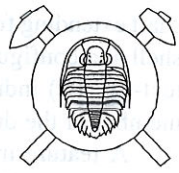
Kvania n. g. and *Petrocrania* Raymond (Brachiopoda, Ordovician) in the Prague Basin



Kvania n. g. a *Petrocrania* Raymond (Brachiopoda, Ordovik) v pražské pánvi (Czech summary)

(2 text-figs., 2 plates)

VLADIMÍR HAVLÍČEK

Jihozápadní III, 1216, 141 00 Praha 4

Minute, Dalmanella-shaped *Kvania* n. g. is assumed as the earliest member of the Orthostrophiinae (Orthida). Encrusting craniids *Petrocrania obsoleta* (Barr.) and *P. inexpectata* (Barr.) are so closely similar to each other that they can be distinguished only by different configurations of muscle scars in their brachial valves.

Remarks on the Lower Ordovician, Dalmanella-shaped, minute brachiopods

The Lower Ordovician (Tremadoc, Arenig) has yielded a small group of minute ortacean brachiopods which are distinguished by subcarinate pedicle valves and correspondingly medially sulcate brachial valves, fascicostellate radial patterns, simple subtriangular ventral muscle fields, and delicate cardinalia. These genera, although closely similar to each others, differ in various shapes of dorsal muscle fields, nature of brachiophores, and presence or absence of cardinal process. These small, Dalmanella-like brachiopods present the earliest members of several stocks, namely of the Orthostrophiinae (*Kvania* n. g.), Nanorthidae (*Nanorthis* Ulrich & Cooper), Ranorthidae (*Nothorthis* Ulrich & Cooper, *Ranorthis* Öpik), and Draboviidae (*Nocturnellia* Havlíček).

A very important feature is the configuration of the dorsal muscle field. Several Lower Ordovician Dalmanella-shaped genera display an archaic type of the field in which the posterior lobes of the anterior adductors penetrate the space flanked by the scars of the posterior pair (see test-fig. 1D); for this reason, the ridges, located between both pairs of adductor scars are oblique and converge toward the hinge margin as in *Nothorthis, Ranorthis,* and the Llanvirnian genus *Eodalmanella.* The second, "advanced" type of dorsal muscle field consists of four scars in a radial arrangment; it means that the anterior scars never penetrate the area between the posterior adductors (e.g. *Kvania, Nanorthis*; see text-fig. 1A).

Another important feature is the cardinal process: this is formed either as a thin ridge (*Ranorthis*) or it may be cleft by a groove into two lobes (*Eodalmanella*), or it may be missing altogether (*Kvania, Nothorthis*).

The outline of notothyrial platform and shape of brachiophores are also characters serving to distinguish separate *Dalmanella*-like genera. The triangular notothyrial platform and low delicate brachiophores with anteriorly diverging bases of orthoid appearance have been found in *Nanorthis*, whereas *Ranorthis* and *Nothorthis* are distinguished by the presence of blade-like brachiophores with nearly parallel bases delimiting an ovoid notothyrial chamber. In *Kvania*, the brachiophores are supported by thin, dorsally converging plates surrounding a narrow, elongate-oval platform in a similar way as in *Gelidorthis*.

The presence of dorsally converging supporting plates in *Kvania* recalls the brachial valve interior of another Lower Ordovician *Dalmanella*-shaped brachiopod, *Nocturnellia*. The latter genus, however, clearly differs from *Kvania* in having much longer bases of brachiophore supporting plates, subparallel ridges bounding laterally the dorsal muscle field, and a long

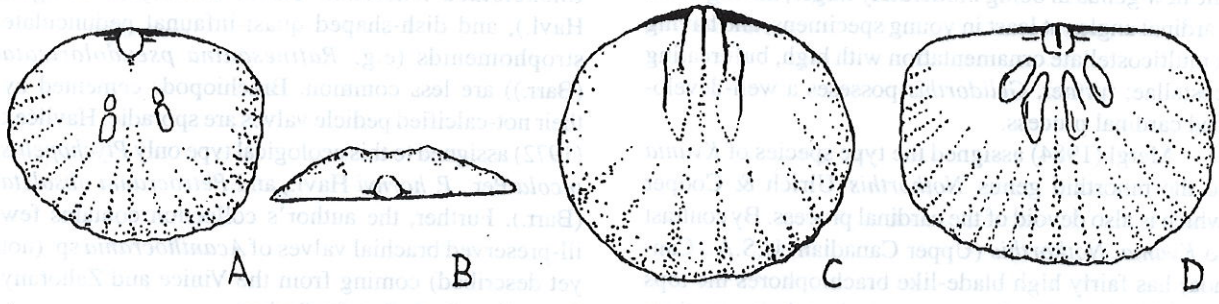


Fig. 1. Minute, Dalmanella-shaped brachiopods: internal moulds of brachial valves showing cardinalia and disposition of muscle fields. A, B - *Kvania kvanica* Mergl, dorsal and posterior views; C - *Nocturnellia nocturna* (Barr.); D - *Ranorthis lipoldi* Havl.

shaft extending from the cardinal process. The punctate shell and configuration of the dorsal muscle field (see text-fig. 1C) indicate that *Nocturnellia* is the earliest member of the draboviid stock.

A feature in common to almost all Dalmanella-shaped Lower Ordovician genera in the presence of well-developed fulcral plates except for *Nanorthis*, the dental sockets of which are probably underlain by low pads of secondary shell material (see Ulrich & Cooper 1938, pl. 12, fig. 23).

Kvania n. g.

Type species: *Nothorthis kvanica* Mergl, 1984

Diagnosis: Shell minute, equally biconvex, circular to subcircular in outline with a short hinge line; cardinal angles rounded; pedicle valve subcarinate to evenly rounded in cross section; brachial valve evenly convex in lateral profile; dorsal sulcus shallow, angular. Ventral interarea low, apsacline, delthyrium open; dorsal interarea very low, anacline to orthocline, notothyrium open.

Costellae angular, narrower than rounded interspaces, arranged in poor bundles; shell substance impunctate.

Dental plates short, divergent; ventral muscle field about a quarter as long as the maximum length of valve, subtriangular, non-lobate, with anterior margin gently arcuate; median adductor scar somewhat broader and longer than diductor impressions.

Notothyrial platform small, flat in cross section, elongate-oval, anteriorly gently elevated above inner valve surface. Cardinal process missing. Shallow dental sockets always underlain by fulcral plates that run parallel with the hinge line. Divergent brachiophores supported by slender plates which converge toward valve floor to surround the notothyrial platform; anterior ends of supporting plates may or may not touch each other. Dorsal muscle field quadripartite, consisting of small, elliptical scars arranged in two subparallel rows.

Comparison: *Kvania* is assumed as the earliest genus of the orthostrophiid stock; its pedicle and brachial valve interiors indicate a close relation to *Gelidorthis* Havl. (Beroun Series) which differs from the new genus in being moderately larger, having acute cardinal angles at least in young specimens, and having a multicostellate ornamentation with high, bufurcating costellae; further, *Gelidorthis* posseses a well-developed cardinal process.

Mergl (1984) assigned the type species of *Kvania* to the ranorthid genus *Nothorthis* Ulrich & Cooper which is also devoid of the cardinal process. By contrast to *Kvania*, *Nothorthis* (Upper Canadian; U.S.A., Canada) has fairly high blade-like brachiophores the tops of which broadly diverge anteriorly relative to their almost parallel bases, and has a quite different configuration of its dorsal muscle field; in this genus, the anterior adductor scars penetrate deep the area flanked by the posterior adductor scars (see text-fig. 1D), whereas the anterior adductor scars of *Kvania* touch the anterior margins of the posterior adductor impressions. Moreover, the shell of *Kvania* is nearly circular, that of *Nothorthis* is much wider than long.

Another closely similar genus is *Nanorthis* Ulrich & Cooper (Ozarkian - Canadian; U.S.A., Canada) which shares with *Kvania* a minute subcircular shell, fascicostellate radial pattern, and the same shape of both muscle fields (configuration of muscle scars in the brachial valve of *Nanorthis hamburgensis:* see Ulrich & Cooper 1938, pl. 12, fig. 22). *Nanorthis*, however, differs from *Kvania* in having orthoid cardinalia consisting of delicate, anteriorly diverging brachiophores flanking a triangular, low notothyrial platform, whereas the broadly diverging brachiophores of *Kvania* are supported by thin, dorsally converging plates the parallel bases of which bound laterally a narrow notothyrial platform.

Kvania kvanica (Mergl, 1984)

Pl. I, figs. 7-9; text-figs. 1A, 1B

1984 *Nothorthis kvanica* sp. n.; Mergl, p. 17, pl. I, figs. 9-11

Holotype (OD). Brachial valve figured by Mergl in 1984, pl. I, fig. 9; Czech Geol. Survey, Prague; MM 074.

Type horizon and locality. Mílina Formation (silicite), upper Tremadoc; Horní Kvaň near Zaječov, Prague Basin.

Exterior and interior. See diagnosis of the genus; dimensions of both valves and the rib system: see Mergl 1984.

Occurrence. Olešná and Horní Kvaň.

Encrusting brachiopods in the Ordovician of the Prague Basin

Most of the Ordovician brachiopods are epibenthic, fixo-sessile elements attached by means of the pedicle to substrate; burrowing lingulids (e.g. *Rafanoglossa siliqua* Havl., *Plectoglossa davidsoni* (Barr.), minute epiplanktinc forms (e.g. *Leptellina primula* (Barr.), *Chonetoidea tenerrima* Havl., *Brandysia benigna* Havl.), and dish-shaped quasi-infaunal pedunculate strophomenids (e.g. *Rafinesquina pseudoloricata* (Barr.)) are less common. Brachiopods cemented by their not-calcified pedicle valves are sporadic. Havlíček (1972) assigned to this ecological type only *Ptychopeltis incola* Per., *P. hornyi* Havl., and *Petrocrania obsoleta* (Barr.). Further, the author's collection contains few ill-preserved brachial valves of *Acanthocrania* sp. (not yet described) coming from the Vinice and Zahořany Formation (both Beroun Series).

The craniids appeared in the Prague Basin in the lowest Beroun (Řevnice Quarzite), became rather frequent in the Letná and Zahořany Formations (both Beroun Series), and disappeared in the latest Beroun (Bohdalec Formation). Barrande (1879) recorded in the Ordovician two closely similar craniids and called them *Crania obsoleta* and *C. inexpectata*. The only reliable feature serving to distinguish them on the species level is the configuration of muscle scars in the brachial valve.

Petrocrania Raymond, 1911

Type species. *Craniella meduanensis* Oehlert, 1888

Remarks. *Petrocrania* (probable junior synonym: *Philhedrella* Kozlowski, 1929), ranging from the Middle Ordovician to the Middle Devonian, is a genus meriting a thorough re-examination. Many species, being cemented to foreign bodies, have not calcified the pedicle valve, whereas others posses a calcified, although very thin, pedicle valve (e.g. *P. hamiltoniae* Hall; see Hall 1867, pl. 3, figs. 21, 22). Several species of *Petrocrania* are distinguished by anterior adductor scars smaller then the posterior pair, but the Bohemian craniids coming from the Upper Ordovician have anterior scars clearly larger than the posterior ones. Further, the sigmoidal vascula lateralia are moderately raised above the inner brachial-valve surface in the Devonian species (e.g. *P. zukalovae*, Givetian, Čelechovice na Hané, Moravia; Ficner & Havlíček 1978)), but no vascular markings are discernible in the Bohemian, Ordovician-age craniids. For this reason, the attribution of *"Crania" obsoleta* Barr. and *"C." inexpectata* Barr. to *Petrocrania* is preliminary. The shape and location of the anterior adductor scars are features used to separate the Bohemian craniids on a species level.

Petrocrania inexpectata (Barrande, 1879)

Pl. I, figs. 1, 2, 4, 5; pl. II, figs. 1-3; text-fig. 2A

1879 *Crania inexpectata* Barr.; Barrande, pl. 110, case V.

1879 *Crania obsoleta* Barr.; Barrande (partim), pl. 102, case VIII, figs. 1, 3, 7.

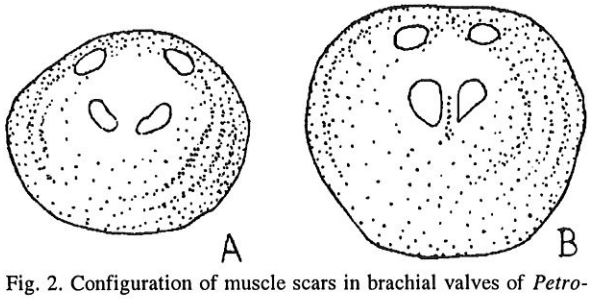


Fig. 2. Configuration of muscle scars in brachial valves of *Petrocrania*. A - *Petrocrania inexpectata* (Barr.); B - *Petrocrania obsoleta* (Barr.)

1972 *Petrocrania obsoleta* (Barrande, 1879); Havlíček, p. 229, pl. 1, figs. 7, 8.

Holotype (by monotypy). Brachial valve figured by Barrande, 1879, pl. 110, case V; National Museum, Prague; L 26048.

Type horizon and locality. Zahořany Formation, Loděnice.

Material. Several dozens of brachial valves (mostly internal and external moulds).

Exterior. Pedicle valve not calcified, specimens cemented to shells of the host (mostly conulariids). Brachial valve is a low, asymmetrical cone, about a fifth as high as its maximum width (extreme: a third of the maximum width), subpentagonal in outline, 3.5-7.8 mm wide, and 77.6-97.0 % as long as wide (exceptionally length is equal to its maximum width); posterior margin short and straight, sides and anterior margin rounded, often moderately irregular due to the shape of the host. Dorsal beak dorsally to postero-dorsally directed, usually located 14-33 % of the valve length from the posterior margin; posterior wall shorter but more steep than the anterior one, in side view flat to slightly concave; the longer anterior wall is flat to gently concave in lateral profile.

Surface smooth, occasionally with a few growth lines. If partly exfoliated, a finely striated inner layer appears consisting of radially disposed "fibres" (e.g. VH-8206). Punctae, discernible only in one brachial valve, are chaotically disposed on inner valve surface. Many specimens copy the ornament of their hosts (e.g. fine pattern of conulariids; see pl. I, fig. 1).

Interior. Anterior adductor scars located anterolaterally to the beak, bean-shaped, obliquely disposed and converging anteriorly toward the mid-line but never touching each other. Posterior adductor scars elliptical, located laterally to the "pseudointerarea", usually slightly smaller than the anterior muscle impressions. No pallial markings discernible.

Life habit. Both *P. inexpectata* and *P. obsoleta* are often attached to all four outer walls of conulariid shells; for this reason, Havlíček (1972) and Havlíček & Vaněk (1990) supposed an epinectic mode of life of these two species. Some specimens, however, may have been attached to dead shells of conulariids as it is evident from the fact that a colony of *P. inexpectata* inhabited the inner chamber of a large, vacant conulariid shell, in which the craniids settled all four inner walls (see pl. II, fig. 3).

Occurrence. Beroun Series, Zahořany Formation; localities: Loděnice; Zahořany; Praskolesy; territory of Prague (Libeň, Vysočany, Spořilov). Bohdalec Formation, territory of Prague (Michle, Žižkov - borehole Pr-I).

Petrocrania obsoleta (Barrande, 1848)

Pl. I, figs. 3, 6; text-fig. 2B

1848 *Orbicula obsoleta* Barr.; Barrande, p. 250, pl. 23, fig. 11.

1879 *Crania obsoleta* Barr.; Barrande, pl. 102, case VIII, figs. 2, 4-6.

Holotype (by monotypy). Brachial valve figured by Barrande in 1848, and refigured by him in 1879, pl. 102, case VIII, fig. 2; National Museum, Prague; L 16293.

Type horizon and locality. Letná Formation (quarzite); Veselá near Beroun.

Material. 26 brachial valves (mostly internal moulds).

Exterior and interior. Closely related to *P. inexpectata* but moderately larger (7.2-10.6 mm wide); outline and convexity about the same in both species, surface smooth.

The main feature serving to distinguish *P. obsoleta* and *P. inexpectata* is the form and location of the anterior adductor scars; those of the earlier species *P. obsoleta* are elongate-oval with parallel inner margins, whereas the scars in *P. inexpectata* are bean-shaped, oblique, with inner sides converging antero-medially toward the mid-line.

Remarks. The typical, rather large and symmetrical forms of *P. obsoleta* have been collected from the quarzite banks, whereas the moderately small, often irregular valves are confined to sequences of dark grey greywackes. The outline of the "smaller" craniids is greatly variable due to accumulation of numerous specimens in a restricted area on a wall of a conulariid. It is a question if the larger, usually symmetrical population and the smaller, more or less irregular population are conspecific.

Occurrence. Beroun Series, Libeň Formation, facies of Řevnice Quarzite; localities: Kařezská hora and the hill near the rail-way station Zbiroh. Letná Formation, quarzite banks; localities: Děd and Veselá near Beroun, and Trubín.

P. cf. *obsoleta* (the "smaller" form) was collected from the Letná Formation at Knížkovice, Háj near Zahořany, Děd near Beroun, and Blýskava east of Chrustenice.

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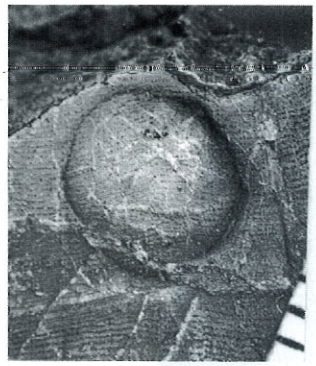
Kvania n. g. a *Petrocrania* Raymond (Brachiopoda, ordovik) v pražské pánvi

Drobní brachiopodi dalmanellidního vzhledu rodu *Kvania* n. g. jsou zřejmě nejstaršími zástupci podčeledi Orthostrophinae (Orthida). Přisedlí craniidní brachiopodi *Petrocrania obsoleta* (Barr.) a *P. inexpectata* (Barr.) jsou si vzhledově tak blízcí, že je lze odlišit pouze podle různé konfigurace svalových vtisků ve hřbetní misce.



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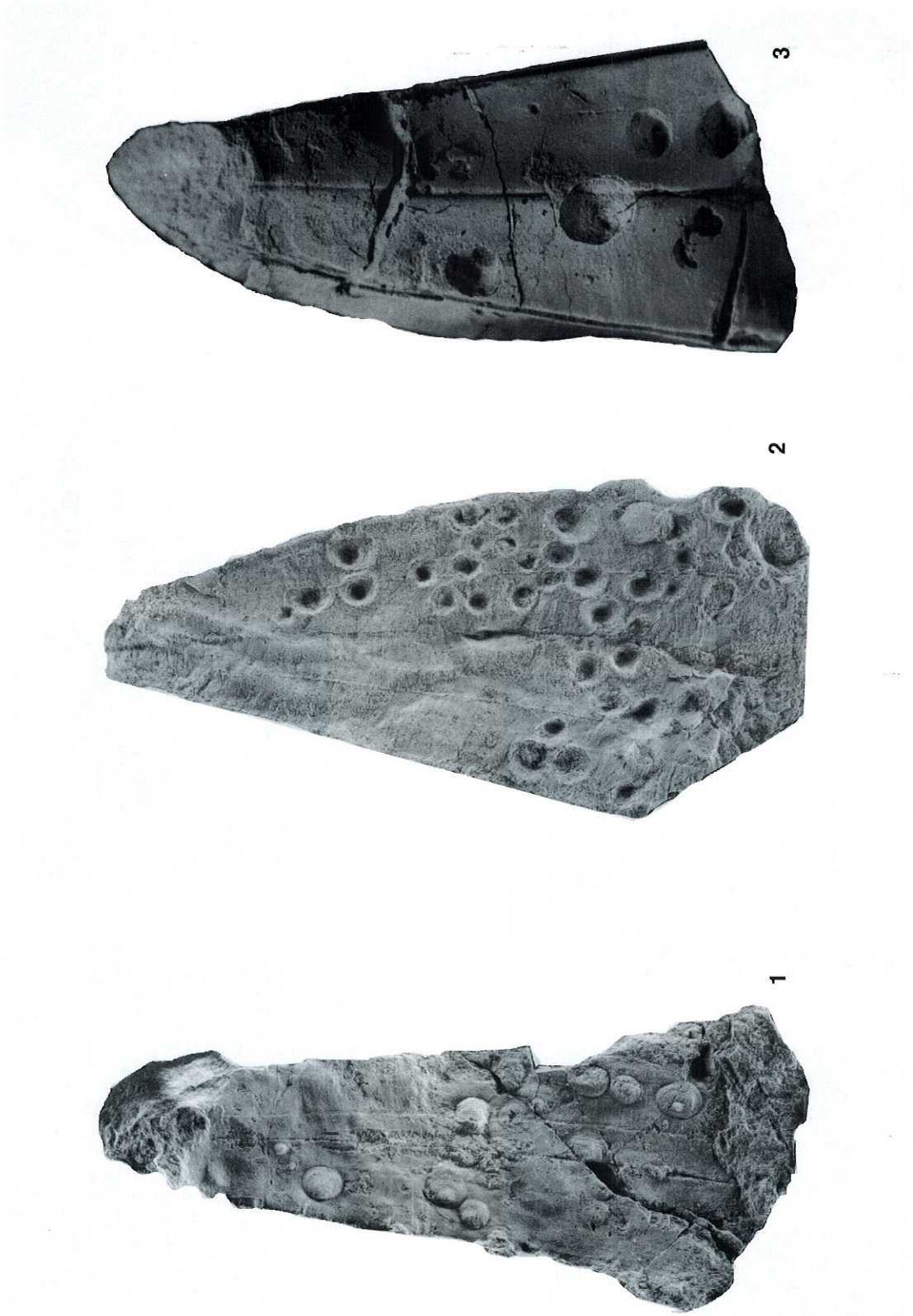
1, 2, 4, 5. *Petrocrania inexpectata* (Barr.), Zahořany Formation, localities: Spořilov (fig. 1), Vysočany (figs. 2, 5) and Loděnice (fig. 4). 1 - shell attached to outer side of *Exoconularia exquisita* (Barr.); brachial valve copies fine ornament of its host, VH-8200, x4.4. 4 - brachial valve, VH-8201, x5.6. 2, 5 - internal moulds of brachial valves; VH-8204 a, b, x4.6

3, 6. *Petrocrania obsoleta* (Barr.); Letná Formation, locality Drabov (Děd) near Beroun. 3, 6 - internal moulds of brachial valves (=orig. Barrande 1879, pl. 102, case VIII, figs. 2, 6), L 16293, x4.8

7-9. *Kvania kvanica* Mergl, Mílina Formation, Horní Kvaň. 7 - internal mould of pedicle valve, VH 5721b, x14.4. 8 - internal mould of brachial valve showing muscle scars, VH-5717, x9.0. 9 - internal mould of brachial valve with a narrow notothyrial chamber, VH-5718, x8.0

V. Havlíček: *Kvania* n. g. and *Petrocrania* Raymond (Brachiopoda, Ordovician) in the Prague Basin... (Pl. II)



1-3. *Petrocrania inexpectata* (Barr.), Zahořany Formation, localities: Zahořany (figs. 1, 2) and Vysočany (fig. 3). 1 - colony of craniids attached to outer side of shell of *Exoconularia exquisita* (Barr.); collection of the National Museum, Prague, x1.0. 2 - colony of craniids attached to outer side of shell of *Exoconularia exquisita* (Barr.), external mould; collection of the National Museum, Prague, x1.0. 3 - colony of craniids attached to inner wall of a conulariid shell; craniids surely settled the vacant chamber of a dead shell; VH-8198, x2.0
Photographs by O. Malina (pl. I, figs. 1, 2, 4, 5; pl. II, fig. 3), R. Horný (pl. I, figs. 3, 6), V. Skala (pl. I, figs. 7-9) and H. Vršťalová (pl. II, figs. 1, 2)