# *Jincelites vogeli* gen. et sp. nov. (Hyolitha) from the Cambrian of the Czech Republic (Příbram-Jince Basin, Teplá-Barrandian region)

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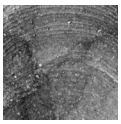

The hyolith *Jincelites vogeli* new genus and new species is described from the "Middle" Cambrian Drumian Stage Jince Formation of the Příbram-Jince Basin in the Czech Republic. The new form is based on two hundred well-preserved external and internal moulds of conchs, opercula and helens. The general morphology of skeletal parts of *J. vogeli* corresponds to the filter feeding life strategy suggested for hyolithids by Marek *et al.* (1997). The character of the associated skeletal fauna and general lithology, as well as the restricted stratigraphical range and geographic distribution suggest that *J. vogeli* lived on muddy substrates in relatively shallow water settings. • Key words: hyoliths, "Middle" Cambrian (Cambrian Series 3), Drumian, Příbram-Jince Basin, Teplá-Barrandian region, Czech Republic.

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Cambrian sediments of the Teplá-Barrandian region contain a highly diverse skeletal fauna that includes hyolithids. Numerous, generally gregarious and locally very common hyolithids have been collected from different stratigraphical levels in the Jince Formation of the Příbram-Jince Basin (Fatka *et al.* 2004) and at major outcrops in the Buchava Formation of the Skryje-Týřovice Basin (Marek 1983). In the Teplá-Barrandian region, the first hyolithid taxa had been established by Barrande (1867) who described five species of the genus *Hyolithes* Eichwald, 1840, namely: *H. primus*; *H. robustus*; *H. parens*; *H. maximus* and *H. venustus*. The sixth species, *Hyolithes signatulus*, was described by Novák (1891). In a series of short papers focused on the systematics of three new taxa, *Buchavalites pompeckji* Marek, 1975; *Maxilites snajdri* Marek, 1972 and *Oboedalites oboediens* Marek, 1981, Marek (1972, 1975, 1980, 1981) also restudied five earlier known species. A reconstruction of one undescribed species of the genus *Circotheca* Sysoev, 1958, from the Bohemian Middle Cambrian, was figured by Marek (1976, fig. 5B). At least eight other species were distinguished by Marek (1983). However, these forms remain undescribed (see Valent 2004). Recently, Martí Mus & Bergström (2005) discussed the morphology of helens and muscle scars in three Cambrian forms from the Skryje-Týřovice Basin, namely *Maxilites robustus*, *M. snajdri* and *Maxilites* sp.

Sixteen species of hyoliths are known from the Middle Cambrian of the Teplá-Barrandian region (see Fatka 1990, 2004; Fatka *et al.* 2004; Valent 2004, 2006). However, in the Příbram-Jince Basin the published information on the hyolithid fauna encompasses only the following four taxa: *Buchavalites primus* (Barrande, 1867); *Maxilites snajdri* Marek, 1972; *Hyolites* sp. A and *Hyolites* sp. B (both *sensu* Fatka *et al.* 2004).

The aim of this paper is to describe a new genus and species known from four localities in the Litavka river Valley.

## Systematic palaeontology

Class Hyolitha Marek, 1963
Order Hyolithida Sysoev, 1957
Family uncertain

**Genus *Jincelites* gen. nov.**

*Type species.* – *Jincelites vogeli* sp. nov., Middle Cambrian, Příbram-Jince Basin, Jince Formation, *Ellipsoce-*

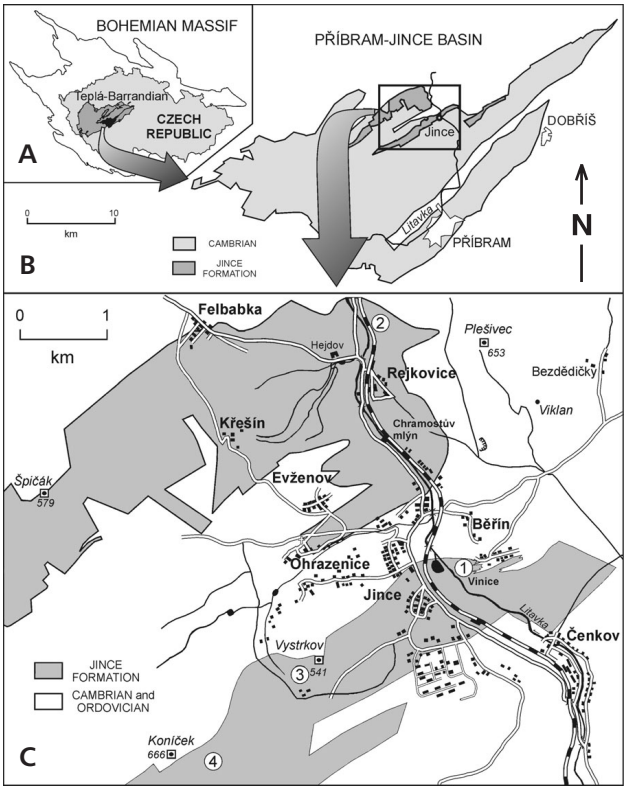



**Figure 1.** Simplified sketch map showing the location of fossil sites in the "Middle" Cambrian Jince Formation within the Příbram-Jince Basin, Central Bohemia. 1 – Vinice Hill near Jince, 2 – railway exposure at the Zelený mlýn Mill locality near Rejkovice, 3 – Koníček Hill locality, 4 – Vystrkov Hill locality.

*phalus hoffi – Paradoxides* (*Rejkocephalus*) *– Lingulella* Zone.

*Derivation of name.* – After the town of Jince in the Litavka river Valley, Czech Republic.

*Diagnosis.* – Hyolithid with small orthocone conch and short broadly rounded ligula. Conch rounded and triangular in cross-section with low keel developed on dorsum. Sculpture consists of only transverse elements. Monoclaviculate operculum with well developed broadly diverging clavicles and with straight adjacent narrow cardinal processes on the inner side. Outer side of operculum bears large conical shield and small cardinal shield; rooflets broad and well developed.

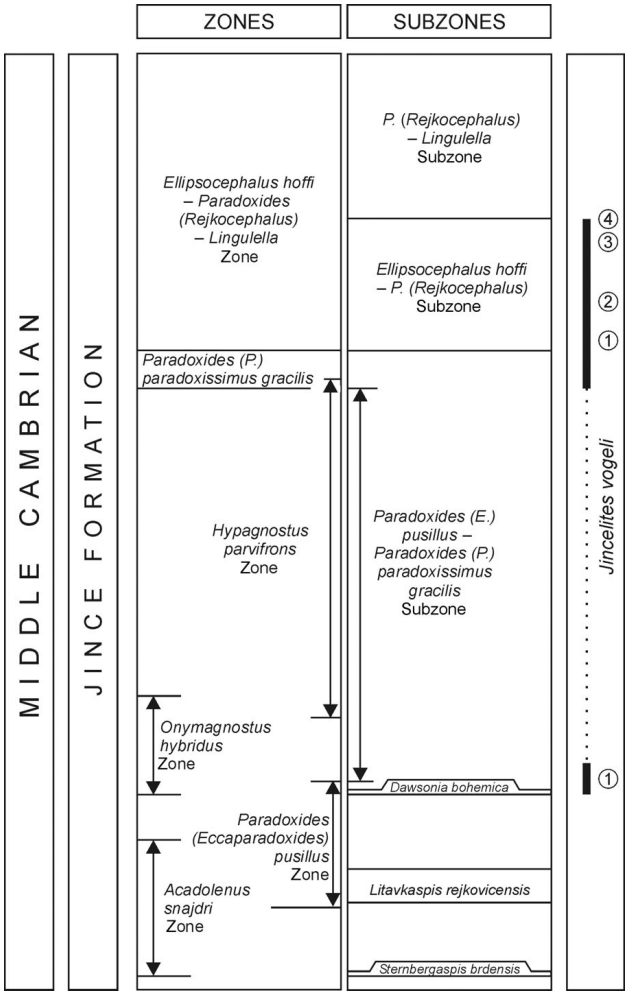
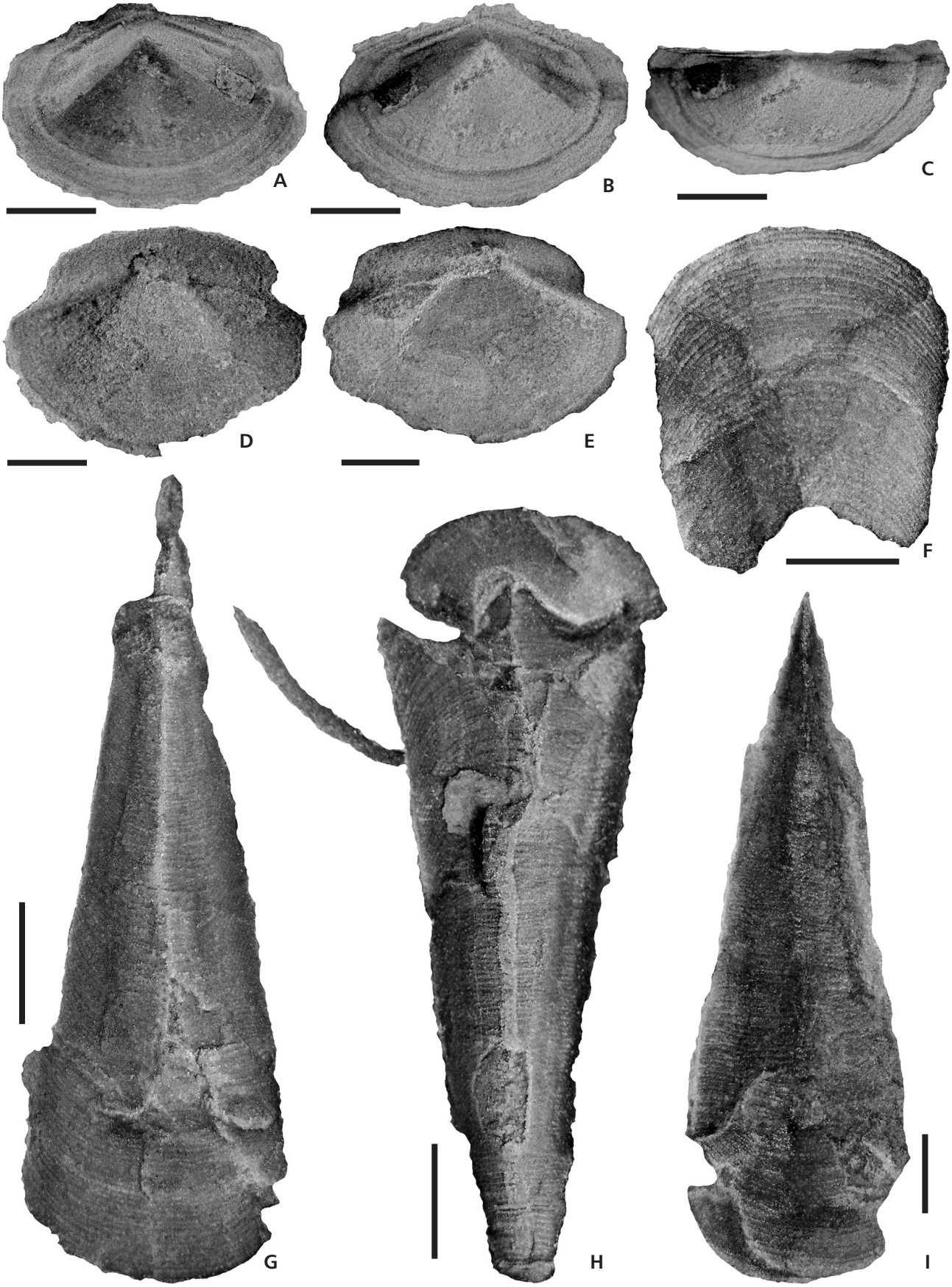



**Figure 2.** Stratigraphical distribution of *Jincelites vogeli* sp. nov. within the Jince Formation of the Příbram-Jince Basin (biostratigraphy after Fatka & Szabad unpublished data). 1 – Vinice Hill near Jince, 2 – railway exposure at the Zelený mlýn Mill locality near Rejkovice, 3 – Koníček Hill locality, 4 – Vystrkov Hill locality.

*Discussion.* – *Jincelites* resembles *Carinolithes* Sysoev, 1958 (type species: *Hyolithus pennatulus* Holm, 1893 from the Upper Middle Cambrian *Paradoxides forchhammeri* Regional Stage of Sweden; *cf.* Berg-Madsen & Malinky 1999) in the morphology of the dorsal keel. However, the keel is distinctly higher in *Carinolithes*. In addition, the genera differ in the basic morphology of the opercula which are of different types: monoclaviculate in *Jincelites* and

**Figure 3.** *Jincelites vogeli* sp. nov. Drumian, Jince Formation, *Ellipsocephalus hoffi – Paradoxides* (*Rejkocephalus*) *– Lingulella* Zone. Holotype specimen MŠ 3048 is deposited in the collection of the Czech Geological Survey in Prague, other specimens are in the Palaeontological Department of the National Museum, Prague. • A – inner side of operculum. Latex cast of MŠ 3084 (holotype). • B – inner side of operculum – negative; MŠ 3084. Vinice Hill near Jince (holotype). • C – anterior view of inner side of operculum– negative; MŠ 3084. Vinice Hill near Jince (holotype). • D – outer side of operculum – positive; L40327. Koníček Hill locality. • E – outer side of operculum. Latex cast of L40327. • F – venter – positive; L40328. Koníček Hill locality. • G – venter – negative; L40329. Koníček Hill locality. • H – broken dorsum with exposed venter, outer side of operculum and helen – positive; L40330. Koníček Hill locality. • I – broken dorsum with exposed venter – positive; L40331. Koníček Hill locality. Scale bars equal 1 mm.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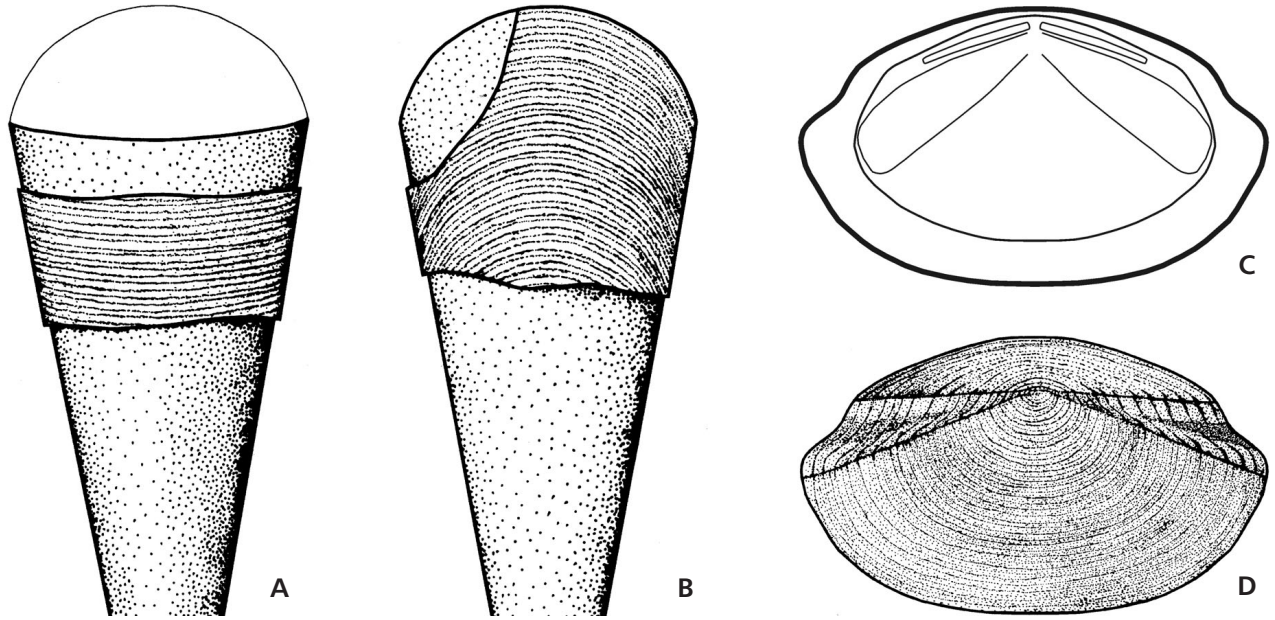


**Figure 4.** *Jincelites vogeli* sp. nov. Reconstruction. • A – ventral surface of conch. • B – dorsal surface of conch. • C – internal surface of operculum. • D – external surface of operculum.

platyclaviculate in *Carinolithes*. The genus *Haplophrentis* Babcock & Robison, 1988 (type species *H. reesei* Babcock & Robison, 1988 from the "Middle" Cambrian Spence Shale of Idaho and Utah, western U.S.A.) differs by having an internal dorsal septum, a more inflated venter and in questionably platyclaviculate operculum.

*Occurrence.* – Cambrian Series 3 (unnamed), Příbram-Jince Basin, Czech Republic.

*Species.* – Only type species *Jincelites vogeli* sp. n.

***Jincelites vogeli* sp. n.**
Figures 3, 4

*Holotype.* – Operculum, MŠ 3084 (Fig. 3B), deposited in the collection of the Czech Geological Survey in Prague, Czech Republic.

*Paratypes.* – Outer side of operculum; L40327. Koníček Hill locality (Fig. 3D, E); complete conch; L40328. Koníček Hill locality (Fig. 3F); complete conch; L40329. Koníček Hill locality (Fig. 3G); conch with exposed venter, outer side of operculum and helen; L40330. Koníček Hill locality (Fig. 3H); conch with exposed venter; L40331. Koníček Hill locality (Fig. 3I). All specimens are deposited in the collection of the National Museum in Prague, Czech Republic.

*Type horizon and locality.* – Cambrian Series 3 (unnamed), Drumian, Jince Formation, *Ellipsocephalus hoffi* – *Paradoxides* (*Rejkocephalus*) – *Lingulella* Zone; Czech Republic, Teplá-Barrandian region, Příbram-Jince Basin (Vinice Hill near Jince).

*Derivation of name.* – After Dr. Jiří Vogel, a theologist at the Charles University in Prague.

*Material.* – More than 30 conchs with opercula, several hundred isolated conchs, about thirty isolated opercula and several helens.

*Description.* – Orthocone conch relatively small and the apical angle is about 20 degrees. Conch has a rounded triangular cross-section with differently inflated sides. Ventral side more or less flat with only slightly convex central region; dorsal side highly convex with slightly concave sides, with the central part of dorsum forming a low, relatively wide keel. This keel is developed along the entire length of the dorsum. Ligula short, moderately rounded and its length reaches about 1/4 of the width of the conch near the aperture. Aperture is orthogonal. Conch reaches up to 15 mm in length. Dorsal side of conch is often compressed as a result of diagenesis.

Internal surface of the conch smooth on both dorsal and ventral sides; no traces of muscle scars have been observed. External sculpture of the conch consists of very fine closely spaced growth lines (about 20 per mm). Growth lines correspond to the anterior outline of the ligula and the dorsal apertural margin respectively. Sculpture can be more distinct on either ventral or dorsal side. Length of tiny helens reaches about 40% of the length of the conch.

Preservation in clastic sediments does not permit observation of the supposed surface sculpture of the helens, or their mode of curvature (*cf.* Martí Mus & Bergström 2005, 2007).

Operculum is monoclaviculate; its internal surface bears a pair of narrow clavicles that extend over ¾ of the operculum width and approach the rim. Rim is not present on all studied opercula. Angle of divergence of the clavicles is about 120 degrees. Cardinal processes straight, extremely narrow and attain about ¾ of the clavicle length. Cardinal processes are adjacent to the anterior side of the clavicles. On the inner side of the operculum a distinct rim around the margin may be developed, wider ventrally and narrower dorsally.

External surface of the operculum composed of a large conical shield and a distinctly smaller cardinal shield (Fig. 4). Rooflets and lateral sinuses are well developed and distinct. Outer surface of the operculum bears fine but distinct growth lines. In addition, the conical shield bears several fine lines running from the margin to the summit of the operculum.

*Occurrence.* – The species *Jincelites vogeli* is known from four localities in the Litavka river valley (Figs 1, 2).

## Stratigraphy, localities and associated fauna

The new species has been discovered at four localities, all belonging to the higher levels of the *Paradoxides* (*Eccaparadoxides*) *pusillus* Zone and/or to different stratigraphical levels within the lower part of the *Ellipsocephalus hoffi – Paradoxides* (*Rejkocephalus*) *– Lingulella* Assemblage Zone, *e.g.*, in the *Ellipsocephalus hoffi – Paradoxides* (*Rejkocephalus*) Subzone (Figs 1 and 2). The associated fossil fauna includes two major types of assemblages.

The association observed at the lower stratigraphical level (locality 1 in Figs 1 and 2) includes common agnostids (*e.g.*, *Onymagnostus*, *Doryagnostus* and more rarely also *Peronopsis* and *Phalagnostus*) associated with abundant polymeroid trilobites (*e.g.*, *Conocoryphe*, *Jincella*, *Paradoxides*). Linguliformean brachiopods, molluscs and echinoderms are also sporadically present. In the higher stratigraphical level the linguliformean brachiopod *Lindinella kordulei* Mergl & Šlehoferová, 1990 is fairly common, and occurs together with locally very abundant complete exoskeletons of the small trilobite *Ellipsocephalus hoffi* (Schlotheim, 1823). More rarely, there are also fragments of the much larger *Paradoxides* (*Rejkocephalus*) *lyelli* (Barrande, 1852). Valves of the problematic arthropod *Forfexicaris*? sp. occur at localities 1 to 3. The fourth locality (the Vystrkov Hill locality) has the same association with the exception of *L. kordulei*.

The presence of specimens of the rare supposed arthropod *Helmetia*? *fastigata* Chlupáč & Kordule, 2002 has been found at the Zelený mlýn Mill locality. The agnostid *Peronopsis integra* (Beyrich, 1845) associated with the polymeroid *Paradoxides* (*Hydrocephalus*) *minor* (Boeck, 1827) and the bivalved supposed arthropod *Tuzoia* sp. are known at the Vystrkov Hill locality.

The fossil associations contained in graywackes and shales at the Zelený mlýn Mill and at the Koníček Hill localities belong to the *Lindinella* Association (*sensu* Mergl & Šlehoferová 1990). The absence of *L. kordulei* at the Vystrkov Hill locality could be explained by the stratigraphical position already being above the range of this species.

The assemblage dominated by trilobites associated with locally common linguliformean brachiopods, hyoliths, different non-trilobite arthropods and rare agnostoids described above inhabited a marine shallow-water environment during the final filling stage of the Příbram-Jince Basin (Havlíček 1971). The occurrence of *Jincelites vogeli* in shale supports the ecological interpretation of hyolithids by Marek & Yochelson (1976) and Marek *et al.* (1997), in that this species and all other hyolithids were most probably suspension feeding organisms living on a muddy substrate in a relatively shallow water setting.

The tiny helens were observed in ten specimens. However, none of them were *in situ* and thus the original relation of helens to operculum and/or conchs is not possible to reconstruct in detail. The three-dimensional curvature of helens (Martí Mus & Bergström 2005) could not be evaluated because of the preservation in shale.

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