

OSTRACODES FROM THE LETNÁ FORMATION (ORDOVICIAN) OF BLÝSKAVA (BOHEMIA)

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Abstract. Until now only a few species of ostracodes were known from the Letná Formation of the Ordovician of Bohemia. New material from the locality of Blýskava yielded 16 species among them 10 new species and subspecies of 16 genera (2 new). In comparison with the ostracode fauna of the older Dobrotivá Formation, the relationships of the fauna to Armorica on one side and Baltica on the other, demonstrates the displacement of Perunica from Armorica on one side and an approaching toward Baltica in the Ordovician on the other side.

■ Ostracoda, Beyrichiocopa, taxonomy, new taxa, Ordovician, Letná Formation, Bohemia, Barrandian Area, Blýskava, palaeobiogeography, Perunica, Baltica, Armorica

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Introduction

As the coarse sandstones of the Letná Formation are not suitable for preserving tiny shells, ostracodes are very rare (Příbyl 1979, p. 112). No illustrations were published before Vannier 1987 described *Ceratopsis krutai* sp. n. from the locality of Blýskava. Older publications listed ostracode species from Praha-Letná but did not describe them. Havlíček and Vaněk (1966) mentioned six species (*Ceratopsis hastata*, *Tallinnella bohemica*, *Trubinella latens*, *Crescentilla pugnax*, "*Cytherina*" *graegaria*, and "*Cytheropsis*" *testis*). The first four species were originally described by Barrande 1872 from the Vinice Formation and appear in lists of synonyms of this paper.

The species mentioned by Havlíček and Vaněk (1966 p. 54) as "*Cytherina*" *graegaria* BARR. refers to the manuscript name of Barrande *Primitia gregaria* mentioned by Jones and Holl (1869 p. 223) and also by Bassler and Kellett (1934 p. 445). Because a description and/or a figure seem to have never been published the name is a *nomen nudum*. Therefore it is not known which species from the Letná Formation, should be represented by that particular report. Possibly the designation of the species as *Cytherina* may indicate a podocope form.

"*Cytheropsis*" *testis* BARRANDE, 1872 is a rather large form (15 mm) and according to Příbyl (1979 p. 54) a phyllocarid. The report of Havlíček and Vaněk may also refer to a podocope form which are rather rare in the Letná Formation material. The present material is insufficient for further descriptions. Příbyl (1979 table p. 112/113) mentioned only two species that had already been listed [*Hastatellina hastata* (BARRANDE, 1872) and *Cerninella bohemica* (BARRANDE, 1872)] and Schallreuter and Krůta (1988) repeated the list given by Havlíček and Vaněk (1966).

The present paper deals with the new discovery of a relatively well preserved ostracode fauna from the Letná Formation locality of Blýskava near Beroun. Most of the ostracode specimens are preserved as negatives (external moulds) and steinkerns in thin layers of limonite that occur in coarse sandstones of the Letná Formation. The thin layers are densely packed with ostracodes. The material is so fragile that casting with Silcoset was possible only for exceptionally well preserved negatives (pl. 2, fig. 1). SEM photographic casts were produced by means of an inverted signal for some of the external moulds. Only a few ostracodes are preserved as shells (figs 1.5, 3.7).

All types are figured as a stereo pairs based on a tilting angle of 10°.

All figured specimens are deposited in the National Museum (Národní muzeum, Přírodovědecké muzeum) in Prague (NMP). The type locality of all new species is Blýskava near Beroun and the stratum typicum is the Letná Formation. Other abbreviations: L, length; H, height.

Systematic descriptions

Order **Beyrichiocopa** POKORNÝ, 1954

Suborder **Palaeocopa** HENNINGSMOEN, 1953

Infraorder **Beyrichiomorpha** HENNINGSMOEN,
1965

Division **Hollinomorpha** HENNINGSMOEN, 1965

Superfamily **Eurychilinae** ULRICH et BASSLER,
1923

Family **Eurychilinidae** ULRICH et BASSLER, 1923
Subfamily **Chilobolbininae** JAANUSSON, 1957

Laccochilina HESSLAND, 1949

Laccochilina ? (sg. n. ?) **blyskava** sp. n.
Pl. 3, fig. 1

Derivatio nominis. After the type locality.

Holotype. Steinkern of a left valve of a female, NMP L 31699 - pl. 3, fig. 1.

Diagnosis. L of the females about 1.59 mm. Sulcus long, the dorsal part perpendicular to the dorsal margin, ventrally directed in an anteroventral direction. Brood pouch long, extending from the anteroventral region to the border of the posteroventral/posterocentral region.

Material. 3 female and 1 ? tecnomorphic steinkerns.

Dimensions. Holotype: L, 1.34 mm; H, 0.73 mm; paratype (female left valve) L 1.59 (1.46), H 0.98 (0.74) [in () without the brood pouch].

Remarks and relationships. The species is characterized by a long, ventrally oblique sulcus and a very long brood pouch. In typical *Laccochilina* species the sulcus is short and restricted to the dorsal half of the valve. The brood pouch does not reach the border of the posteroventral/posterocentral region (Jaanusson 1957, pl. 1, figs 12, 15, 16; pl. 2, figs 1, 2, 6, 8, 14; pl. 3, fig. 8). Because the species is based on steinkerns only it could not be determined whether it represents a genus or subgenus of its own. In *Eurychilina* the sulcus is also restricted to the dorsal half of the valve, but the brood pouch may also be very long (Harris 1957, pl. 7, figs 14a, 15a; Levinson 1961, pl. 1, figs 3c, d). *Oepikium* also possesses a long sulcus, but the dolon is much broader.

Superfamily **Hollinacea** SWARTZ, 1936

Family **Tvaerenellidae** JAANUSSON, 1957

Subfamily **Tvaerenellinae** JAANUSSON, 1957

Duringia SCHALLREUTER, 1984

Duringia angustosulcata sp. n.
Pl. 1, fig. 1

Derivatio nominis. After the narrow sulcus.

Holotype. External mould of a right valve of a female, NMP L 28826 - pl. 1, figs 1a, b.

Material. Holotype.

Diagnosis. Up to 1.51 mm. Long S2 narrow throughout. Relatively large oval preadductorial node. Lateral surface with characteristic spines: one in front of the ventral end of S2, two behind and three spines at the dorsal margin of the posterior half. There are further smaller spines on the other parts of the lateral surface. Long, strongly convex antrum (, false brood pouch'), reaching from anteroventral to posteroventral regions, and covered by several spines.

Relationships. *D. spinosa* from the uppermost Caradoc of Thuringia is more spinose and possesses a distinctly tubu-

lose dolon (Schallreuter 1984, pl. 11, 10; 11, 12). *D. aculeata* OLEMPSKA, 1994 from the *Amorphognathus variabilis* Zone (Early Ordovician) of the Mójca Limestone of the Holy Cross Mts. has a broader S2 and a tubulose, non-spinose dolon (Olempska 1994, pl. 25, figs 1-3). *D. triformosa* JONES, 1984 from the Llandeilo 'Flags' of Dyfed (Wales) has a diminutive preadductorial node, a narrow depression (remnant S3?) extending from the posterocentral region to the dorsum, and a weakly convex tubulose dolon (Jones 1984, pl. 11, 14; 11, 16). *D. ? alembogensis* SCHALLREUTER, 1987 from an Upper Viruan glacial erratic boulder (geschiebe) of N Germany also has a narrow S2, but differs in many other features (Schallreuter 1987, fig. 3.4).

Euprimites (Euprimites) HESSLAND, 1949

Euprimites (Euprimites) cf. **kahalaensis** SARV,
1963 (ssp. n. ?)
Pl. 1, figs 3, 4

Material. Several valves, mostly steinkerns, among them 1 female steinkern (pl. 1, fig. 1) and 1 juvenile tecnomorphic left valve preserved as a shell (no. 75/28)

Remarks. The female valve is about 1.94 mm long and reaches the same size as *E. kahalaensis* from slightly younger beds (upper Keila - Oandu) of Estonia. The tecnomorphic left valve strongly resembles *E. kahalaensis* in its outline and in the form of the sulcus. The female valve is also very similar to the holotype of that species with respect to the development of the dolon which seems only to be a little broader (Sarv, 1963, pl. 1, figs 1-10). In *E. kahalaensis* the surface is tuberculate, whereas in the Bohemian material it seems to be smooth as demonstrated principally by the tecnomorphic valve. The juvenile specimen from Bohemia (no. L 28814, fig. 1.4) does not show any sign of a plica, but in the female steinkern there is an indistinct bend at the relevant position and in the shelly tecnomorphic specimen (75/28) the presence of a plica could not be excluded with certainty. If a narrow plica was present in the Bohemian species this would be another feature that distinguishes it from *E. kahalaensis* which possesses no plica.

Euprimites (Bichilina) SARV, 1959

Euprimites (Bichilina) bichilus tirelacuta ssp. n.
Pl. 1, fig. 2

Derivatio nominis. Anagram of *reticulata*.

Holotype. External mould of a ? female left valve, NMPL 28827 - pl. 1, figs 2a, b.

Material. Several specimens.

Diagnosis. Length 1.17 mm. Dorsal plica distinct. Zygal ridge weak. Velum in posterior part missing or rather narrow only. Surface reticulate.

Relationships. *E. (B.) bichilus bichilus* (SIDARAVICIENE, 1975) from the Johvi stage (D₁) of Lithuania is most similar to *E. (B.) tirelacuta* but larger (1.50 mm) and not reticulate. As in that species the velum in the posterior part seems to be only small or missing.

E. (B.) prima (SARV, 1959) from equivalent beds (C₃ - D₂) has an entire velum, a more distinct zygal crista, and is not

reticulate (Schallreuter 1973, pl. 23, fig. 8; pl. 24, figs 1, 2, 4).

E. (B.) easchmidti (SCHALLREUTER, 1967) from the younger Bohdalec Formation has a more rounded outline. The rounded-rectangular outline of *E. (B.) tirelacuta* is more similar to the type species, *E. prima* (SARV, 1959), from Estonia.

E. bohdalecensis PŘIBYL, 1979 is a synonym of *E. easchmidti* (SCHALLREUTER, 1967). Schmidt (1941 p. 29) introduced the new name *jonesiana* for *Primitia jonesii* KRAUSE, 1889 because of the homonymy with *Primitia jonesii* KONINCK, 1876. He placed *jonesiana* in the genus *Mirochilina* BOUČEK, 1936. At the same time he assigned to *Mirochilina jonesiana* n. nom. specimens he had found in the Bohdalec Formation. (Ordovician) of Bohemia. The Baltoscandian form *Primitia jonesii* KRAUSE, 1889 belongs to the genus *Uhakiella* ÖPIK, 1937 and is not identical with Bohemian *Mirochilina jonesiana*. Moreover, the Bohemian *M. jonesiana* can not be placed within *Mirochilina* which is a Silurian - Devonian ostracode genus without any Ordovician species. Therefore Schallreuter 1967 introduced for the Bohemian material of *Mirochilina jonesiana* sensu SCHMIDT, 1941 the new species *Bichilina easchmidti*, and selected the specimen X/E 826b (Schmidt 1941, table 3, fig. 22) as the holotype. Přebyl (1979, p. 73) established the new species *Euprimites bohdalecensis* PŘIBYL, 1979 on the same specimen and it is therefore an objective synonym. Investigation of the type, 826b, proved that in fig. 22 two carapaces are figured: a female carapace 22d (length 1.66 mm) and a tecomorphic carapace 221, v (length 1.44 mm). Therefore the female carapace shown in fig. 22d is designated as the lectotype for *Bichilina easchmidti* SCHALLREUTER, 1967 and *Euprimites bohdalecensis*.

Vendona SCHALLREUTER, 1988

Vendona sulcutula sp. n.

Pl. 1, fig. 5

Derivatio nominis. *Sulcutulus*, lat. - basin, bowl; alluding to the basin-like sulcus.

Holotype. Left valve, female with shell of the domicilium and of the brood pouch partly broken away, NMP L 28628 - pl. 1, fig. 5.

Material. Holotype.

Diagnosis. Females around 1.47 mm in length. Domicilium very high. Sulcus short, dorsally open, and ventrally closed. Broad, indistinct preadductorial node. Plica ridge-like and slightly reduced centrodorsally. Lateral and ventral side of dolon flexed.

Relationships. *V. angulata* (SCHALLREUTER, 1993) from an upper Oelandian (B₃) geschiebe (glacial erratic boulder) of Northern Germany is most similar and also possesses a flexure on the dolon (Schallreuter 1993, pl. 35A, figs 1, 2), but in that species the sulcus is pit-like, the preadductorial node smaller and more distinct and the plica is not reduced centrodorsally. The type-species, *V. ventrodolonata* (SCHALLREUTER, 1988), is of about the same size but has a more elongate domicilium, a more pit-like S2 and a more bulge-like, unevenly broad plica (Schallreuter 1993, pl. 53A). *V. noncanalis* (SCHALLREUTER, 1993) differs mainly by the presence of a flat laterodolone furrow (Schallreuter 1993, pl. 35B, fig. 2). In *V. cicatriosa* (SARV, 1959) the outline of the domicilium is more elongate and the S2 is more pit-like (Sarv, 1959, pl. 4, figs 1-4; Schallreuter 1993, pl. 45A, fig. 3).

Family *Ctenonotellidae* SCHMIDT, 1941 Subfamily *Ctenentominae* SCHMIDT, 1941

Piretopsis HENNINGSMOEN, 1953 *Piretopsis (Cerninella)* PŘIBYL, 1966

Piretopsis (Cerninella) bohemica (BARRANDE, 1872) Pl. 2, figs 1-7

- 1975 *Cerninella bohemica* (BARR.) - Přebyl p. 163
1984 *Piretopsis (Cerninella) bohemica* (BARRANDE, 1872) Schallreuter, Siveter and Krůta pp. 127-136, pls 11, 128; 11, 130; 11, 132; 11, 134 (q.v. for further synonymy)
1986a *Beyrichia bohemica* BARRANDE, 1872A; *Cerninella bohemica* (BARRANDE, 1872A) Přebyl 1966a; *Piretopsis (Cerninella) bohemica* (PŘIBYL, 1966a) SCHALLR., SI. and K., 1984a; *Tallinnella ? bohemica* (BARRANDE, 1872A) JAANUSSON, 195A; *Tallinnella bohemica* (BARRANDE, 1872A) HAVLÍČEK et VANĚK 1966a; *Tetradella bohemica* (BARRANDE, 1872A) ULRICH et BASSL., 1908 - Kempf, p. 110, 167, 168, 593, 708, 712
1986b dtto. - Kempf, pp. 95, 96
1987 dtto. - Kempf, pp. 62, 131, 322, 468, 474, 761
1988 *Tallinnella bohemica*; *Piretopsis (Cerninella) bohemica* (BARRANDE, 1872) - Schallreuter and Krůta, p. 103 (? 102)

Lectotype. NM no. L 10010 [ex. CD 805, Imv. No. 1700] Schallreuter et al. 1984, pp. 11, 135.

Type locality. Trubín near Králův Dvůr (Königshof), Bohemia.

Stratum typicum. Vinice Formation (d3 of Barrande), Caradocian (Beroun Regional Stage).

Material. More than 100 external moulds and steinkerns.

Remarks. The largest valve in the material from the Letná Formation, the specimen figured in pl. 2, fig. 3 (L, 3.28 mm), is a little smaller than specimens from the stratum typicum, the slightly younger Vinice Formation (3.72 mm). The material from the Letná Fm. also contains larvae. In the young instars the cristae are still missing (pl. 2, figs 5-6). The cristae become gradually distinct during ontogeny, and are already present in larger instars (pl. 2, fig. 4). This is in accordance with the other ctenonotellid species, for example *Steusloffia costata* LINNARSSON, 1869 (Schallreuter 1976, pp. 189-190; pl. 5, figs 1, 3-5) and *Tallinnellina murus* SCHALLREUTER, 1993 (Schallreuter 1993, p. 58; pl. 14A; pl. 14B, figs 2-4; pl. 15A, figs 2-3; pl. 15B). In *T. murus* the cristae only appear in the adults.

Superfamily *Tetradellacea* SWARTZ, 1936 [SCHALLREUTER, KANYGIN et HINZ-SCHALLREUTER, 1999]

Family *Tetradellidae* SWARTZ, 1936 Subfamily *Tetradellinae* SWARTZ, 1936

Ceratopsis ULRICH, 1894 *Ceratopsis (Hastatellina)* PŘIBYL, 1975

Remarks. In his revision of the genus *Ceratopsis* Vannier (1987, pp. 725, 726, 734) placed *Hastatellina* PŘIBYL, 1975 in synonymy with *Ceratopsis*, but Schallreuter and Krůta (1988, p. 103) reinstated *Hastatellina* as a subgenus of *Ceratopsis*. Vannier

(1987, fig. 11) showed that there are two main branches in the phylogenetic tree of the genus *Ceratopsis*. These two branches are considered by the present authors as two subgenera. The *Ceratopsis* branch is the more conservative one, preserving quadri-lobality even in the terminal taxa, whereas the *Hastatellina* branch is characterized by reduction of the lobation.

***Ceratopsis (Hastatellina) krutai* VANNIER, 1987**

Pl. 3, fig. 5

- 1966 *Ceratopsis hastata* (BARRANDE) - Havlíček and Vaněk, pp. 32, 54
1979 *Hastatellina hastata* (BARRANDE, 1872) - Přibyl, p. 63 (partim), table between, p. 112/113 (partim)
1987 *Ceratopsis krutai* nov. sp. - Vannier, pp. 725, 731, 732-734, 736, 737, 740, 744; figs 5, 7A, 9-11; pl. 2, fig. 6; pl. 3, figs 1, 2; pl. 4, figs 1, 2
1988 *Ceratopsis hastata*; *Ceratopsis krutai* sp. n. "which is presumably identical with *Ceratopsis hastata*: HAVLÍČEK et VANĚK" - Schallreuter and Krůta, p. 103

Holotype. External mould of a right tecnomorphic valve, replicated as a Silcoset-Cast IGR (Institut de Géologie de l'Université Rennes) no. 32100 - Vannier 1987, pl. 3, figs 1a-g.

The number of the piece of rock that was casted was not given by the author, and the external mould that he casted could not be found among the present material. This is the case also for all paratypes (IGR no.32102, 32104).

Type locality. Blýskava Hill near Loděnice.

Type stratum. Letná Formation.

Original diagnosis. Vannier 1987, p. 732.

Material. More than 40 steinkerns and external moulds.

Remarks. The species was formerly determined as *Ceratopsis hastata*, a species that has been mentioned from all formations (Libeň, Letná, Vinice, Zahořany and Bohdalec) of the Beroun Regional Series. The lectotype of *Ceratopsis hastata* comes from the Vinice Formation. The name *C. posthastata* was introduced by Přibyl (1979) for the Schmidt's (1941) material of *Ceratopsis hastata* from the Bohdalec Fm.

Vannier (1987, p. 732) placed one specimen of *Ceratopsis hastata* BARRANDE sensu SCHMIDT, 1941 (pl. 2, fig. 16) in his taxon *C. krutai*. This specimen was tentatively designated as *C. posthastata* by Přibyl (1979, p. 63). Schmidt's material from the Bohdalec Formation is washed material and seems to be more or less corroded by the preparation technique, or by the sedimentation processes. The spine of the left valve of the specimen mentioned above is also broken away as in other specimens, for example the holotype of *C. posthastata* PŘIBYL, 1979 (Schmidt 1941, pl. 2, fig. 19). Therefore, the development of the spine is unknown in the holotype. Presumably it was developed as on the right valve of the carapace figured in pl. 2, fig. 16 which is assigned here to *C. posthastata*.

The exact placement of the specimen from the Zahořany Formation from Loděnice figured by Přibyl (1979, pl. 1, fig. 5) as *Hastatellina hastata* and also assigned by Vannier (1987, p. 732) to *C. krutai* could not be decided here without inspection of the holotype of *C. krutai*.

Subfamily Dilobellinae KAY, 1940

***Bohuckea* gen. n.**

Type-species. *Bohuckea bohemica* sp. n.

Derivatio nominis. Artificially formed from Bohemia and the similar genus *Huckea*.

Diagnosis. Median-sized. Sulcus (S2) rather broad but not very deep; no other sulci. Preadductorial node indistinct. Main adventral sculpture (histiovelum ?) extends from the antero-central to the posteroventral regions, and strongly diverges, with the free margin in the posterior direction. The valve is broadest at its posterior end where it may end in a more or less spine-like form. Marginal sculpture occurs as a row of spines.

Relationships. The genus resembles *Huckea* SCHALLREUTER, 1964 in the main adventral sculpture which strongly diverges ventrally, with the free margin in the posterior direction so that it has a very high position at its spine-like end in the posteroventral region. Both also share unisulcality and a marginal sculpture developed as a row of spines. *Huckea* is distinguished mainly by the development of the S2 as a cavum and the rudimentary presence of S1 and S3 as fissa.

***Bohuckea bohemica* sp. n.**

Pl. 3, figs 7, 8

Holotype. External mould, NMP L 31698 - pl. 3, fig. 8.

Type locality: Blýskava Hill near Loděnice.

Stratum typicum: Letná Formation.

Material. 1 external mould and 1 steinkern.

Diagnosis. As for the genus which is currently monotypic.

Remarks. This species is represented only by two presumably juvenile tecnomorphic valves. They are characterized by a high velum (histiovelum ?) and a marginal row of spines. *Eolomatella* SCHALLREUTER, 1974 also has a high velum, but in tecnomorphs the anterior end of the velum consists of a spur (Schallreuter 1981, pl. 8, 132, figs 1, 2; pl. 8, 136, fig. 4). Furthermore, the marginal sculpture in *Eolomatella* is ridge-like and the lobation is more complex.

Pelecypolbina JAANUSSON, 1966 also possesses a rather high velum or histiovelum, but there is no anteroventral spur. In this respect the species from the Letná Formation is more similar to *Pelecypolbina*. However, the marginal sculpture of *Pelecypolbina* is developed as a ridge and not as a row of spines.

Subfamily Glossomorphitinae HESSLAND, 1954

Tribe Hippulini SCHALLREUTER, 1983

***Hippula* TROMELIN et LEBESCONTE, 1876**

***Hippula (Hippula) latens* (BARRANDE, 1872)**

Pl. 2, fig. 8; pl. 3, fig. 6

1980 *Hippula latens* (BARRANDE, 1872); Schallreuter and Krůta, pp. 506, 507-509; fig. 1

(q. v. for further synonymy)

1986 *Hippula latens* BARRANDE, 1872 A; *Hippula latens* (BARRANDE, 1872 A) TROMELIN et LEB, 1876 A; *Hippula (Hippula) latens* (BARRANDE, 1872 A) TROMELIN et LEB, 1876 A; *Trubinella latens* (BARRANDE, 1872A) PŘIBYL, 1950 A - Kempf, pp. 402, 403

1986b - ditto. - Kempf, p. 323

1987 - ditto. - Kempf, pp. 62, 67, 256

1988 *Trubinella latens*; *Hippula latens* (BARRANDE, 1872); Schallreuter and Krůta, p. 103 (? *Trubinella latens* (BARRANDE), p. 102)

Lectotype. NMP Coll. geol. no. 1546 of Barrande's collection (L 8839), steinkern of a right valve - Barrande 1872, pl. 26, figs 2d-f; Přibyl 1979, pl. 4, fig. 8 and text-fig. 4, fig. 2.

Type locality. Trubín near Králův Dvůr.
Stratum typicum. Vinice formation (d3 of Barrande).
Material. 20 external moulds and steinkerns.

Remarks. The Letná Formation species is considered to be conspecific with the type which comes from the slightly younger Vinice Formation. However, this could not be confirmed by direct comparisons with material from that formation. Barrande's type series is the only material available from that formation. It is rather restricted. Because of the special morphology of the adventral sculptures of that genus which are only visible at the outer surface of the valve exact determinations are only possible with external moulds. Unfortunately Příbyl designated as the lectotype a steinkern (without external mould) and the species should be, therefore, considered as a nomen dubium. The paralectotype NM no. 1545a, the only example of an external mould, clearly shows the characteristic generic features so that the genus (and subgenus) could be clearly defined. Comparison of the paralectotype with the Letná Formation material shows no fundamental differences so they are considered to be conspecific. Small differences that may be found in the new material could be considered as an evidence of a subspecies.

Suborder **Binodicopa** SCHALLREUTER, 1972
Superfamily **Drepanellacea** ULRICH et BASSLER, 1923
Family **Bolliidae** BOUČEK, 1936

Warthinia SPIVEY, 1939

Warthinia paupa SCHALLREUTER et HINZ-SCHALLREUTER, 1998

Pl. 3, figs 2, 3

1988 *Warthinia paupa* sp. n.; Schallreuter and Hinz-Schallreuter, pp. 351-352 (q.v. further synonymy)

Holotype. Carapace. Senckenberg Museum, Frankfurt am Main no. X/e 833a - Schmidt 1941, pl. 4, figs 30d, l; Příbyl 1979, pl. 7, figs 14-15; text-fig. 3.11. Type locality. Praha 9 (Hloubětín), Na bílém koni.

Stratum typicum. Bohdalec Formation, upper Caradocian (Beroun Regional Stage).

Diagnosis. Length at least up to 0.55 mm. Outline rounded-rectangular. Three nodes. Posterior node largest, elongate and oblique to dorsal margin; anteroventral node smaller than anterodorsal node and distinctly separated from the anterodorsal node. Pseudovelum bulge-like, slightly thickened in the anterodorsal region. All nodes non-punctate.

Material. More than 10 steinkerns and external moulds.

Relationships. A very similar species from the Bohdalec Formation of Bohemia was described by Schmidt (1941, pp. 57-58) as a new subspecies, *Ulrichia nodosa paupera*. However, Schmidt designated a specimen from the "Eden Group" of Cincinnati, Ohio figured by Ulrich (1890, pl. 10, fig. 12) as the lectotype. This species was redescribed by Warshauer and Berdan (1982, H23-H26) who considered *W. nodosa nodosa* (ULRICH, 1890) and *W. nodosa paupera* (SCHMIDT, 1941) as synonyms. The lectotype of *W. nodosa* has four nodes whereas the former was established for three-node forms. Warshauer and Berdan (1982, H25) found in populations that

include quadrinodose variants (only two collections) a complete morphologic gradation between these two forms and compared this phenomenon with the variable number of nodes in the Holocene cytherid *Cyprideis torosa* (JONES, 1850), which is thought to be induced by reductions in salinity.

W. nodosa is distinguished from the new species by its more rounded outline and the reticulation which is also "well developed on nodes" (op. cit., H24). Warshauer and Berdan did not include Schmidt's material in that species and genus. Schallreuter and Hinz-Schallreuter (1998, p. 351) introduced the name *Warthinia paupa* for *Ulrichia nodosa paupera* SCHMIDT, 1941. *W. lauta* (GAILITE, 1971) seems to be higher, the reticulate nodes show less disparity in size, and the pseudovelum seems to be more ridge-like (Gailite 1971, pl. 2, fig. 4).

Family **Circulinidae** NECKAJA, 1966

Orechina KRŮTA, 1968

Orechina parcipunctata sp. n.

Pl. 4, fig. 1

Derivatio nominis. *Parcus*, lat. - sparse; reflecting the relatively few puncta.

Holotype. External mould of a left valve, NMP L 31707 - pl. 4, fig. 1.

Type locality. Blýskava Hill near Loděnice.

Type stratum. Letná Formation.

Diagnosis. Length at least up to 0.90 mm. Marginal surface forms a rather low angle with the contact plane and there is only a very indistinct bend with the flat lateral surface. Lateral surface has relatively few but distinct puncta.

Material. More than 30 steinkerns and external moulds.

Relationships. The type-species, *O. punctata* KRŮTA, 1968 from the Králův Dvůr Formation, has a steeper marginal surface which forms a more distinct bend with the flat lateral surface, and a stronger, much more distinct epicline dorsum. Furthermore, the lateral surface is reticulate instead of punctate (Schallreuter and Krůta 1987, fig. 1.1).

Parapyxion JAANUSSON, 1957

Parapyxion xion sp. n.

Pl. 4, fig. 2

Derivatio nominis. Formed artificially.

Holotype. External mould of a right valve, NMP L 31708 - pl. 4, fig. 2.

Type locality. Blýskava Hill near Loděnice.

Type stratum. Letná Formation.

Diagnosis. Length at least up to 1.00 mm. Outline subamplete. Weak epicline dorsum centrodorsally. Muscle spot relatively distant from flat, indistinct centrodorsal lobe-like elevation. Lateral surface finely reticulate.

Material. 5 external moulds and 4 steinkerns.

Relationships. The Baltoscandian type-species, *P. suvovatum* (THORSLUND, 1948), is nonreticulate and has a distinct hypoclinal dorsum and a muscle spot close to the centrodorsal lobe (Schallreuter 1980, pl. 5, figs 4, 5; pl. 7, fig. 7).

P. pragense PŘIBYL, 1979 from the Bohdalec Formation of Bohemia which is based on a steinkern is much larger (up to 2.90 mm, holotype: 2.07 mm) and more closely resembles *P. subovatum* (THORSLUND, 1948) in the presence of a hypoclinal dorsum and presumably in the development of a sulcament.

***Pseudulrichia* SCHMIDT, 1941**

***Pseudulrichia blyskava* sp. n.**

Pl. 4, figs 5, 6

Derivatio nominis. Derived from the name of the type locality. Holotype. Steinkern of a right valve, NMPL 31706 - pl. 4, fig. 6. Type locality. Blýskava Hill near Loděnice.

Type stratum. Letná Formation.

Diagnosis. Length at least up to 1.22 mm. Outline distinctly postplete, but shape rather elongate. Spines relatively close to the center. Anterior spine thicker than posterior spine.

Material. 11 steinkerns.

Relationships. The species is characterized by its relatively long shape, the central position of the spines and the unequal development of the spines, resulting in a stronger anterior node. Normally the spines are of nearly equal size. In *P. posteroerata* BLUMENSTENGEL, 1965, *P. tubulata* (NECKAJA, 1966) and *P. albraca* SCHALLREUTER et LEHNERT, 1993 the posterior node is much stronger, thus forming a transitional state to *Aechmina* JONES et HOLL, 1869 (Blumenstengel 1965, fig. 14; Sidaraviciene 1992, pl. 42, figs 1-3; Schallreuter and Lehnert 1993, pls 110, 112).

***Crescentilla* BARRANDE, 1872**

***Crescentilla* cf. *pugnax* BARRANDE, 1872**

Pl. 1, fig. 6

- 1872 *Crescentilla pugnax* BARRANDE, pp. 507, 588, 591; pl. 26, fig. 1a-1
1884 *Crescentilla* BARR., 1872 - Jones and Woodward, p. 354
1885 *Crescentilla pugnax* BARR. - Jones, p. 87 (zit. n. van Straelen and Schmitz, p. 163)
1928 *Crescentilla pugnax* BARR. - Bouček, p. 25
1934 *Crescentilla pugnax* BARR., 1872 - van Straelen and Schmitz, pp. 163, 208, 226, 236
1961 *Crescentilla pugnax* BARR., 1872 - Scott in Benson et al., Q132 [non fig., 64.5 = *C. Vaneki* (PŘIBYL 1979, p. 82)]
1966 *Crescentilla pugnax* BARR., 1872 - Neckaja, p. 19
1966 *Crescentilla pugnax* BARR. - Havlíček and Vaněk, pp. 32, 53, 54, 55 [non 58, 60 (Přibyl 1979, p. 82)]
1979 *Crescentilla pugnax* BARR., 1872 - Přibyl, pp. 81-83, 84; table between p. 112/113; pl. 5, figs 1, 5-7; text-figs 5.4, 12.1-3
1986a *Crescentilla pugnax* BARR., 1872 A - Kempf, p. 192
1986b *Crescentilla pugnax* BARR., 1872 A - Kempf, p. 475
1987 *Crescentilla pugnax* BARR., 1872 A - Kempf, p. 62
1988 *Crescentilla pugnax* BARR. - Schallreuter and Krůta, pp. 102, 103

Material. 1 external mould, 4 steinkerns.

Type locality. Trubín near Králův Dvůr.

Stratum typicum. Vinice Formation (d3 of Barrande).

Remarks. This taxon from the Letná Formation was already noted by Havlíček and Vaněk (1966, p. 32, 54) and subsequently by the present authors as *Crescentilla pugnax*. The lectotype of *Crescentilla pugnax* came from the succeeding Vinice Formation, and is probably the same species, as is shown by

comparison of the figured specimen (Pl. 1B, fig. 4) with figures of the lectotype (Přibyl 1979, pl. 5, figs 1, 6).

***Bidion* gen. n.**

Type-species. *Bidion bidum* sp. n.

Derivatio nominis. From the Czech word bída - miser + suffix ion from *Parapyxion*.

***Bidion bidum* sp. n.**

Pl. 4, figs 3, 4

Derivatio nominis. see genus.

Holotype. Left valve, NMP 31704 - pl. 4, fig. 3.

Type locality. Blýskava Hill near Loděnice.

Type stratum. Letná Formation.

Diagnosis. Medium-sized. Subcomplete to slightly postplete. Relatively short, straight hinge-line and rounded outline. Dorsum hypoclinal. Greatest convexity occurs in anterodorsal quarter of valve where the valve is broadest. Lobal/sulcal sculptures practically absent.

Material. 3 external moulds, 1 steinkern.

Relationships. The new genus resembles *Easchmidtella* SCHALLREUTER, 1967, but the type-species of *Easchmidtella* is much smaller (~ 0.60 mm) and possesses a distinctly triangular umbo (Schallreuter 1967a, fig. 7). Furthermore, the outline is more elliptical whereas the Bohemian species is more rounded. The broadest part of the valve is situated in the anterodorsal quarter of the valve whereas in *E. crassiumbonata* SCHALLREUTER, 1967 the broadest part of the valve is central.

The new genus also resembles the type-species of *Parapyxion* JAANUSSON, 1957, but there are fundamental differences in the convexity: notably, *Parapyxion* is broadest centrally and rather uniformly convex (Schallreuter 1980, pl. 5, figs 4, 5, pl. 7, fig. 7). *Bidion bidum* is irregularly convex, with the greatest convexity in the anterodorsal part, so that *Bidion bidum* species has a rounded-triangular profile in both longitudinal and in transverse section. Furthermore, the characteristic weak lobation (anterior node, muscle spot and centrodorsal lobe) of *Parapyxion* is missing in *Bidion bidum*, though the latter may show only an extremely weak *Pseudulrichia*-like lobation.

Order *Platycopa* SARS, 1966

Suborder *Kloedenellocopa* SCOTT in BENSON et al., 1961

Family *Moniotiopleuridae* GUBER et JAANUSSON, 1964

? *Unisulcopleura* SCHALLREUTER, 1968

***Unisulcopleura* ? *letna* sp. n.**

Pl. 3, fig. 4

Derivatio nominis. From the Letná Formation.

Holotype. External mould of a slightly distorted left valve, NMPL 31702 - pl. 3, fig. 4.

Type locality. Blýskava Hill near Loděnice.

Type stratum. Letná Formation.

Material. Holotype only.

Diagnosis. Length at least up to 0.85 mm. Elongate (L:H about 1.80), amplete, rounded-rectangular in shape; cardinal corners both of about equal size. Sulcus relatively broad, and close to the dorsal margin on the border of the anterodorsal and the centrodorsal regions. Admarginal ridge ventrally. Lateral surface distinctly reticulate except for the sulcus.

Relationships: The type-species of *Unisulcopleura*, *U. unisulcata* SCHALLREUTER, 1968 from the Middle Ordovician geschiebes of Northern Germany, is slightly preplete, the cardinal corners are of different size, the sulcus is narrower and the surface is not reticulate. *U. ? hinzae* SCHALLREUTER, 1990 from the Lower Ordovician Rogö sandstone has a semi-spherical outline, a sulcus that is not so close to the dorsal margin and a reticulation with puncta in the luminae (Schallreuter 1990, figs 4.3-5). *U. ? reticulata* OLEMPSKA, 1994 (upper Lower Ordovician, Holy Cross Mts.) also has a semi-spherical outline and only a weak sulcus in a more posterior position (Olempska 1994, pl. 46, figs 4-7). *U. ? tenuireticulata* (HESSLAND, 1949) from Sweden possesses a narrow sulcus in a more dorsocentral position and a finer reticulation (Hessland 1949, pl. 5, fig. 15).

Discussion

The Letná Formation is the second of the five formations of the Bohemian Beroun series that corresponds to the Caradoc (Havlíček et al. 1994, fig. 2). Previous knowledge of ostracodes from the Letná Formation was poor and comparisons with other formations and regions was restricted or impossible. The fauna from Blýskava Hill now provides some insights into this question.

Four ostracode species of the Letná Formation have also been found in the older Libeň Formation, (Schallreuter and Krůta 1988, p. 102) but the ostracode fauna of the latter Libeň Fm. is not very well known so that the conspecificity of the species is uncertain. *Piretopsis (Cerninella) bohemica*, *Hippula latens* and *Crescentilla pugnax* were originally described from the suprajacent Libeň Formation and apparently also occur in the Letná Formation. Among the species restricted to the Letná Formation the most important seems to be *Ceratopsis (Hastatellina) krutai* which presumably could thus be used as a zone fossil.

The most common species in the fauna is *Piretopsis (Cerninella) bohemica*. The subgenus is unknown from outside Bohemia and seems to be endemic to this region (table 1). *Ceratopsis* which includes one of the commonest species is known from Armorica and Avalonia and

Table 1. Comparison of the ostracodes of the Letná Formation from Blýskava Hill with potentially congeneric species of other regions [Olempska 1994 (Holy Cross Mts.), Jones 1986, 1987 (Avalonia), Vannier 1986 (Armorica)].

Genera	Letná Formation	N*	Baltica	Holy Cross	Thuringia	Armorica	Avalonia
<i>Laccochilina</i>	? <i>blyskava</i>	4	<i>estonula</i> & <i>c.</i>				
<i>Duringia</i>	<i>angustosulcata</i>	1	? <i>alemboeg.</i>	<i>aculeata</i>	<i>spinosa</i>		<i>triformosa</i>
<i>Euprimites</i>	<i>cf. kahalaensis</i>	X	<i>kahalaensis</i>	<i>grandis</i>			sp.**
<i>E. (Bichilina)</i>	<i>b. tirelacuta</i>	X	<i>bichilus b.</i>				
<i>Vendona</i>	<i>sulcutula</i>	1	<i>angulata</i>				
<i>P. (Cerninella)</i>	<i>bohemica</i>	C					
<i>C. (Hastatellina)</i>	<i>krutai</i>	X				<i>normandien.</i>	sp.1 Jones
<i>Bohuckea</i>	<i>bohemica</i>	2					
<i>Hippula (H.)</i>	<i>latens</i>	X	<i>latonoda</i> & <i>c.</i>		(sp.)***		
<i>Warthinia</i>	<i>paupa</i>	X	<i>lauta</i>				
<i>Orechina</i>	<i>parcipunctata</i>	X	<i>procera</i>	<i>krutai</i>			
<i>Parapyxion</i>	<i>xion</i>	9	<i>subovatum</i>	<i>aequa</i>		<i>ngakoi</i>	<i>hemidiscus</i>
<i>Pseudulrichia</i>	<i>blyskava</i>	X	<i>bucera</i> & <i>c.</i>		<i>norvegica</i>	<i>raguenezensis</i>	<i>aequinoda</i>
<i>Crescentilla</i>	<i>cf. pugnax</i>	5	? <i>baltica</i>		***		& <i>c.</i>
<i>Bidion</i>	<i>bidum</i>	4			? sp.		sp.1 Jones
<i>Unisulcopleura</i>	? <i>letna</i>	1	<i>unisulcata</i>				

* N no. of specimens (steinkerns + external moulds); X >=10, C >100

** S.W. Scotland (pers. comm. Williams 1997)

*** boulder from the Lederschiefer

indicates similar conditions to the ostracode fauna of the older Dobrotivá Formation in which Armorican elements are represented by only a few genera, but with many individuals that outnumber the Baltoscandian elements (Schallreuter et al. 1996, p. 458). The Armorican connections seem to be less strong during deposition of the quartzites and shales of the Dobrotivá Formation. On the other hand, the relationships to Baltoscandia seem to have been closer during Letná Formation time. The closer relationships are mainly documented by the common species *Euprimites* (*E.*) cf. *kahalaensis* and *E. (Bichilina) bichilus* and by the common genera *Vendona* and *Hippula*. *Euprimites* and *Vendona* are very common in Baltoscandia and unknown from other regions.

The ostracode faunas of the Dobrotivá and the Letná Formations clearly document displacement of Armorica and Perunica on one side and the approach of Perunica and Baltica on the other side during the Ordovician period. Provinciality of the ostracode faunas of the Beroun was apparently not intense and Tornquist's Sea may not have functioned as such an effective barrier as for trilobites and brachiopods (Havlíček et al. 1994).

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Explanations to the plates

PLATE 1

Duringia angustosulcata sp. n.

1. holotype (NMP L 28826), external mould of female right valve (1a) and photographical cast (1b), L 1.51 mm.

Euprimites (Bichilina) bichilus tirelacuta ssp. n.
2. holotype (NMP L 28827), external mould of a tecnomorphic left valve (2a) and photographic cast (2b), L 1.17 mm.

Euprimites (Euprimites) cf. kahalaensis SARV, 1963 (ssp. n.?)
3. steinkern of a female left valve (NMP L 28817), L 1.70 mm
4. tecnomorphic right valve (NMP L 28614) with shell partly broken away, L 0.88 mm.

Vendona sulcutula sp. n.
5. holotype (NMP L 28628), female left valve with shell of the domicilium and brood pouch partly broken away, L 1.47 mm.

Crescentilla cf. pugnax BARRANDE, 1872
6. steinkern of a right valve (NMP L 28825), L 1.36 mm.

PLATE 2

Piretopsis (Cerninella) bohémica (BARRANDE, 1872)
1. silcoset cast of external mould of a tecnomorphic right valve (NMP L 28828), L 3.04 mm.
2. steinkern of a tecnomorphic left valve (NMP L 28829), L 2.98 mm.
3. external mould of a tecnomorphic left valve (NMP L 28830) (3a) and photographic cast (3b), L 3.28 mm.
4. photographic cast of external mould of a juvenile right valve (NMP L 28832), L 2.37 mm.
5. photographic cast of external mould of a juvenile left valve (NMP L 31693), L 1.70 mm.
6. photographic cast of external mould of a juvenile left valve (NMP L 31694), L 1.58 mm.
7. external mould of a juvenile left valve (NMP L 31695), L 1.07 mm.

Hippula (Hippula) latens (BARRANDE, 1872)
8a. external mould of a tecnomorphic left valve (NMP L 28831), L 1.75 mm.
8b. photographic cast, L 1.75 mm.

PLATE 3

Laccochilina? (sg n.?) blyskava sp. n.
1. holotype (NMP L 31699), steinkern of a female left valve, L 1.34 mm.

Warthinia paupa SCHALLREUTER et HINZ - SCHALLREUTER, 1998
2. steinkern of a right valve (NMP L 31700), L 0.51 mm.
3. photographic cast of the external mould of a right valve (NMP L 31701), L 0.51 mm.

Unisulcopleura ? letna sp. n.
4. holotype (NMP L 31702), external mould of a left valve, L 0.85 mm.

Ceratopsis (Hastatellina) krutai VANNIER, 1987
5. photographic cast of external mould of a tecnomorphic right valve (NMP L 31696), L 1.20 mm.

Hippula (Hippula) latens (BARRANDE, 1872)
6. steinkern of a tecnomorphic right valve (NMP L 31697) L 1.58 mm.

Bohuckea bohémica gen. et sp. n.
7. right valve (NMP L 31698a), L 1.10 mm.
8. and photographic cast of the holotype, an external mould of a right valve (NMP L 31698), L 1.22 mm.

PLATE 4

Orechina parcipunctata sp. n.
1a. holotype (NMP L 31707), external mould of a left valve, L 0.90 mm.
1b. photographic cast (1b), L 0.90 mm.

Parapyxion xion sp. n.
2a. holotype (NMP L 31708), external mould of a right valve, L 1.00 mm.
2b. photographic cast (2b), L 1.00 mm.

Bidion bidum gen. et sp. n.
3. external mould of a right valve, (NMP L 31703), L 1.60 mm.
4. holotype (NMP L 31704), steinkern of a left valve, L 1.66 mm.

Pseudulrichia blyskava sp. n.
5. steinkerns of right valve (NMP L 31705), L 1.71 mm.
6. holotype, steinkerns of right valve (NMP L 31706), L 1.22 mm.







