

## 1. Introduction

The Cambrian of the Barrandian area is one of the classical areas of the palaeontological research of the world; its importance was created mostly by the work of BARRANDE (1852). Subsequent authors (ŠNAJDR 1958, CHLUPÁČ et HAVLÍČEK 1965, HAVLÍČEK 1971, FATKA et al. 1992, CHLUPÁČ 1995, a.o.) contributed to better knowledge of main groups of fossils and to their biostratigraphical evaluation. However, trace fossils of the Cambrian of the Barrandian area have remained unacquainted so far.

In several past years, a complex research of the Paseky Shale (Early Cambrian, the Holšiny-Hořice Formation) has been realised by the team led by Prof. I. Chlupáč. The Paseky Shale is a sole fossiliferous member of the Bohemian Early Cambrian, yielding the entirely unique fauna and representing exceptional (probably brackish or freshwater) settings. Besides its geological settings (CHLUPÁČ, KRAFT, and KRAFT 1995), sedimentology (KUKAL 1995), macrozoopaleontology (Chlupáč 1995) and micropaleontology (FATKA-KONZALOVÁ 1995), the trace fossils of the Paseky Shale were also studied (MIKULÁŠ 1995b).

Richly fossiliferous rocks of the Middle Cambrian of the Barrandian area are represented by the Jince Formation (in the Příbram-Jince area) and by the Skryje Shale (in the Skryje area). At present, a sole ichnological paper concerning the Barrandian Middle Cambrian exists (CHLUPÁČ-MIKULÁŠ 1995); several preliminary reports and brief notices not documented by detailed descriptions and figures were also published only. Therefore, the aim of the present paper is to give an overall picture of the ichnological content of the Barrandian Middle Cambrian.

*Acknowledgements.* I thank to the Grant Agency of the Czech Republic for a financial support of the research (Grant No. 205/93/0340). I am obliged to Professor I. Chlupáč and to Dr. O. Fatka (both the Charles University, Prague) for numerous consultations, for introduction to biostratigraphical problems and other aspects of the study. I thank to Mr. V. Kordule (Příbram) and to the students of geology M. Szabad and M. Kříha for valuable comments and for a help during the field work. I feel to be obliged to all the above-named professional or fellow workers and to Mr. P. Šlehofer (formerly the Geological Institute, Academy of Sciences of Czech Republic, Prague) for providing numerous finds of trace fossils to my study. I thank to Dr. P. Budil and Mrs. R. Šarič and P. Novotný for their help during my study of the material in the collections of the Czech Geological Survey, Prague. I thank to the reviewer of the manuscript, late Dr. I. Pek (Palacký University, Olomouc) for valuable helpful comments.

## 2. Geological settings

A present-day knowledge of the Bohemian Cambrian resulted from contributions of several past generations of re-

searchers (BARRANDE 1852; KETTNER 1915, 1923), from a detailed geological investigations of HAVLÍČEK (summary 1971), sedimentological research of KUKAL (1971), from numerous palaeontological papers (e.g., ŠNAJDR 1958) and from a recent biostratigraphical and palaeontological research (e.g., FATKA and KORDULE 1992, FATKA et al. 1992, MERGL and ŠLEHOFEROVÁ 1991). The last-mentioned papers show a possibility of further refinement of biostratigraphical scale and subsequent biostratigraphical correlations between the Skryje and the Jince areas. Review of essential knowledge of the Bohemian Cambrian is involved in a guide-book of CHLUPÁČ (1993). More detailed summary was published by HAVLÍČEK (1998).

The below-adduced characteristics of the Cambrian of the Central Bohemia is adapted from CHLUPÁČ (1993): "A new, postorogenic phase of sedimentation started after the main effects of the Cadomian orogeny. Locally this sequences of terrigenous clastic rocks accumulated in some intermontane depressions and grabens between uplifted and eroded Cadomian ranges. Tectonic activity resulted in synsedimentary faults, and volcanic processes are documented at different levels.

The main sedimentary area in the Lower Cambrian was the Příbram-Jince Basin situated in the SE flank of the Barrandian and was filled with an up to more than 2000 m thick sequence of varied continental fluvial conglomerates, sandstones, and subordinated shales lacking all typical marine fauna. The only fossiliferous member – the green Paseky Shale yielded a special assemblage of arthropods with the index merostome *Kodymirus vagans* CHL. et HAVL. found in the Brdy Mts. This fauna is remarkable from the palaeoecological and evolutionary viewpoints, as it evidently inhabited a non-marine, probably lagoonar environment. A Lower Cambrian age is inferred from the superposition: the shale with *Kodymirus* is several hundred metres below the strata containing earliest Middle Cambrian faunas.

The Middle Cambrian Epoch is distinguished by marine transgression which reached not only the Příbram-Jince Basin, but covered even other parts, e.g. the graben-like depression in the NW part of the Barrandian (the Skryje-Týřovice area), or the Železné hory in eastern Bohemia. Apart from some local littoral sediments accompanying the first phase of marine transgression, grey-green siltstones and shales of the Jince Formation, world-famous for rich and well preserved trilobites and other faunas are characteristic. In the classical Jince area, the rich trilobite assemblages allow a zonal subdivision and correlation with the Middle Cambrian deposits of other regions. Faunistic relationships point to the Mediterranean, rather cool-water subprovince of the Prototethys realm with only subordinated North European elements.

A marine regression marked by preceding gradual impoverishment in marine benthic biota falls within the late Middle Cambrian. No demonstrable Upper Cambrian sediments are known from the Barrandian, but volcanic activity concentrated on SW-NE trending tectonic lines is remarkable. Upper Cambrian erosion had reduced the areal

extent of preserved Cambrian deposits and the Ordovician strata overlay the eroded surface of the Cambrian to Proterozoic basement."

### 3. Previous work

The first note on ichnofossils from the Central Bohemian Cambrian is that of VLČEK (1902), who described and figured the "species" *Fucoides primulus* (= *Palaeophycus* isp.) from the locality Podmokly (probably in a vicinity of present locality Buchava). The same specimen was described and re-figured by FRITSCH (1908).

Brief notices on trace fossils in the monograph by ŠNAJDR (1958, p. 16) are remarkable. ŠNAJDR (op. cit.) stated that flat passages made by the locomotion of unknown organisms were found in the uppermost layers of the Chumava Member in silty shales. At present, no finds of ichnofossils from the Chumava-Baština Formation are known. Moreover, the same author stated similar finds from the non-marine Upper Cambrian Pavlovsko Formation at Lhůta village. Again, there are no ichnofossils known from the Pavlovsko Fm., neither from my own fieldwork nor from museum collections. In my opinion, it is probably that the mistakes in stratigraphical attribution of finds or in interpretation are concerned. In the first case, it is because the boundary between the Chumava-Baština Formation and the marine, fossiliferous Jince Formation is compli-

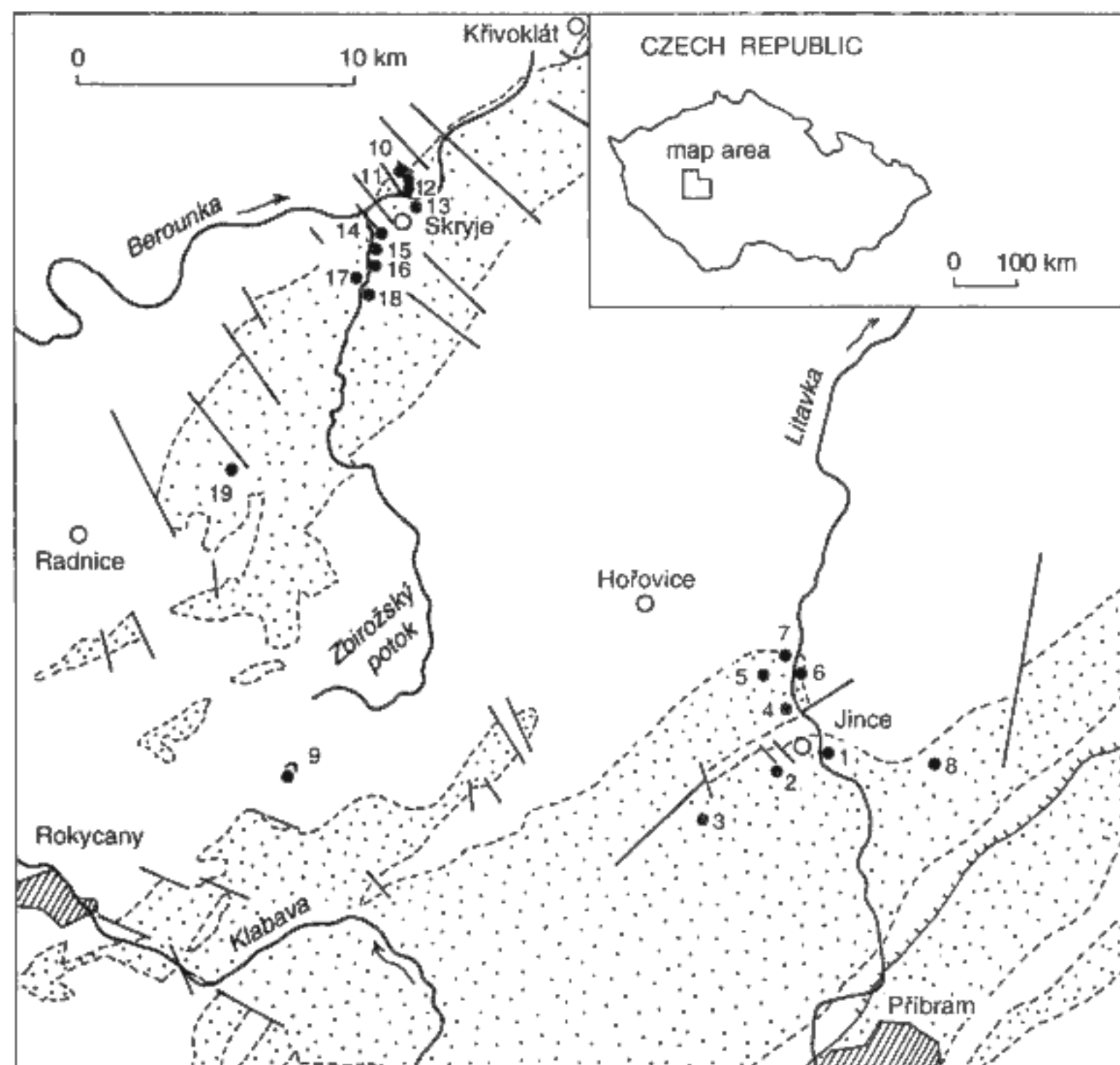
cated and not fully understood; in the second case, inorganic structures (e.g., flow rolls) might be concerned.

PROKOP (1960) stated that "traces of animal activity" and "archaeocyatha in natural life position perpendicular to bedding planes" occur in the Jince Formation along the road from Rejkovice to Felbabka. Analogical finds of "archaeocyatha" have been reported in the same paper from the Vystrkov locality.

In 1960's to 1970's, larger amount of ichnofossils from the Middle Cambrian has been collected by B. Bouček; however, he died leaving his knowledge unpublished. His collection of ichnofossils (deteriorated, unfortunately, by a lost of some data on finding places) is housed in the Czech Geological Survey, Prague, coupled with brief manuscript notes of B. Bouček. The collection was one of the material sources for the presented monograph. Concerning the Bouček's notices, the most interesting is that on the above-mentioned references of R. Prokop on archaeocyathids. After Bouček, the ichnofossils have to be concerned; Archaeocyatha are not known from the Bohemian Cambrian and the Prokop's observations can be probably attributed to vertical, finely sculptured burrows probably of inarticulate brachiopods.

During the study of the oldest Middle Cambrian fauna at the Vinice locality (FATKA et al. 1992), the ichnofossil *Diplocraterion* was found, confirming the assumption of dynamic shallow-water settings (FATKA et al. 1992, HAVLÍČEK in CHLUPÁČ et al. 1992).

CHLUPÁČ (1993) published the first ichnofacies charac-



1. Sketch map of the Central Bohemian Cambrian showing the position of the localities. 1 - Vinice; 2 - Vystrkov; 3 - Koníčec; 4 - Jince - Ovčín; 5 - Felbabka - Potůček; 6 - Rejkovice; 7 - Ostrý; 8 - Písky; 9 - Medový Újezd; 10 - Kamenná hůrka; 11 - Pod tmím; 12 - Mouth of the Karáskova rokle Gorge; 13 - Luh; 14 - Slapnice - camp; 15 - Dlouhá hora; 16 - Dubinky; 17 - Jezírka; 18 - Buchava; 19 - Biskoupky. Dotted area corresponds to the present occurrence of the Cambrian rocks, including the Lower Cambrian conglomerates and sandstones and the Upper Cambrian volcanites.