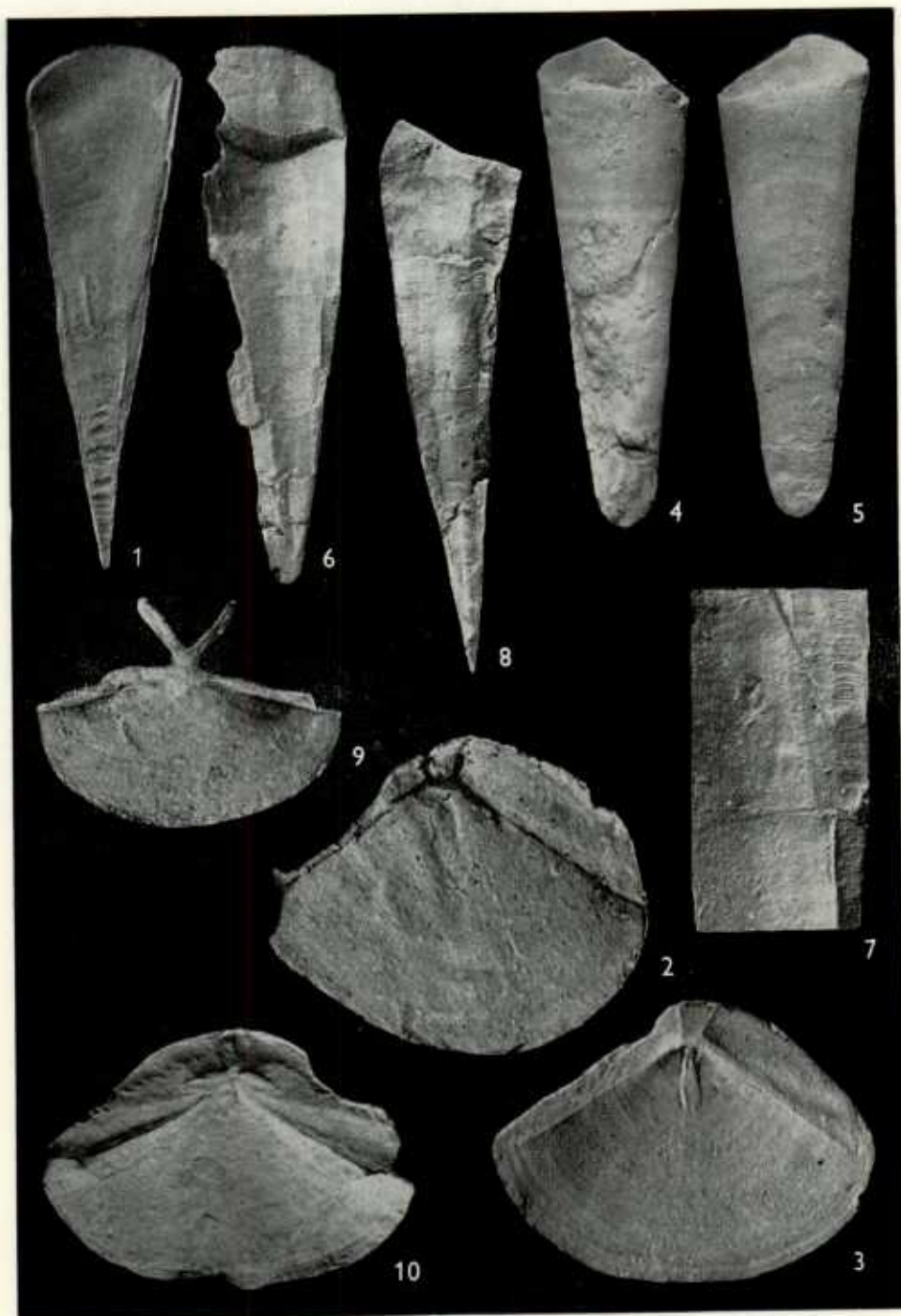
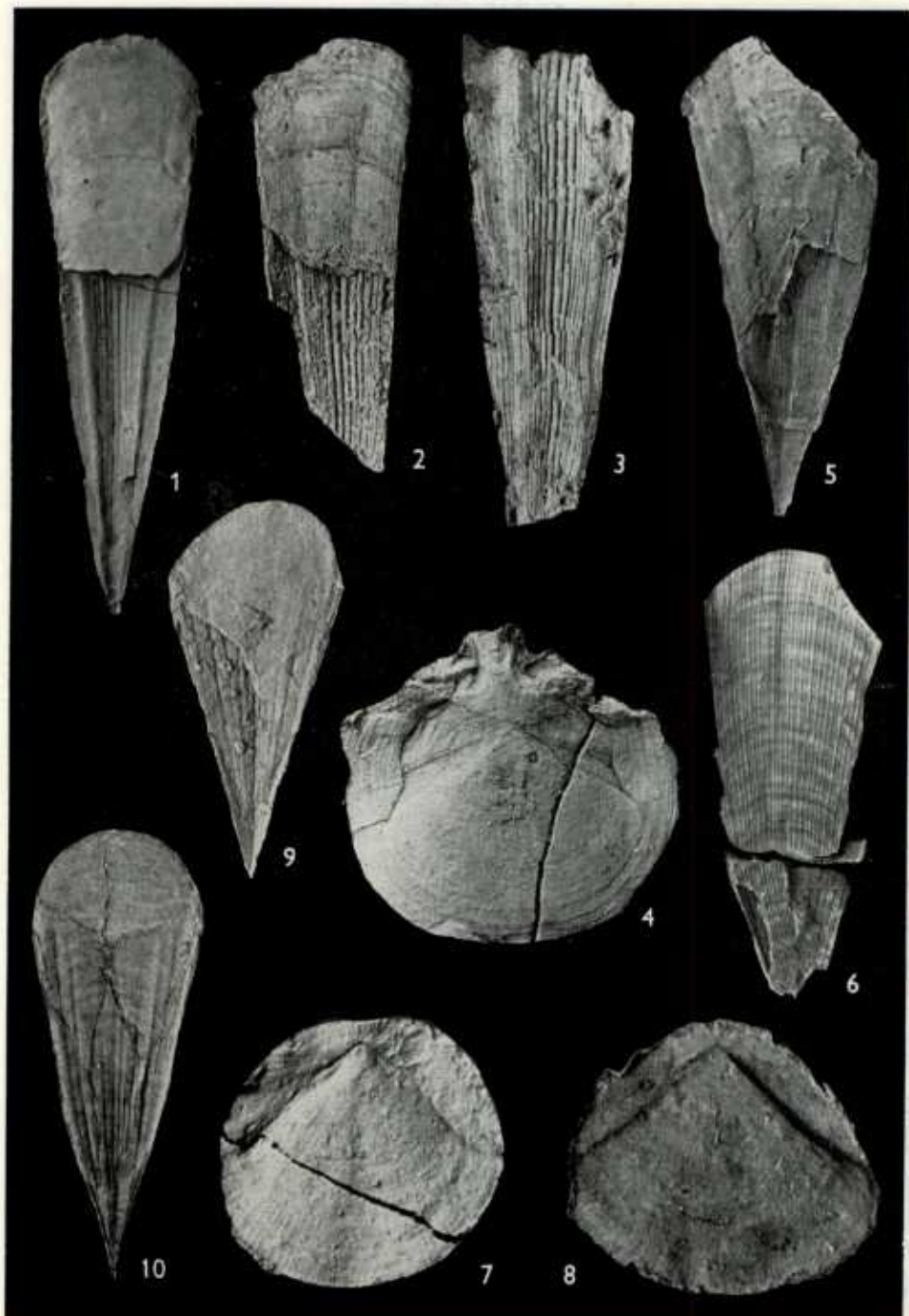
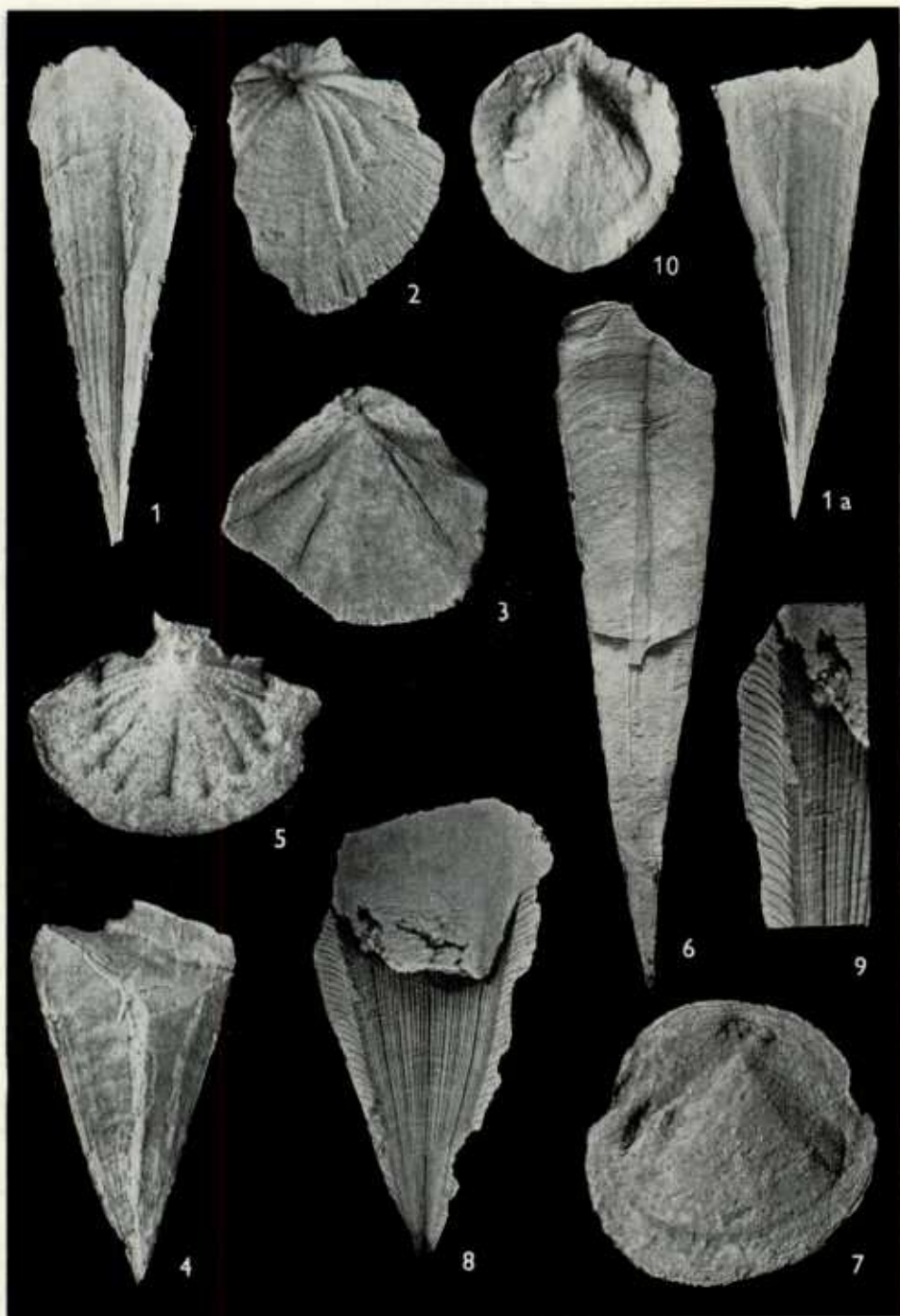


Illustration of the fossils of the Lower Devonian  
(continued)







*Sololites* MAREK, 1967

Type species: *Sololites ferrigenus* MAREK, 1967. Ordovician (Vinice Formation), Bohemia.

*Sololites?* *sulcatulus* (NOVÁK, 1891)

Pl. III, figs. 1–4

1891 *Hyolithus sulcatulus* NOV.; NOVÁK, p. 26, pl. 3, figs. 22–24.

1893 *H. (H.) sulcatulus* NOV.; HOLM, p. 25.

1946 *H. sulcatulus* NOVÁK, 1891; SINCLAIR, p. 80.

1962 *Ambrolinevitus?* *sulcatulus* (NOVÁK); SYSSOIEV, p. 44.

Lectotype: Originally designated herein, conch figured by NOVÁK (1891) on pl. 3, figs. 22–24, refigured here on pl. 3, fig. 1. NM L 26000.

Stratum typicum: Králův Dvůr Formation.

Locus typicus: Králův Dvůr.

Material: In addition to the lectotype 9 incomplete conchs and 1 operculum.

Description: Conch elongate, with angle of divergence of about 15 degrees. Its cross-section is unknown. Ligula comparatively short, vaulted in a regular arch; its length attains one-third to one-quarter apertural width. The aperture was most probably orthogonal as seen from the course of obscure growth-lines.

The sculpture of the dorsal side consists of distinct longitudinal ribs with rounded ridges, numbering totally about 18–20. NOVÁK (1891, p. 26). counted only 8 riblets on the dorsum; this mistake was undoubtedly caused by unfavourable preservation. The furrows bordering first lateral ribs along the lateral sides are deeper than the other furrows, dividing the riblets. Their distance from the lateral edges is bigger than that of the next ribs. It is probable that these deeper furrows could appear as depressions on the lateral parts of dorsal side in the cross-section of conch. Such depressions are developed in *Sololites ferrigenus* MAREK and in *S.?* *clausus* MAREK, 1983.

The operculum attributed to this species differs in its internal morphology from all known opercula of the Bohemian Ordovician species, but strongly resembles the operculum of *Sololites?* *clausus* MAREK, 1983a (p. 5, figs. 4, 5). It has flattened and comparatively wide (exsag.) clavicles of platyclavicate type. Similar clavicles are known in the genus *Carinolithes* SYSSOIEV and certain relations between *Sololites* and *Carinolithes* was already mentioned by MAREK (1967).

Dimensions: The length of lectotype — 27.5 mm, the width of its aperture — 6.5 mm.

Remarks: A definite attribution of the species *sulcatulus* and *clausus* to the genus *Sololites* demands new finds in the Ordovician of the Mediterranean Province.

Occurrence: Králův Dvůr, Kosov and Liteň.



*Pauxillitidae* MAREK

*Decipilites* MAREK, 1975

Type species: *Hyolithes decipiens* BARRANDE, 1867. Ordovician (Králuv Dvůr Formation), Bohemia.

*Decipilites decipiens* (BARRANDE, 1867)

Pl. III., fig. 5; pl. IV., fig. 3

1867 *Hyolithes decipiens* BARR.; BARRANDE, p. 80, pl. 12, figs. 33–37.

1891 *Hyolithes decipiens* BARR.; NOVÁK, p. 16, pl. 3, figs. 25–28.

1893 *H. (H.) decipiens* BARR.; HOLM, p. 25.

1946 *H. decipiens* BARRANDE, 1867; SINCLAIR, p. 75.

1962 *Ambrolinevitus decipiens* (BARRANDE); SYSSOIEV, p. 44.

1975 *Decipilites decipiens* (BARRANDE, 1967); MAREK, p. 238, pl. 1, figs. 1–5.

Lectotype: Originally designated by MAREK (1975), conch figured by BARRANDE (1867) on pl. 12, figs. 33, 34. NM L 13561.

Stratum typicum: Králův Dvůr Formation.

Locus typicus: Kosov.

Material: 27 conchs, 15 opercula.

Remarks: The original description of this species, given by Barrande was completed by NOVÁK (1891) and by MAREK (1975).

Occurrence: Kosov, Karlík, Zadní Třebaň, Praha-Velká Chuchle, Praha-Nusle (Jezerka). The occurrence of this species in the Vinice and Zahořany Formation (according to BARRANDE and NOVÁK) was not proved.

*Recilites* MAREK, 1967

Type species: *Hyolithes solitarius* BARRANDE, 1867. Ordovician (Zahořany Formation), Bohemia.

*Recilites?* aff. *poeta* MAREK, 1967

Pl. III, figs. 6–8

Material: 3 conchs and 2 opercula.

Description: The cross-section of elongate conch is unknown, the angle of divergence approximately 15 degrees. Ligula regularly arched, attains the length of one-third to one-fourth of apertural width.

The sculpture of conch is composed of fine but distinct longitudinal, not quite equidistant riblets, spaced less densely on the dorsal side, where they count about 5 per mm; their number on the ventral side is 7–8 per mm. This side bears also not very distinct fine vaultings, arched anteriorly, copying the margin of ligula. Nothing is known about the presence of transverse sculpture on the dorsal side.

The opercula attributed to this species are preserved as composite molds and their outline is deformed in a certain degree. The operculum was most probably monoclavulate and the clavicles were thin. The shape of the cardinal processes is unknown except for their bases which are thin and diverge at an angle of 95 to 105 degrees.

The cardinal shield is very narrow in the axial line. The ratio of its length (sag.) to the length of the conical shield is about 1 : 10. The same ratio in *R. ? poeta* is about 1 : 4 to 1 : 5.

The surface is sculptured by fine, not very distinct radial riblets.

Dimensions: The maximum length of the conch exceeded 15 mm. The width of the figured conch (LM 205) measures 5.4 mm at the aperture.

Remarks: This species differs only slightly from *R. ? poeta* MAREK occurring in the upper layers of Zahořany Formation and in Bohdalec Formation. The difference is in the spacing of riblets on the conch and in a different ratio of the length of cardinal shield to the length of conical shield of operculum. The scarcity and poor preservation of the material do not allow yet the specific separation of both taxa. Another problem poses the generic appurtenance of these taxa. Monoclavulate operculum is not yet known in the representatives of the family *Pauxilitidae*. It is probable, that *R. ? poeta* and *R. ? aff. poeta* belong to a new separate genus of uncertain affinities within *Hyolithida*. The material available is insufficient for solving this problem.

Occurrence: Praha-Spořilov, Kosov.

### *Leolites* MAREK, 1967

Type species: *Leolites cognatus* MAREK, 1967. Ordovician (Zahořany Formation), Bohemia.

#### *Leolites paucicostatus* sp. n.

Pl. III, fig.s. 9, 10; pl. IV., fig. 5

Holotype: Conch, figured on pl. 3, fig. 10. LM 209.

Stratum typicum: Králův Dvůr Formation.

Locus typicus: Praha-Spořilov.

Material: 5 conchs and 3 opercula.

Description: Conchs of small size (about 5—8 mm) with comparatively big angle of divergence (30—35 degrees). Ligula of semicircular outline attains the length of a half apertural width. The shape of the aperture could not be ascertained due to pressure deformation of conch.

The sculpture of the dorsal side consists of 11—13 ribs, the detailed morphology of which is unknown. The ventral side practically smooth.

The operculum is polyclavulate and bears three pairs of main clavicles and 3—5 additional clavicles, radially arranged on the central part of operculum. The

morphology of cardinal processes and the shape of cardinal shield are unknown as well as the surface sculpture.

Dimensions: The length of holotype — 6.5 mm, the width of aperture — 2.6; the length of specimen LM 208 — 4.5 mm.

Remarks: The Berounian species *Leolites cognatus* MAREK, known from the Vinice and Zahořany Formations differs clearly in more closely spaced longitudinal riblets. The operculum of this species bears a greater number of additional clavicles (6—9).

Occurrence: Praha-Spořilov, Praha-Nusle (Jezerka).

### *Mediolites* gen. n.

Type species: *Mediolites sporilovensis* sp. n. Ordovician (Kráľův Dvůr Formation), Bohemia.

Diagnosis: Pauxillitid hyoliths with sparsely spaced longitudinal riblets on the dorsal side of considerably elongate conchs with semicircular ligula.

Operculum tetracavicate, with four pairs of radially arranged narrow clavicles. Clavicles of the 2nd to 4th pairs slightly arched and increasing in length, so that the clavicles of the 4th pair are the longest. Surface bears radial riblets.

Remarks: *Mediolites* gen. n. shows closest relations to *Leolites* MAREK, which has a radially ribbed polyclavicate operculum. *Pauxillites* MAREK from the Šárka and Dobrotivá Formations has triclavicate opercula with comparatively robust clavicles and smooth surface. The opercula of *Recilites* MAREK bear radial sculpture but only three pairs of clavicles are developed on their internal surface.

Occurrence: Ordovician (Kralodvor), Bohemia.

Species: Only *M. sporilovensis* sp. n.

### *Mediolites sporilovensis* sp. n.

Pl. IV., figs. 1, 2

Holotype: By monotypy, conch with disarticulated operculum, figured here on pl. 4, fig. 1—2.

Stratum typicum: Kráľův Dvůr Formation.

Locus typicus: Praha-Spořilov.

Material: Only holotype.

Description: Narrow conch with angle of divergence of about 13 degrees has a comparatively long ligula, the length of which attains one-third to one-half apertural width. The type of aperture and the shape of cross-section are unknown due to compression.

The surface of the dorsal side bears sparsely spaced longitudinal ribs numbering about 12. The ventral side is covered only with indistinct growth-lines copying the margin of ligula.

Tetracavicate operculum bears on the surface of conical shield fine radial

riblets numbering 11—13 per mm on its margin. Cardinal shield and processes unknown. The internal surface is characterized by four pairs of narrow clavicles, of which the basal (main) pair is straight and wider (exag.) than the other three, slightly arcuate pairs; the clavicles of the fourth pair are the longest.

Dimensions: The conch of holotype measures 9.3 mm.

Remarks: See the diagnosis of the genus.

Occurrence: Praha-Spořilov.

## Familia incerta

### *Gompholites* MAREK, 1966

Type species: *Hyolithes cinctus* BARRANDE, 1867. Ordovician (Šárka Formation), Bohemia.

Remarks: The external and internal morphology of the conch and operculum of *Gompholites* differs substantially from all hitherto known Ordovician genera of the family *Hyolithidae*. In my opinion, this genus is the representative of a separate family within the order *Hyolithida*, comprising but one genus. This is the main reason why I hesitate to establish the new family.

The occurrence of *Gompholites* was ascertained outside Bohemia also in the Ordovician of France (MAREK, 1975, species not established) and Morocco (MAREK 1983).

### *Gompholites* sp. n.

Pl. IV, figs. 6, 7

Material: 1 conch and 7 opercula, all flattened in shale.

Description: The angle of divergence of compressed conch makes about 17 degrees. The cross-section of conch and the exact shape of aperture are unknown. The ligula is moderately arched, not very long; its length attains only about one-fourth of apertural width. Apertural sinuses strongly rounded.

The sculpture is known only on the ventral side of conch. It consists of fine growth-lines of unequal prominence numbering about 10 per mm. Anteriorly arched growth-lines copy the margin of ligula and are more distinct close to the aperture.

The operculum of subcircular outline is monoclavicate. The bases of cardinal processes seem to be more or less rounded. The lateral sinuses are comparatively deep and broad.

The sculpture of operculum consists of fine concentric growth-lines.

Dimensions: The length of conch = 31 mm. Dimensions of three opercula in mm:

Width:	4.3	4.1	3.8	4.7
Length:	3.9	3.7	3.7	3.8

Remarks: This species is insufficiently known. Compressed opercula do not differ from those of possibly related Berounian species *Gompholites striatulus* (BARR.), when preserved in the same mode. However, the sculpture of conch in the last mentioned species is more coarse than in *Gompholites* sp. n. *C. cinctus* (BARR.) from the Llanvirn attains a smaller size and its sculpture is formed by fine but distinct transverse riblets and irregularly spaced imbrications. Several species of *Gompholites* described in open nomenclature from the Moroccan Ordovician (MAREK 1983) are too poorly preserved for any comparison. *Gompholites* sp. n. is the stratigraphically youngest representative of the genus *Gompholites* as yet known.

Occurrence: Kosov.

### *Raitilites* gen. n.

Type species: *Raitilites metallicus* sp. n. Ordovician (Královodvor), Bohemia.

Diagnosis: Conch of low subtrigonal cross-section with sharply expanded lateral edges. Ventral side slightly convex with broad shallow grooves along lateral edges of ventral side. Aperture distinctly oxygonal.

Sculpture of dorsal side consists of distinct longitudinal riblets except for its lateral parts, which bear transverse terrace lines. Longitudinal ribs are crossed by transverse growth-lines.

Operculum unknown.

Remarks: It is difficult to compare *Raitilites* gen. n. with other Ordovician hyolithid genera without knowing the operculum. Longitudinal ribs of dorsal side resemble somewhat the sculpture of *Sololites*. Oxygonal type of aperture and grooves on ventral side indicate the possible appurtenance of this genus to the family *Pauxillitidae*. Most significant features of *Raitilites* are flat lateral margins with "terrace lines".

Occurrence: Ordovician (Kralodvor), Bohemia.

### *Raitilites metallicus* sp. n.

Pl. IV, fig. 8

Holotype: By monotypy, conch figured herein on pl. 4, fig. 8. LM 214.

Stratum typicum: Králův Dvůr Formation.

Locus typicus: Praha-Pankrác (Rajtknechtka).

Material: Only holotype, fragmentary steinkern with external mold of dorsal side.

Description: Conch of flattened subtrigonal cross-section with very sharp lateral edges. The angle of divergence about 35—40 degrees, the w/h index very approximately 4.3. Ventral side very slightly convex, almost flat. On the ventral anterior part of the steinkern, two broad shallow grooves are developed, each along

the lateral edge of the conch. Flanks of the dorsal side slightly inflated, meeting at a rounded edge. Aperture oxygonal as seen from adaperturally arched growth-lines.

The sculpture of the dorsal side consists of about 41 distinct longitudinal riblets. Three riblets are more pronounced: one in the median axis and two closer to the lateral edges. The flattened lateral parts of conch are sharply divided from its inflated longitudinally ribbed part and bear a different sculpture. This is formed by transverse and somewhat anteriorly directed lines, resembling the terrace lines in trilobites. These lines are slightly adaperturally arched.

The operculum is unknown.

Dimensions: The length of holotype measures 9.5 mm.

Remarks: The morphology and sculpture of this species is unique among hyolithids and any comparison with other Ordovician species is impossible. It seems that it was confined to a specific environment.

Occurrence: *Raitilites metallicus* sp. n. was found in the so-called "Podolí ore" horizon in the site called Rajtknechtka in Praha-Podolí. This horizon forms the base of the Králův Dvůr Formation.

*Hyolithida* gen. et sp. n.

Pl. IV, fig. 10

Material: 1 operculum at 1 conch probably belonging to it.

Description: Small compressed and smooth conch without any characteristic feature except a distinct ligula.

The operculum is monoclaviculate with parabolically elongate anterior margin of conical shield. The shape of clavicles and cardinal processes unknown. The cardinal shield is narrow and protracted in its median axis into a short and blunt tip, indicating a probable presence of a keel on the dorsal side of conch.

Dimensions: The length of conch 8.8 mm; length of operculum 1.9 mm, its width 1.7 mm.

Remarks: Owing to insufficient material, the taxonomical evaluation of the remains is impossible. The shape of operculum indicates that this taxon could be tentatively attributed to *Carinolithes* SYSSOIEV (see MAREK 1967, text-fig. 26).

Occurrence: Lejškov.

*K tisku doporučil R. Prokop*

*Přeložil autor*

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### Explanation of plates

The specimens have been coated with ammonium chloride. Unretouched photographs were taken by the author.

LM — author's collection housed provisionally in the Institute of Geology and Geotechnics of the Czechoslovak Academy of Sciences, Praha. NM L — collections of the National Museum (Natural History), Praha.

#### Pl. I

*Circotheca neptis* sp. n.

1, 2. Holotype; incomplete steinkern of conch with remain of shell; 1 — dorsal view; 2 — lateral view, ×7. Praha-Kačarov. LM 186.

*Nephrotheca ruderalis* sp. n.

3. Conch; ventral side of steinkern, ×6.4. Praha-Kačarov. LM 187.

4. Holotype; conch, latex cast of ventral side, ×6.4. Praha-Kačarov. LM 188.

*Panitheca* aff. *collector* MAREK, 1967

5. Conch; anterior half shows external mold of ventral side, posterior half shows internal mold of dorsal side, ×4. Kosov. LM 189.

6. Same specimen; detail of sculpture (external mold), ×16.

7. Fragment of conch; external mold of dorsal side showing zig-zag sculpture, ×12.5. Kosov. LM 190.

*Bactrotheca deleta* NOVÁK, 1891

- 8, 9. Lectotype; external mold of conch; 8 — almost complete conch,  $\times 4.6$ ; 9 — detail of sculpture close to the aperture,  $\times 8$ . Králův Dvůr. NM L 26105.
10. Operculum most probably belonging to this species; internal mold,  $\times 13$ . Kosov. LM 191.

*Bactrotheca aethetica* sp. n.

11. Holotype; conch with displaced operculum; external mold of ventral side,  $\times 7.6$ . Praha-Spořilov. LM 192.
12. Ditto; detail of sculpture at the aperture,  $\times 13.5$ .
13. Ditto; external mold of operculum,  $\times 16.5$ .
14. Another operculum; external mold,  $\times 11$ . Praha-Spořilov. LM 193.

*Nephrotheca* ? sp. n.

15. Conch; ventral side,  $\times 3.3$ . Lejškov. NM L 25103.

Pl. II

*Elegantilites indistinctus* (BARRANDE, 1867)

1. Lectotype; composite mold of conch showing ventral side with septa in apical part,  $\times 2.7$ . Králův Dvůr. NM L 22002. Orig. BARRANDE, pl. 9, fig. 4.
2. Operculum; internal mold,  $\times 5.3$ . Kosov. LM 194.
3. Operculum; negative of composite mold,  $\times 5$ . Kosov. LM 195.
- 4, 5. Conch, probably belonging to this species; internal mold; 4 — dorsal side; 5 — ventral side,  $\times 2.8$ . Lejškov. NM L 22001. Orig. Barrande, pl. 9, figs. 2, 3.

*Joachimilites viridis* sp. n.

- 6, 7. Holotype, conch; 6 — compressed specimen showing external mold of dorsal side and internal mold of ventral side in the apertural part,  $\times 3$ ; 7 — detail of sculpture,  $\times 5.5$ . Kosov. LM 197.
8. Conch; dorsal side,  $\times 2.3$ . Kosov. LM 199.
9. Operculum; composite mold showing clavicles and cardinal processes,  $\times 10$ . LM 200.
10. Operculum; composite mold,  $\times 7.4$ . Kosov. LM 201.

Pl. III

*Sololites* ? *sulcatulus* (NOVÁK, 1891)

1. Lectotype; almost complete conch showing external mold of ventral side in its anterior part and external mold of dorsal side in its posterior part,  $\times 3$ . Králův Dvůr. NM L 26000. Orig. NOVÁK, pl. 3, figs. 22—24.
2. Incomplete conch, showing similar features,  $\times 3.5$ . Kosov. LM 202.
3. Incomplete conch; external mold of dorsal side,  $\times 3.5$ . Kosov. LM 203.
4. Operculum; composite mold most probably belonging to this species,  $\times 7.8$ . Kosov. LM 204.

*Decipilites decipiens* (BARRANDE, 1867)

5. Conch in ventral view; posterior part shows sculpture of dorsal side,  $\times 4.5$ . Kosov. LM 146.

*Recilites* ? aff. *poeta* MAREK, 1967

6. Conch; ventral side with distinct longitudinal riblets. Sculpture of dorsal side formed by less closely spaced riblets visible in the right posterior part of specimen,  $\times 4.8$ . Praha-Spořilov. LM 205.
7. Operculum; composite mold,  $\times 9$ . Kosov. LM 206.
8. Operculum; composite mold,  $\times 13$ . Kosov. LM 207.

*Leolites paucicostatus* sp. n.

9. Conch in ventral view showing external mold of dorsal side with longitudinal ribs,  $\times 11$ . Praha-Spořilov. LM 208.
10. Holotype; composite mold of conch showing the sculpture of dorsal side,  $\times 10$ . Praha-Spořilov. LM 209.



Pl. IV

*Mediolites sporilovensis* sp. n.

1. Holotype; composite mold of conch; la — counterpart,  $\times 7.6$ . Praha-Spořilov. LM 210.
2. Holotype; displaced operculum belonging to the conch, fig. 1,  $\times 13$ . Praha-Spořilov. LM 210.

*Decipilites decipiens* (BARRANDE), 1867)

3. Operculum; composite mold,  $\times 8$ . Kosov. LM 150.

*Leolites paucicostatus* sp. n.

4. Conch; dorsal side,  $\times 11$ . Praha-Spořilov. LM 211.
5. Operculum; internal mold,  $\times 14$ . Praha-Nusle (Jezerka). LM 212.

*Gompholites* sp. n.

6. Conch; dorsal side,  $\times 3.1$ . Kosov. NM L 26104.
7. Operculum; composite mold,  $\times 8$ . Kosov. LM 213.

*Raitilites metallicus* sp. n.

8. Holotype; external mold of dorsal side of conch with preserved internal mold of ventral side in the apical area,  $\times 7$ . Praha-Michle (Rajtknechtka). LM 214.
9. Ditto; detail of sculpture,  $\times 11$ .

*Hyolithida* gen. et sp. n.

10. Operculum; composite mold,  $\times 18$ . Lejškov. LM 215.

## Hyoliti královského souvrství českého ordoviku

(Résumé anglického textu)

LADISLAV MAREK

Předloženo 6. října 1986

V práci jsou popsány všechny dosud známé druhy hyolitů z královského souvrství českého ordoviku. Podkladem pro studium byl především nově nasbíraný materiál, na jehož základě bylo možno v královském souvrství zjistit výskyt rodů *Circotheca*, *Nephrotheca*, *Panitheca*, *Bactrotheca*, *Elegantilites*, *Joachimilites*, *Gompholites*, *Leolites*, *Decipilites*, *Recilites* ? a pravděpodobně i rodu *Sololites*. Byly stanoveny dva nové rody *Mediolites* gen. n. a *Raitilites* gen. n. a 7 nových druhů. Celkem je z královského souvrství známo v současné době 15 druhů, z toho čtyři jsou v otevřené nomenklatuře.

### Хиолиты кралодворской свиты ордовика Чехии

В представленной работе описаны все известные до сих пор виды хиолитов из кралодворской свиты ордовика Чехии, изученные, главным образом, на основании вновь собранного материала, благодаря которому в кралодворской свите можно было установить наличие родов: *Circotheca*, *Nephrotheca*, *Panitheca*, *Bactrotheca*, *Elegantilites*, *Joachimilites*, *Gompholites*, *Leolites*, *Decipilites*, ? *Recilites* и, по всей вероятности, тоже рода *Sololites*. Определены два новых рода: *Mediolites* gen. n., *Raitilites* gen. n. и 7 новых видов. Из кралодворской свиты в настоящее время известно 15 видов, в том числе 4 вида, находящиеся в открытой номенклатуре.

Пřeložil A. Kříž

