*Bulletin of Geosciences, Vol. 78, No. 2, 113–117, 2003*


# Trilobite fauna of the Šárka Formation at Praha – Červený vrch Hill (Ordovician, Barrandian area, Czech Republic)

*PETR BUDIL [1] – OLDŘICH FATKA [2] – JANA BRUTHANSOVÁ [3]*

[1] Czech Geological Survey, Klárov 3, 118 21 Praha 1, Czech Republic. E-mail: budil@cgu.cz
[2] Charles University, Faculty of Science, Institute of Geology and Palaeontology, Albertov 6, 128 43 Praha 2, Czech Republic. E-mail: fatka@natur.cuni.cz
[3] National Museum, Palaeontological Department, Václavské nám. 68, 115 79 Praha 1, Czech Republic. E-mail: jana.bruthansova@nm.cz

Abstract. Shales of the Šárka Formation exposed in the excavation on Červený vrch Hill at Praha-Vokovice contain a common but monotonous assemblage of phyllocarids associated with other extremely rare arthropods. Almost all trilobite remains (genera *Ectillaenus* Salter, 1867, *Placoparia* Hawle et Corda, 1847 and Asaphidae indet.) occur in a single horizon of siliceous nodules of stratigraphically uncertain position, while the surprising occurrence of possible naraoid trilobite (*Pseudonaraoia hammanni* gen. n., sp. n.) comes from dark grey shales. The general character of the arthropod assemblage characterized by an expressive dominance of planktonic and/or epi-planktonic elements (phyllocarids) indicates a specific life environment (most probably due to poor oxygenation). This association corresponds to the assemblage preceding the Euorthisina-Placoparia Community sensu Havlíček and Vaněk (1990) in the lower portion of the Šárka Formation.

Key words: Ordovician, Arthropoda, Trilobita, Naraoiidae, Barrandian

## Introduction

The temporary exposure at the Praha-Červený vrch Hill provided a unique possibility to study a well-exposed section of the lower part of the Šárka Formation which is underlain by volcanic rocks (tuffs and basalts) representing the base of the Ordovician sequence in this area. Geological documentation of this section is provided by Budil et al. (2003, this volume) and Kraft and Kraft (2003, this volume). The aim of this short contribution is to describe and discuss non-phyllocarid arthropod fauna found in this section.

## General description of trilobite fauna

Trilobite remains found at the Červený vrch outcrop are rare, the faunal assemblage being absolutely dominated by phyllocarid crustaceans (*Caryocaris*; see Chlupáč 2003, this volume). The occurrence of rare polymerid trilobites is bound only to the horizon with common siliceous nodules of problematic stratigraphical position (for discussion see Kraft et al. 2003, this volume). The trilobite association found in nodules in the studied outcrop is characterized by a low diversity and a poor preservation. Nevertheless, it contains typical representatives of the lower part of Šárka Formation such as *Ectillaenus katzeri katzeri* (Barrande, 1872), *Placoparia* (*Placoparia*) sp. cf. *P.* (*P.*) *cambriensis* Hicks, 1875 and Asaphidae indet. This trilobite fauna shows remarkable similarities with that from the lower part of the Šárka Formation exposed at the Jenerálka (Na Salátce) locality (see Chlupáč 1970) and "Na Palouku" playground (Budil, unpublished). Much like at the above mentioned localities, the trilobite remains on Červený vrch Hill occur in siliceous nodules in association with rare finds of carpoids (*Lagynocystites* a.o.), frequent remains of phyllocarids (*Caryocaris subula* Chlupáč, 1970 and C. *wrighti* Salter, 1863), rare orthocone nautiloids and ichnofossils (*Skolitos* isp. etc.).

Trilobites tentatively assigned to naraoids in the present paper are extremely rare. One almost complete specimen and one fragment were found in shales, associated with very frequent dendroids and graptoloids (see Kraft and Kraft 2003, this volume).

Although naraoids are well-documented from the Lower Cambrian to the Upper Ordovician of Europe and other continents (see Fortey and Theron 1994, Hammann et al. 1990, etc.), this group has been never reported from the Prague Basin yet.

Morphological terminology used by Robison (1984), Fortey and Theron (1994) and Vannier and Chen (2002) is followed in this paper. All the figured specimens are kept in the West Bohemian Museum in Plzeň (prefixed by S) and in the collections of the Czech Geological Survey (prefixed by CGS).

## Systematic palaeontology

Class: Trilobita Walch, 1771
Family: ?Naraoiidae Walcott, 1912

Genus: *Pseudonaraoia* gen. n.

Type species: *Pseudonaraoia hammanni* sp. n., Middle Ordovician, Prague Basin, Barrandian area, Czech Republic.

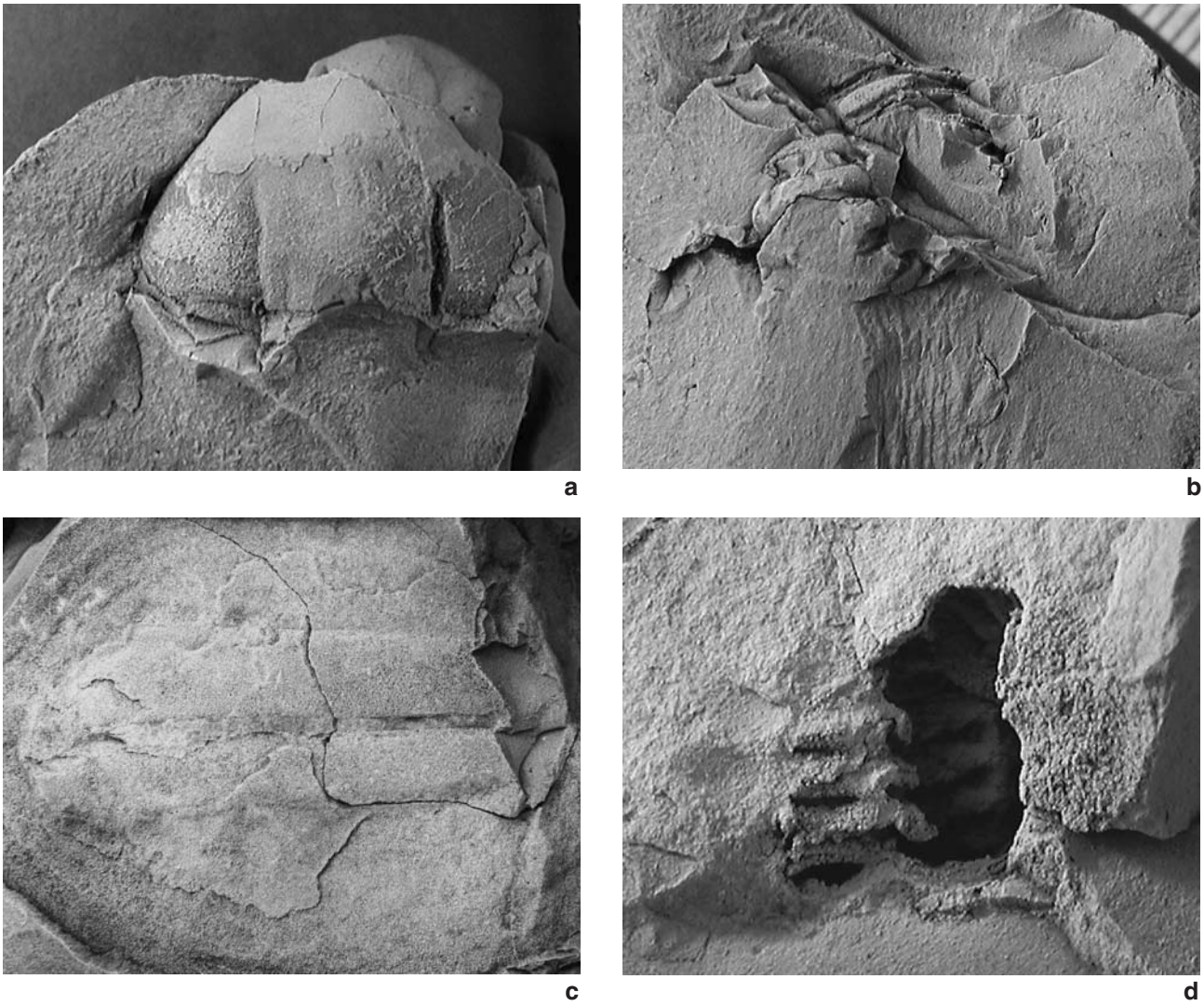


Fig. 1.
a – *Ectillaenus katzeri katzeri* (Barrande). Almost complete cranidium from a siliceous nodule, positive, CGS PB 201. c – Asaphidae gen. et sp. indet. Fragment of the pleuron, positive, CGS PB 202. b, d – *Placoparia (Placoparia)* sp. cf. *P. (P.) cambriensis* Hicks, 1875. b – disarticulated thoracic segments, CGS PB 204. d – a counterpart of enrolled specimen, CGS PB 203.

Derivatio nominis: Refers to possible affinities with *Naraoia* Walcott, 1912.

Diagnosis: Exoskeleton composed of cephalic and trunk shields. Cephalic shield slightly vaulted, effaced, subcircular in outline, axis and axial furrows indistinct. Narrow lateral border with slightly impressed shallow border furrow, doublure probably narrow. External surface of cephalic shield smooth, internal surface with very fine anastomosing sculpture. Trunk shield slightly vaulted, effaced, of elliptical outline. Axis indistinct. Missing and/or only very slightly impressed axial furrows with very slightly indicated segmentation. Doublure probably narrow, flat. The cephalic/trunk shields length ratio ca 1 : 1–1 : 1.1.

Discussion: Although the general morphology of *Pseudonaraoia* gen. n. recalls that of the Cambrian genus *Naraoia* Walcott, 1912 (smooth exoskeleton surface, subcircular outline of cephalic shield, absence of thorax), some features suggest possible affinities with agnostoids, e.g., the narrow border and the assumed doublure at the cephalic and trunk shields. Such borders are developed on cephalon and pygidium of several agnostoid genera (e.g. *Leiagnostus* Jaekel, 1909; *Toragnostus* Robison, 1988 and/or *Megagnostus* Robison, 1994). The type of preservation of both studied specimens of *Pseudonaraoia* gen. n. is very different from other arthropod remains found in the studied section (both in shales and siliceous nodules) and/or at other localities in the Šárka Formation (compare Fig. 1 and Plate I), suggesting rather very thin, or only slightly mineralized exoskeleton. However, all the available material is not sufficient for a detailed study and description. Consequently, the possibility that the two specimens described herein as *Pseudonaraoia* gen. n. represent rests of effaced agnostoids (e.g. *Leiagnostus*) preserved under specific taphonomic conditions cannot be entirely excluded. Nevertheless, we assume that the unique combination of diagnostic features justifies the erection of a new genus, *Pseudonaraoia* n. gen. Its final affiliation depends on finding better preserved material in the future.

Early Middle Ordovician age of *Pseudonaraoia* gen. n. is younger than the main distribution of the family

Naraoiidae Walcott, 1912 but it corresponds to the earliest known occurrence of the naraoid family (?subfamily) Liwiidae Dzik et Lendzion, 1988.

Genera ranged to Liwiidae, such as *Liwia* Dzik et Lendzion, 1988 and *Tarricoia* Hammann et al., 1990 show different pygidial outline and a presence of thoracic segments; (see also Hammann and Leone 1997) *Soomaspis* Fortey and Theron 1994 is distinguished by 3–2? thoracic segments and distinctly segmented trunk shield. *Misszhouia* Chen et Zhou, 1997 and *Tegopelte* Simonetta et DellaCave, 1975 clearly differ in their much more elliptical outline of the body, *Tegopelte* Simonetta et DellaCave, 1975 also in the presence of the probable tagmata.

Occurrence: Middle Ordovician, Oretanian (in the peri-Gondwanan chronostratigraphy), Darriwillian, Bohemia, Šárka Formation.

*Pseudonaraoia hammanni* sp. n.
Plate I, figs. 1–4, Fig. 2

Derivatio nominis: Named in honor of Dr. Wolfgang Hammann, the outstanding German palaeontologist who studied both trilobites and naraoids, died in 2002.

Holotype: Almost complete but strongly flattened specimen, S 03739.

Paratype: Fragment of trunk shield, S 03740.

Type horizon: Lower part of the Šárka Formation, Oretanian (Darriwillian), Middle Ordovician.

Type locality: Praha – Červený vrch Hill, Prague Basin of the Barrandian area, Czech Republic.

Diagnosis: Same as for the genus.

Description: Sagittal length of whole body 1.73 cm, max. transverse width 0.8 cm. Exoskeleton showing many signs of crushing and plastic deformation, its margins being not easy to define. Such type of preservation implies that the cuticle was most probably very slightly mineralized and/or even non-mineralized. Cephalic shield with indistinct lateral margin, semicircular in outline, axial part only slightly vaulted and very indistinctly separated from the lateral and anterior regions. External cephalic surface smooth, no indication of visual organs or sutures. Trunk shield most probably articulated directly to cephalic shield, forming a narrow overlapping area of crescent-like shape, originated by a simple intersection of both shields, similarly as in *Naraoia compacta* Walcott (see Robison 1984). Trunk shield slightly elliptical in outline, only slightly longer (sag.) than cephalic shield (length ratio max. 1 : 1.1), with poorly defined lateral margins. Pygidial axis indistinct, very poorly defined axial furrows. Only slightly indicated segmentation observable on internal surface, external pygidial surface smooth.

Discussion: Species of the genus *Leiagnostus* Jaekel, 1909 (present in Lower and Middle Ordovician of the Prague Basin, including the Šárka Formation) differ in their prominent node on the pygidial axis, more elliptical pygidial outline, different anterolateral pygidial margin and also in the presence of a prominent marginal pygidial furrow.

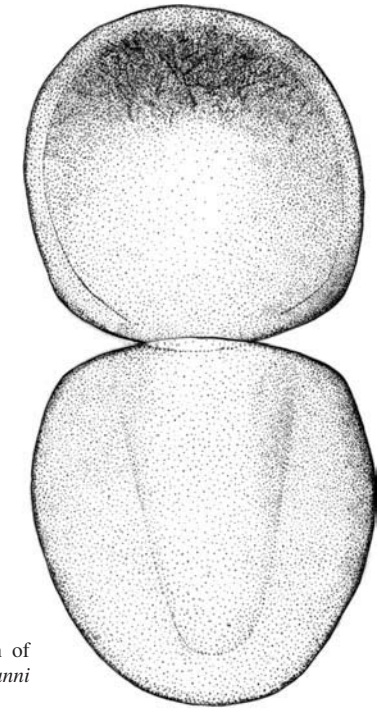

Fig. 2. Reconstruction of *Pseudonaraoia hammanni* gen. n. sp. n., ×3.

Occurrence in the section: Dark silty shales with frequent dendroids and graptoloids.

Order: Corynexochida Kobayashi, 1935
Family: Illaenidae Hawle et Corda, 1847
Genus: *Ectillaenus* Salter, 1867

Type species: *Illaenus perovalis* Murchison, 1839

*Ectillaenus katzeri katzeri* (Barrande, 1872)
Fig. 1a

Material: One cranidium preserved in a siliceous nodule as internal mould with the rests of exoskeleton.

Remarks: An almost complete cranidium, secondarily damaged in its anterior part. It is preserved in the siliceous nodule as an internal mould with remains of the original exoskeleton mainly in the anterior part of cranidium and on the fixigenae. The ornamentation consists of fine dense pits and terrace lines.

Discussion: The only one cranidium fits well with the diagnosis of *Ectillaenus katzeri katzeri* known from the lower part of the Šárka Formation (Bruthansová 2003). *E. katzeri katzeri* is the most widely distributed species of the genus *Ectillaenus* in the Šárka Formation. It differs from all other Bohemian Llanvirnian illaenids in having minute eyes positioned in the anteral third of cephalic shield (in palpebral view), and parabolic outlines of both cephalon and pygidium. The specimen represents one of the stratigraphically earliest occurrences of this genus in the Prague Basin (with the exception of the rare finds in the uppermost Klabava Formation at Ejpovice near Rokycany and at the Hlava Mine near Komárov; see Mergl 1991).

Occurrence in the section: The horizon with siliceous nodules.

Order: Phacopida Hawle et Corda, 1847
Family: Pliomeridae Raymond, 1913
Genus: *Placoparia* Hawle et Corda, 1847
Subgenus: *Placoparia* (*Placoparia*) Hawle et Corda, 1847
Type species: *Trilobites zippei* Boeck, 1828

*Placoparia* (*Placoparia*) sp. cf. *P.* (*P.*) *cambriensis* Hicks, 1875
Figs. 1b, 1d

Material: Incomplete, partially dissolved counterpart of one enrolled specimen preserved in siliceous nodules, fragments of the disarticulated thorax preserved both in shales and in nodules.

Remarks: The available material is poorly preserved. Major diagnostic features (shape of the thoracic pleurae) permit the assignment to the genus *Placoparia (Placoparia)*.

The occurrence of articulated remains of *Placoparia* (as a representative of bottom-dwelling trilobite; see Hammann 1971) indicates at least temporary, short-time increase in oxygen level in the water column and/or in the sediment, allowing settlement of the sea floor.

Occurrence in the section: Horizon with siliceous concretions, shales (layer No. 10 – see Budil et al. 2003, this volume).

Family: Asaphidae Burmeister, 1843
Asaphidae gen. et sp. indet.
Fig. 1c

Material: Fragment of pleura (internal mould).

Remarks: One fragment of the right pleura and a part of the axis belonging to a large asaphid trilobite. Pleural width (tr.) reaches 55 mm, its length (exsag.) ca. 12 mm. Lateral axial lobes inconspicuous, pleural furrows deep. External surface of the exoskeleton is smooth, without sculptation. Such morphology recalls the genera *Asaphellus* and/or *Megistaspis*.

Occurrence in the section: Horizon with siliceous nodules.

## Conclusions

The non-phyllocarid arthropods represent a rare but important component of the faunal assemblage at Praha – Červený vrch Hill. All these finds are poor for a detailed evaluation of taphonomical aspects. However, at least part of the trilobite remains is supposed to be autochthonous and/or paraautochthonous (articulated remains of probably endobenthic *Placoparia*). The problematic finds of naraoiids in the dark shales of the Šárka Formation are also supposed to be autochthonous because of the occurrence of an articulated specimen. Such occurrence agrees with the nectobenthic mode of life suggested for *Tarricoia* by Hammann et al. (1990). The recently published investigations of Vannier and Chen (2002) presumed that naraoids were probably epibenthic scavengers or predators rather than mud-eaters.

Acknowledgements. The authors are particularly grateful to Dr. Jean Vannier (C.N.R.S. Lyon) and Dr. Michal Mergl (West Bohemian University Plzeň) for reviewing the manuscript and making many helpful remarks. This study was supported by the Grant of the Ministry of Education (No. CEZ: J13/98:113100006). P. Budil and J. Bruthansová thank the Grant Agency of the Academy of Sciences of the Czech Republic (project No. B 3407201) for financial support.

*References*

Bruthansová J. (2003): The trilobite family Illaenidae Hawle et Corda, 1847 from the Ordovician of the Prague Basin (Czech Republic). Trans. Royal Soc. of Edinburgh: Earth Sci. 93, 167–190.

Budil P., Chlupáč I., Hradecký P. (2003): Middle Ordovician at Praha – Červený vrch Hill (Barrandian area, Czech Republic). Bull. Geosci. 78, 2, 91–98.

Chlupáč I. (1970): Phyllocarid crustaceans of the Bohemian Ordovician. Sbor. geol. Věd, Paleont. 12, 41–77, Praha.

Chlupáč I. (2003): Phyllocarid crustaceans from the Middle Ordovician Šárka Formation at Praha-Vokovice. Bull. Geosci. 78, 2, 107–111.

Fortey R., Theron J. N. (1994): A new Ordovician arthropod, *Soomaspis* and the agnostid problem. Palaeont. 37, 4, 841–861.

Hammann W. (1971): Die Placopariinae (Trilobita, Cheirurina, Ordovizium). Senckenberg. lethaea 52, 53–75. Franfurt a/M.

Hammann W., Laske R., Pillola G. L. (1990): *Tarricoia arrusensis* n. gen. n. sp., an unusual trilobite-like arthropod. Rediscovery of the "phyllocarid" beds in Taricco (1922) in the Ordovician "Pudinga" sequence of Sardinia. Boll. Soc. Palaeont. Ital. 29, 163–178.

Hammann W., Leone F. (1997): Trilobites of the post-Sardic (Upper Ordovician) sequence of southern Sardinia. Part I. Beringeria 20, 1–217.

Havlíček V., Vaněk J. (1990): Ordovician invertebrate communities in black-shale lithofacies (Prague Basin, Czechoslovakia). Bull. Czech Geol. Surv. 65, 4, 223–236.

Kraft P., Budil P., Chlupáč I., Fatka O., Kraft J., Mikuláš R., Mergl M., Bruthansová J. (2003): Fossil assemblages from the Middle Ordovician Šárka Formation at Praha – Červený vrch Hill (Prague Basin, Barrandian area). Bull. Geosci. 78, 2, 99–101.

Kraft P., Kraft J. (2003): Middle Ordovician graptolite fauna from Praha – Červený vrch (Prague Basin, Czech Republic). Bull. Geosci. 78, 2, 129–139.

Mergl M. (1991): New Lower Ordovician (Arenig) trilobite assemblages in Bohemia. Čas. Mineral. Geol. 36, 4, 193–203.

Robison R. A. (1984): New occurrence of the unusual trilobite *Naraoia* from the Cambrian of Idaho and Utah. Univ. Kansas Pal. Contrib. 112, 1–8.

Vannier J., Chen J. Y. (2002): Digestive system and feeding mode in Cambrian naraoiid arthropods. Lethaia 35, 107–120.

*Handling editor: Zdeněk Kukal*

1

2

3

4

Plate I

*Pseudonaraoia hammanni* gen. n. sp. n. 1– holotype, flattened, almost complete specimen, S 03739, internal mold, ×2. 2 – as above, external mold, ×2. 3 – paratype, S 03740, internal mold, ×2. 4 – as above, external mold, ×2.