

## **PATELLICONUS HORNÝ, 1961 AND MYTOCONULA GEN. N. (MOLLUSCA, TERGOMYA) FROM THE ORDOVICIAN OF PERUNICA**

RADVAN J. HORNÝ

Department of Palaeontology, National Museum, Prague, Czech Republic; radvan\_horny@nm.cz



Horný, R. J. (2009): *Patelliconus* HORNÝ, 1961 and *Mytoconula* gen. n. (Mollusca, Tergomya) from the Ordovician of Perunica. – Acta Mus. Nat., Pragae, Ser.B, Hist. Nat., 65(1-2): 25-36, Praha. ISSN 0036-5343.

Abstract. *Patelliconus* HORNÝ, 1961, is a small thin-walled Ordovician tergomyan mollusc with a low cone-like patelliform shell and subcentral, narrowly projecting apex. Pedal muscle attachment is a narrow, continuous, concentric band-like scar, periodically migrating to the apertural margin. The type species, *P. primulus* (BARRANDE in PERNER, 1903) occurs in the Šárka Formation (lower Darriwilian). A new, related genus *Mytoconula* with anteriorly shifted apex is described, based on a new species, *M. vonkai* sp. n., occurring in the Dobrotivá Formation (upper Darriwilian). It has delicate internal shell sculpture which can be interpreted as radial musculature running from the apex towards the apertural margin. Both Bohemian genera are classified as representatives of cyrtoneid tergomyans, family Protoconchoididae. The relationship with the middle Cambrian *Protoconchoides* SHAW, 1962 is discussed.

■ Mollusca, Tergomya, Cyrtoneidida, *Patelliconus*, *Mytoconula*, patelliform shell, muscle scars, Ordovician, Bohemia.

Received December 20, 2008

Issued July 2009

### **Introduction**

Small cone-like, cap-shaped patelliform shells are abundant and characteristic elements of the Middle Ordovician molluscan fauna of Perunica (Barrandian Area, Prague Basin). They comprise representatives of gastropods (*Barrandicella* PEEL et HORNÝ, 1999, *Barrandicellopsis* HORNÝ, 2000), tergomyans (tryblidiids – *Peelipilina* HORNÝ, 2006b, *Pentalina* HORNÝ, 1961 and cyrtoneidids (*Pygmaeoconus* HORNÝ, 1961, *Patelliconus* HORNÝ, 1961, and *Mytoconula* gen. n.). All of them have similar shell morphology but their muscle scar patterns remain characteristic for various systematic units. Muscle scars in *Micropileus*? WILSON, 1951 and *Kornoutella* HORNÝ, 1997 have not been ascertained.

*Patelliconus primulus*, maximum length 11.5 mm, has a widely ovate shell outline with a subcentral apex and a continuous, periodically migrating ring-shaped muscle zone. The new taxon, *Mytoconula vonkai* sp. n. has a maximum length of 12 mm long, it is generally similar to *Patelliconus primulus* (BARRANDE in PERNER, 1903) with which it has been commonly confused. However, its shell is more elongate with a slightly anteriorly shifted apex and its musculature is probably represented by numerous radial elements arranged in a periodically migrating muscle zone. *Patelliconus primulus* occurs only in the Šárka Formation (lower Darriwilian) while *M. vonkai* occurs exclusively in the overlying Dobrotivá Formation (upper Darriwilian).

Like *Peelipilina latiuscula* (BARRANDE in PERNER, 1903), both species are definitely more common than the available specimens in various collections would suggest. Small, unattractive, smooth fossils may often be overlooked or left in the debris at the localities.

Considering *Patelliconus primulus*, four specimens exist in the collections of the Department of Palaeontology, National Museum, Prague, all from localities near Rokycany; two come from the Barrande collection (the holotypes of *P. primulus* and the synonymous *P. immigrans*), one is a specimen collected by Bedřich Bouček and figured by Horný (1963) (Text-fig. 3); the best specimen was found by Štěpán Rak Jr. (Text-fig. 2). Two specimens are deposited in the collection of the Museum of Dr. B. Horák in Rokycany, one of them is a counterpart of an immature shell, collected by Jaroslav and Petr Kraft (Text-fig. 4).

Regarding *Mytoconula vonkai*, 22 specimens are housed in the collections of the National museum, Prague; 13 of these specimens were collected by Celda Klouček (Malé Přílepy, Praha-Šárka), nine specimens were gathered by František Hanuš in Praha-Šárka, and determined by him as either *Palaeacmaea* sp. or *P. primula*, two specimens were found by Vladimír Vonka at Mýto near Holoubkov (Text-figs 6 and 7) and one, the best preserved specimen and the holotype, was collected by Vladimír Plas and Božena Plasová at Malé Přílepy (Text-fig. 5).

A concretion from the Dobrotivá Formation, found by F. Hanuš in Praha-Šárka (Text-fig. 8), contains several counterparts of *Barrandicella* cf. *tarda* (PERNER, 1903) with well-preserved outer shell surface. Two of them bear early juvenile shells, one *Barrandicella* sp. and one *Mytoconula* sp. in life position. This unusual find gives evidence of the mode of life of these molluscs.

Specimens studied are deposited in the National Museum, Prague (abbreviation NM L) and in the Museum of Dr. B. Horák at Rokycany (abbreviation MBHR).

## Material and methods

Specimens of *P. primulus* occur individually in hard, dark grey to black siliceous concretions. The majority of collected specimens of *M. vonkai* are preserved in weathered, light grey, silty concretions and also a few in hard, dark grey to black siliceous concretions; specimens from the silty concretions are slightly flattened. Both types of concretions, derived from clayey shales which were weathered during the late Cenozoic, were probably originally carbonatic. The shell matrix has not been preserved. Concretions mostly contain taphocoenoses of abundant and often fragmentary nekto-benthic and benthic fauna, above all trilobites, brachiopods, ostracods, echinoderms, gastropods, tergomyans, cephalopods, and bivalves. Fragments of fossils are mostly covered with limonite. As in *Peelipilina latiuscula*, the thin space left after the shell wall is either empty or filled with limonite; altered shell was not observed.

Specimens of *P. vonkai* usually occur individually but some samples contain two, three or even four specimens in close proximity. The shell wall is about 0.05 mm thick on average and the shells of both species are never laterally compressed and radially crushed as in *Peelipilina latiuscula*. The shells are rather small in size (length often about 4–8 mm) and therefore the radial structures interpreted as connected with muscles are weak and often indistinct.

Photographs of specimens whitened with ammonium chloride sublimate were taken with an Olympus Digital Camera DP 70.

## Systematic palaeontology

### Class Tergomya HORNÝ, 1965

### Order Cyrtonegida HORNÝ, 1963

### Family Protoconchoididae GEYER, 1994 (orthographic variant, ex Protoconchioididae; = Patelliconidae FRÝDA, 1998)

**Discussion:** The genus *Patelliconus* HORNÝ, 1961 was originally placed in the family Hypseloconidae KNIGHT, 1956 (Horný 1961, 1963). Yochelson (1977) reported *Patelliconus* as a monoplacophoran of the family Hypseloconidae in the Ordovician of Norway. For the genus *Protoconchooides* SHAW, 1962 a separate family was established, Protoconchoididae, by Geyer, 1994 (spelled as Protoconchioididae) and located within the order Tryblidiida LEMCHE, 1957. In 2002, Horný listed *Patelliconus*, although tentatively, as a gastropod under the family Archinacellidae KNIGHT, 1956 or ?Protoconchioididae GEYER, 1994. The family Protoconchoididae is transferred here to the order Cyrtonegida HORNÝ, 1963, which has priority over the order Kirengellida ROZOV, 1975 (see Peel 1991). Thus the superficially similar genus *Kirengella* ROZOV, 1968, reported by several authors from Cambrian to Ordovician strata (e.g. by Doguzhaeva 1972, 1981, Rozov 1975, Stinchcomb 1986, Webers, Pojeta Jr., and Yochelson 1992, Geyer 1994, Stinchcomb and Angeli 2002) belongs in the same order. Unfortunately, the majority of the described species of *Kirengella* lack shells and their muscle scars are rare, poorly pre-

served or unknown. As already noted by Horný (2006a), the family Kirengellidae STAROBOGATOV, 1970 requires a detailed study of better preserved specimens and critically defined genera. An important criterion could be either presence of a muscle zone consisting of more or less equivalent muscle scars or coalesced muscle scars in a continuous band-like ring. This complicated situation can be illustrated by the well-known specimen of Rasetti's *Scenella* sp. undet. (1954), tentatively assigned to *Protoconchooides* by Geyer (1994) as *Protoconchooides? rasettii* n. sp., and reinterpreted by Peel (1991) as a helcionellid.

Frýda (1998) established a new family Patelliconidae of unceratin class affinity, based on *Patelliconus* HORNÝ, 1961 and containing, besides *Patelliconus*, a Lower Devonian genus *Chuchleconus* FRÝDA, 1998. Because the shell morphology and musculature of *Protoconchooides* SHAW, 1962 and *Patelliconus* HORNÝ, 1961 are almost identical, the family Patelliconidae is here synonymized with the family Protoconchoididae Geyer, 1994.

**Included genera:** *Patelliconus* HORNÝ, 1961; *Protoconchooides* SHAW, 1962; *Chuchleconus* FRÝDA, 1998; *Mytoconula* gen. n.

**Distribution:** middle Cambrian; Ordovician; Lower Devonian.

### Genus *Patelliconus* HORNÝ, 1961

partim 1903 *Palaeaecmaea* HALL et WHITFIELD; J. Perner, p. 27.

1961 *Patelliconus* HORNÝ: R. Horný, p. 301.

1963 *Patelliconus* HORNÝ: R. Horný, p. 29.

1977 *Patelliconus* HORNÝ: E. L. Yochelson, p. 310, 311.

1994 *Patelliconus* HORNÝ: G. Geyer, p. 81.

1998 *Patelliconus* HORNÝ: J. Frýda, p. 46.

2002 *Patelliconus* HORNÝ: R. Horný, p. 76.

2005 *Patelliconus* HORNÝ: P. Bouchet et al., p. 126.

**Type species:** *Palaeaecmaea primula* BARRANDE in PERNER, 1903. Middle Ordovician, lower Darriwilian, Šárka Formation.

**Diagnosis:** Genus of the family Protoconchoididae with low, conical, thin-shelled conch; early shell narrower, followed by a change in slope between the early shell and teleoconch; aperture planar, widely ovate in outline, l/w ratio 1.10–1.25; apex subcentral, slightly shifted in anterior direction, projecting; muscle scar circular, narrow, ring-shaped; outer sculpture, concentric growth lines and shallow periodical rugae, corresponding to position of the muscle ring.

**Discussion:** *Patelliconus* HORNÝ, 1961 was based on *Palaeaecmaea primula* BARRANDE in PERNER, 1903 from the early Middle Ordovician (lower Darriwilian) Šárka Formation of the Barrandian Area (Perunica). A very similar middle Cambrian mollusc is *Protoconchooides* established by Shaw 1962, originally as a subgenus of *Scenella* BILLINGS, 1872 (type species, *Scenella hermitensis* RESSER, 1945). Geyer (1994), emending *Protoconchooides* (spelled as *Protoconchioides*) as a separate genus, noted its morphological similarity with various Cambrian and Lower Ordovician genera of China and the Siberian Platform, and also with *Patelliconus* HORNÝ, 1961 (erroneously dated by Geyer as 1963). As the main differences between *Patelli-*

*conus* Horny and this genus, Geyer pointed out its larger size, strongly rugose outer shell surface, and location of the muscle scar, lying in a more central position. These features, alone however, can hardly be recognized as generic ones. The largest specimen of *Patelliconus primulus* is 11.5 mm long, the length of the largest specimen of *P. douli* GEYER, 1994 is 9.4 mm. Rugosity of the outer shell surface in *Patelliconus* is connected with the extremely thin shell, reflecting positions of repeated location of the ring-shaped muscle zone, and may be a better specific character. Thus the position of the muscle ring varies according to the age of the animal.

The representative of *Patelliconus* from the Upper Ordovician of Norway, *P. osloensis* YOCHELSON, 1977, shows radial structures on the internal shell surface which may indicate a closer relationship with the new genus *Mytoconula*.

A close morphologic similarity of the Cambrian *Protoconchoides* and Ordovician *Patelliconus* may lead to a synonymy of these genera; nevertheless, this similarity could be a result of a morphologic convergence (see also Frýda, 1998). *Patelliconus* and *Protoconchoides* display an important feature, unfortunately rarely completely fossilized: a narrower early shell, followed by wider teleoconch (according to Geyer: "Apex, if preserved, projects as a nipple"; 1994, p. 82; plate I, figs P, Q). This character may be an important diagnostic feature of a higher systematic category.

**Included species:** *Patelliconus primulus* (BARRANDE in PERNER, 1903), Middle Ordovician, lower Darriwilian, Šárka Formation; Barrandian Area, Bohemia.

***Patelliconus primulus* (BARRANDE in PERNER, 1903)**

Text-figs 1–4

- 1903 *Palaeacmaea primula* Barr. sp.; J. Perner, p. 27.
- 1903 *Palaeacmaea immigrans* Barr. sp.; J. Perner, p. 28.
- 1961 *Patelliconus primulus* (Perner, 1903); R. Horný, p. 301.
- 1963 *Patelliconus primulus* (Perner, 1903); R. Horný, p. 29–31.
- 1977 *Patelliconus primulus* (Perner); E. L. Yochelson, p. 311.
- 2002 *Patelliconus primulus* (Barrande in Perner, 1903); R. Horný, p. 76.

**H o l o t y p e :** By monotypy, specimen NM L 8425, figured here in Text-fig. 1.

**S t r a t u m t y p i c u m :** Middle Ordovician, lower Darriwilian, Šárka Formation.

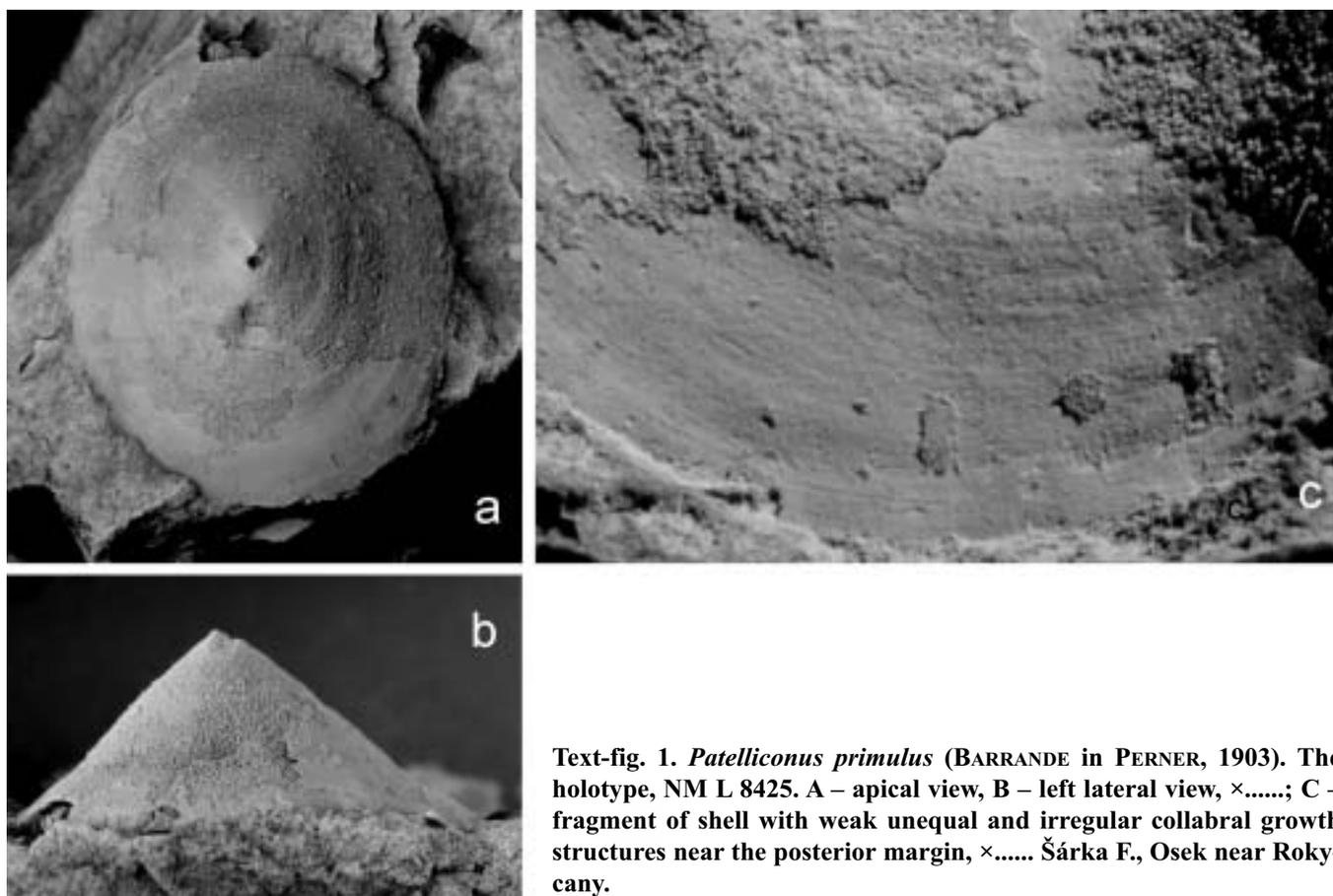
**T y p e l o c a l i t y :** Osek near Rokycany.

**M a t e r i a l :** 6 specimens, incl. the holotypes of *P. primula* and *P. immigrans*.

**D i a g n o s i s :** Species of *Patelliconus* HORNÝ, 1961 with a subcentral apex; shell interior almost smooth; a concentric band-like muscle zone periodically migrating towards the apertural margin. L/w ratio 1.10–1.25.

**D e s c r i p t i o n :** The description published by Horný (1963) is completed by observation based on two new specimens, MBHR 2418 and NM L 39616.

Specimen MBHR 2418, collected by Jaroslav and Petr Kraft at Osek near Rokycany (Text-fig. 4) is a counterpart of an incomplete, immature specimen with preserved cavity left after the apical part of the juvenile shell. The early

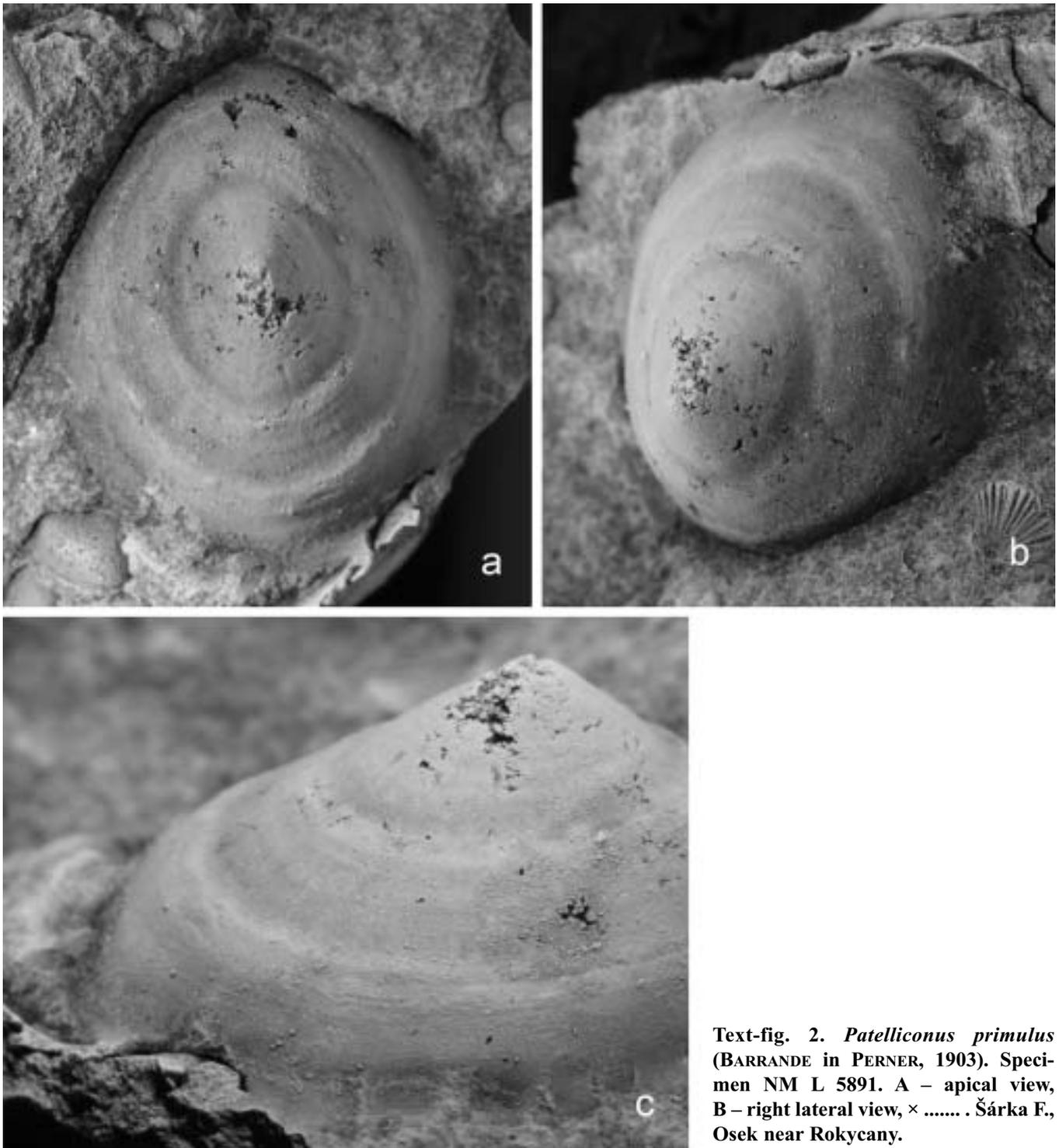


**Text-fig. 1.** *Patelliconus primulus* (BARRANDE in PERNER, 1903). The holotype, NM L 8425. A – apical view, B – left lateral view, ×.....; C – fragment of shell with weak unequal and irregular collabral growth structures near the posterior margin, ×..... Šárka F., Osek near Rokycany.

shell with ovate aperture bears fine, dense comarginal threads and initially a distinct groove then rapidly expanding into the wider teleoconch. The apical angle of the early shell is 70° (l), 90° (w).

Specimen NM L 39616, collected by Štěpán Rak, Jr. at Volduchy – Díly near Rokycany (Text-fig. 2) is a mature specimen, 10.5 mm long and 9.5 mm wide (l/w ratio 1.10), an internal mould with weathered apical part but relatively well-preserved internal shell surface and the apertural margin. It bears three raised concentric rugae corresponding to grooves in the shell interior. There are no visible traces of migration of muscle insertions; the continuous muscle zone probably displaced by saltation as in *Pygmaeoconus* HORNÝ,

1961 (see Horný 2006a) and in the majority of other cyrtoneidids. The adapertural muscle scar is adorally bordered with a thin line which probably represents either an adapertural margin of the band-like muscle scar or, less likely, the pallial line. (Location of the pallial line close to muscle insertions figured by Runnegar and Pojeta, Jr. [1964], fig. 2 in a reconstruction of the Rasetti's specimen of *Scenella* sp.). The posterior slope of the shell bears fine, irregular, radial structures normal to the apertural margin. The ring-shaped muscle zone, located on a raised wall or ridge, is about 0.3 mm wide, flat, probably continuous, without isolated scars of muscle bundles (Text-fig. 1c). The aperture is planar, its outline almost circular, the l/w ratio 1.03. The



Text-fig. 2. *Patelliconus primulus* (BARRANDE in PERNER, 1903). Specimen NM L 5891. A – apical view, B – right lateral view, × ..... . Šárka F., Osek near Rokycany.



Text-fig. 3. *Patelliconus primulus* (BARRANDE in PERNER, 1903). Specimen NM L 39616, internal mould. A – apical view, B – oblique left posterolateral view, both  $\times\dots\dots$ ; C – right posterolateral view showing the second and third successive positions of muscle band (arrowed), located on top of each elevation (= in the deepest place of the wide depression of shell interior at the periphery of a flat ramp),  $\times\dots\dots$ . Šárka F., Volduchy – Díly near Rokycany.



Text-fig. 4. *Patelliconus primulus* (BARRANDE in PERNER, 1903). Specimen MHBR 2418, revultex impression. A – apical view showing the early shell and earliest stages of teleoconch. Note patches of shell with irregular incremental structures; B – left lateral view; C – oblique left apicolateral view showing finely ribbed early shell and patches of shell in earliest stages of teleoconch, all  $\times\dots\dots$ . Šárka F., Osek near Rokycany.

apical angle of adult shell varies between 90–100°. The longitudinal shell profile is asymmetric as in *Pygmaeoconus*: the slightly shorter side interpreted as anterior is almost straight, the posterior side is gently arched.

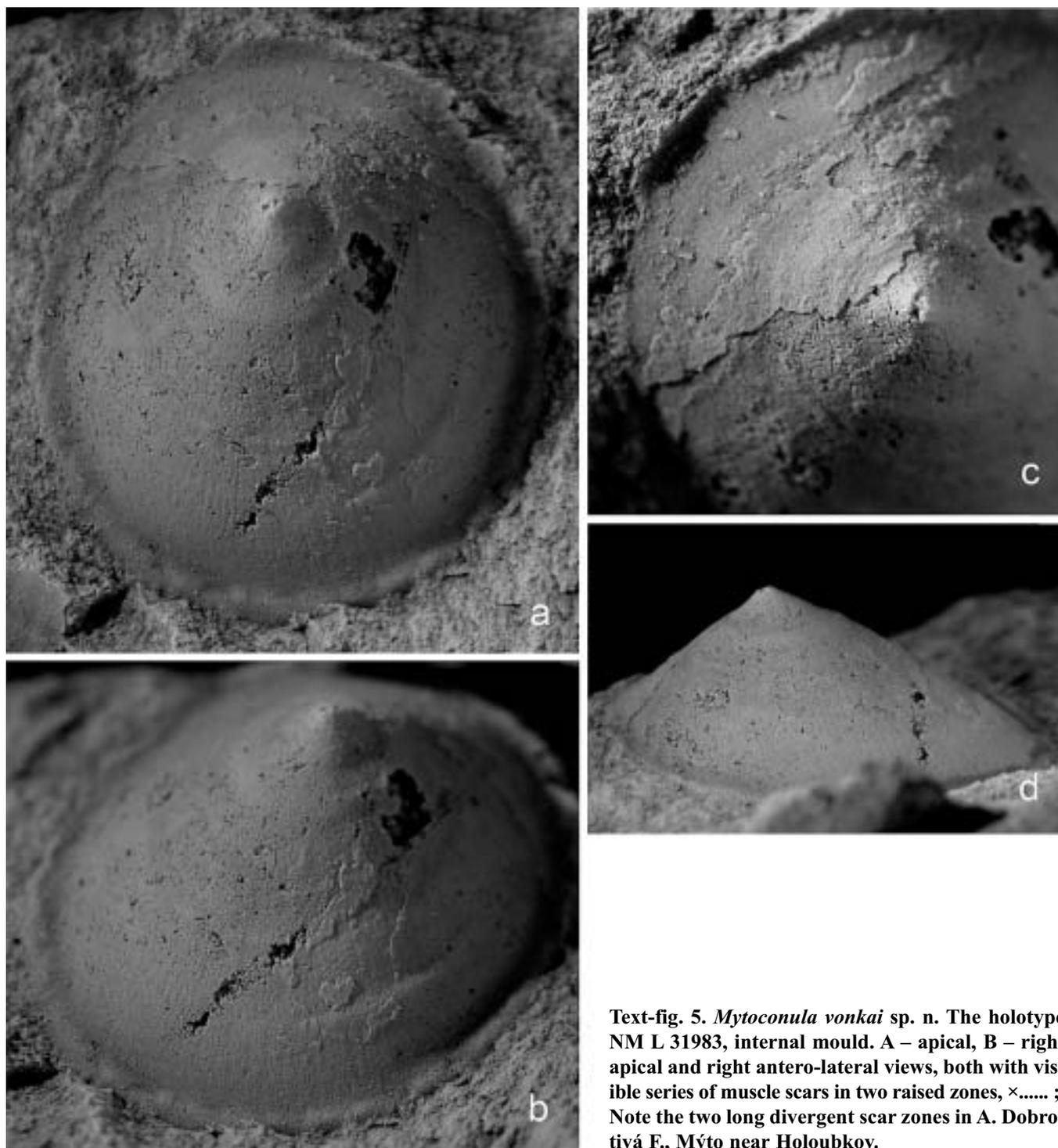
Genus *Mytoconula* gen. n.

Type species: *Mytoconula vonkai* sp. n., Middle Ordovician, upper Darriwilian, Dobrotivá Formation; Bohemia, Barrandian Area.

Derivatio nominis: Ater the village of Mýto near the type locality, with suffix *-conula* (Lat.), a small cone. Feminine.

Diagnosis: Genus of the family Protoconchoididae with low, conical, thin-shelled conch, with apex shifted about a half way between the shell centre and the anterior apertural margin; early shell is narrower, sharply separated by a groove from the wider teleoconch; aperture planar, widely ovate in outline, l/w ratio 1.12–1.39; fine radial striation of shell interior; concentric muscle zones disintegrated into a series of small scars.

Discussion: Dense radial striation of the internal shell surface may represent an ancestral type of musculature of tergomyan molluscs, traceable in several early Palaeozoic genera – e. g. *Pilina* KOKEN in KOKEN et PERNER, 1925 (*P. liaoningensis* YU WEN et YOCHELSON, 1999); *Bipulvina*



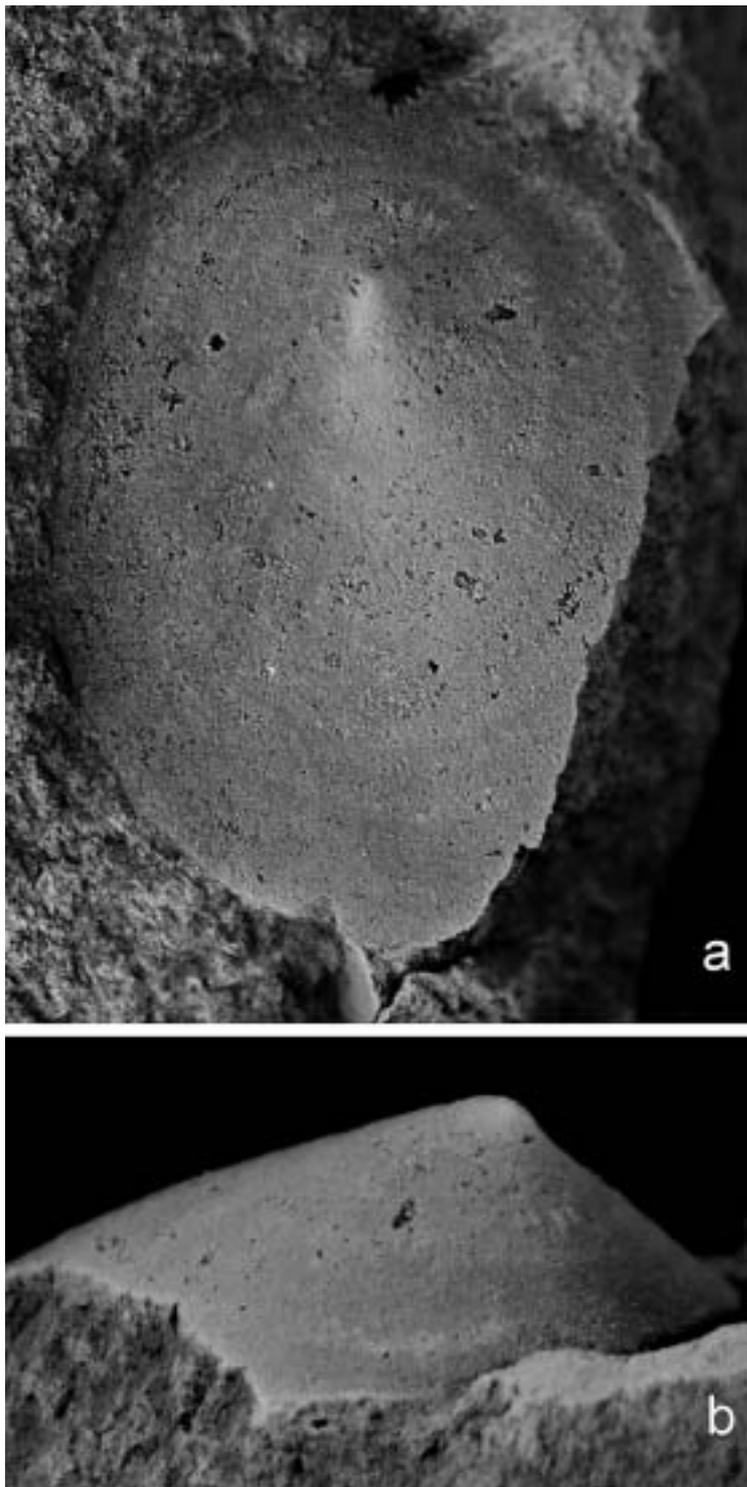
Text-fig. 5. *Mytoconula vonkai* sp. n. The holotype NM L 31983, internal mould. A – apical, B – right apical and right antero-lateral views, both with visible series of muscle scars in two raised zones, ×..... ;. Note the two long divergent scar zones in A. Dobrotivá F., Mýto near Holoubkov.

YOCHELSON, 1958 (*B. croftsae* YOCHELSON, 1958); *Drahomira* BARRANDE in PERNER, 1903 (*D. kriziana* HORNÝ, 2005), and even the cyrtoneidids – *Simuitopsis* PERNER, 1903 (*S. neglecta* BARRANDE in PERNER, 1903). In this connection *Cambridium* HORNÝ, 1957 should also be mentioned. This middle Cambrian genus, originally a representative of the order Cambriiida HORNÝ in KNIGHT et YOCHELSON, 1960, may be classified as an ancient tergomyan with strongly emphasized radial structure.

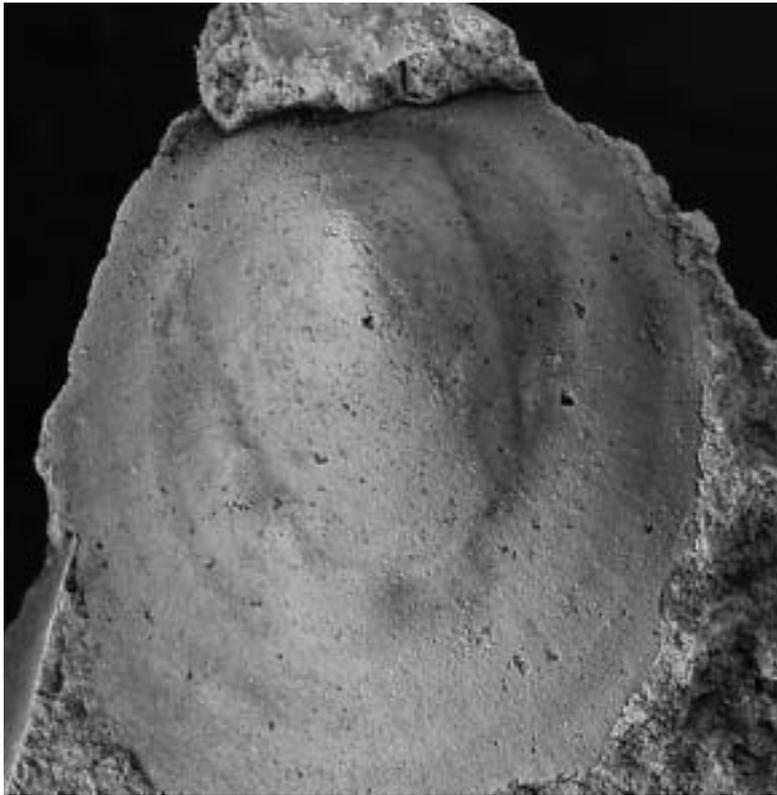
*Patelliconus osloensis* YOCHELSON, 1977 from Upper Ordovician of Norway (Grimsøy Formation, upper Katian) has a radially striated internal shell surface. Yochelson (p. 311) describes this structure as closely spaced, irregular

ridges near the margin, which may have been areas of blood vessels leading to the mantle margin or may have been connected with attachment of the mantle to the shell. According to his fig. 2K, these ridges bifurcate or trifurcate adaper-turally, being similar to structures in *Pilina liaoningensis* YU WEN et YOCHELSON, 1999 or e. g. *Cambridium nikifor-ovae* HORNÝ, 1957. For these reasons, in spite of the sub-central apex, I prefer to classify this species as *Mytoconula osloensis* (YOCHELSON, 1977).

Species included: *Mytoconula vonkai* sp. n., Middle Ordovician, upper Darriwilian, Dobrotivá Formation; Bohemia, Barrandian Area.



**Text-fig. 5.** *Mytoconula vonkai* sp. n. The holotype NM L 31983, internal mould. A – apical, B – right apical and right antero-lateral views, both with visible series of muscle scars in two raised zones, ×..... ;. Note the two long divergent scar zones in A. Dobrotivá F., Mýto near Holoubkov.



Text-fig. 7. *Mytoconula vonkai* sp. n. Counterpart of specimen NM L 3876c, apical view showing weathered radial structures; A – ×....., B – ×..... . Dobrotivá F., Malé Přílepy.



Text-fig. 6. *Mytoconula vonkai* sp. n. Specimen NM L 31984, internal mould. A – apical, B – right lateral views, ×..... and ×..... . Note the outline of an indeterminate object on which the larva settled. This specimen, embedded in a siliceous concretion, lied closely near the holotype NM L 38914. Dobrotivá F., Mýto near Holoubkov.

*Mytoconula vonkai* sp. n.

Text-figs 5–8

**H o l o t y p e**: specimen NM L 31983, figured here in Text-fig. 5.

**P a r a t y p e**: specimen NM L 31984, figured here in Text-fig. 6.

**S t r a t u m t y p i c u m**: Middle Ordovician, upper Darriwilian, Dobrotivá Formation.

**T y p e l o c a l i t y**: Mýto near Holoubkov.

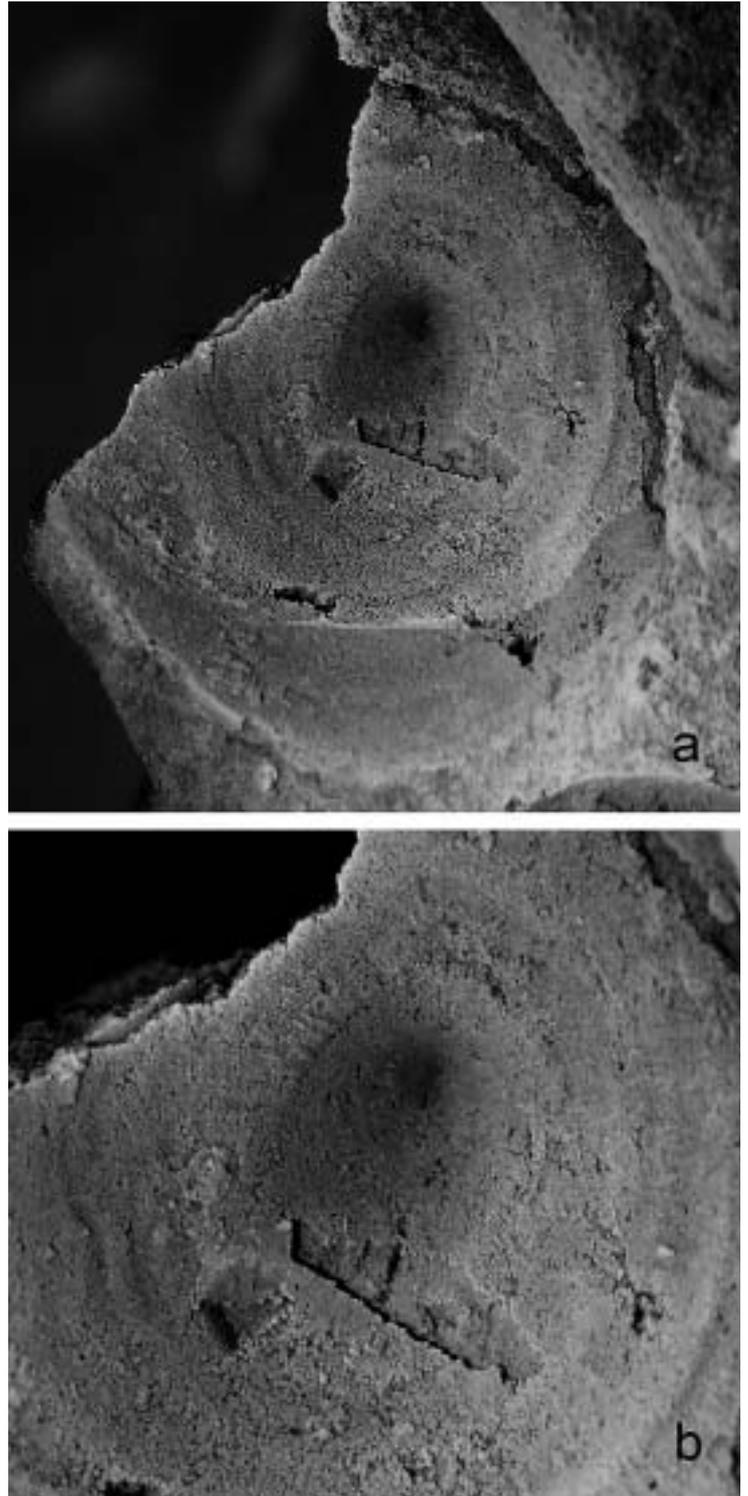
**D e r i v a t i o n o m i n i s**: Named after ing. Vladimír Vonka, collector and palaeontology enthusiast,

who found important specimens for our understanding of morphology.

**M a t e r i a l**: 22 specimens, including the type specimens, deposited in collections of the National Museum, Prague.

**D i a g n o s i s**: see the genus.

**D e s c r i p t i o n**: The low cone-like shell is widely ovoid in outline with a subcentral, anteriorly shifted apex. The average length:width ratio is 1.25 (14 specimens measured). The smallest specimen, NM L 38765, is 4.20 mm long, 3.5 mm wide, and 0.6 mm high, the largest, NM L 38761a, is 12.10 mm long and 10.8 mm wide. The growth

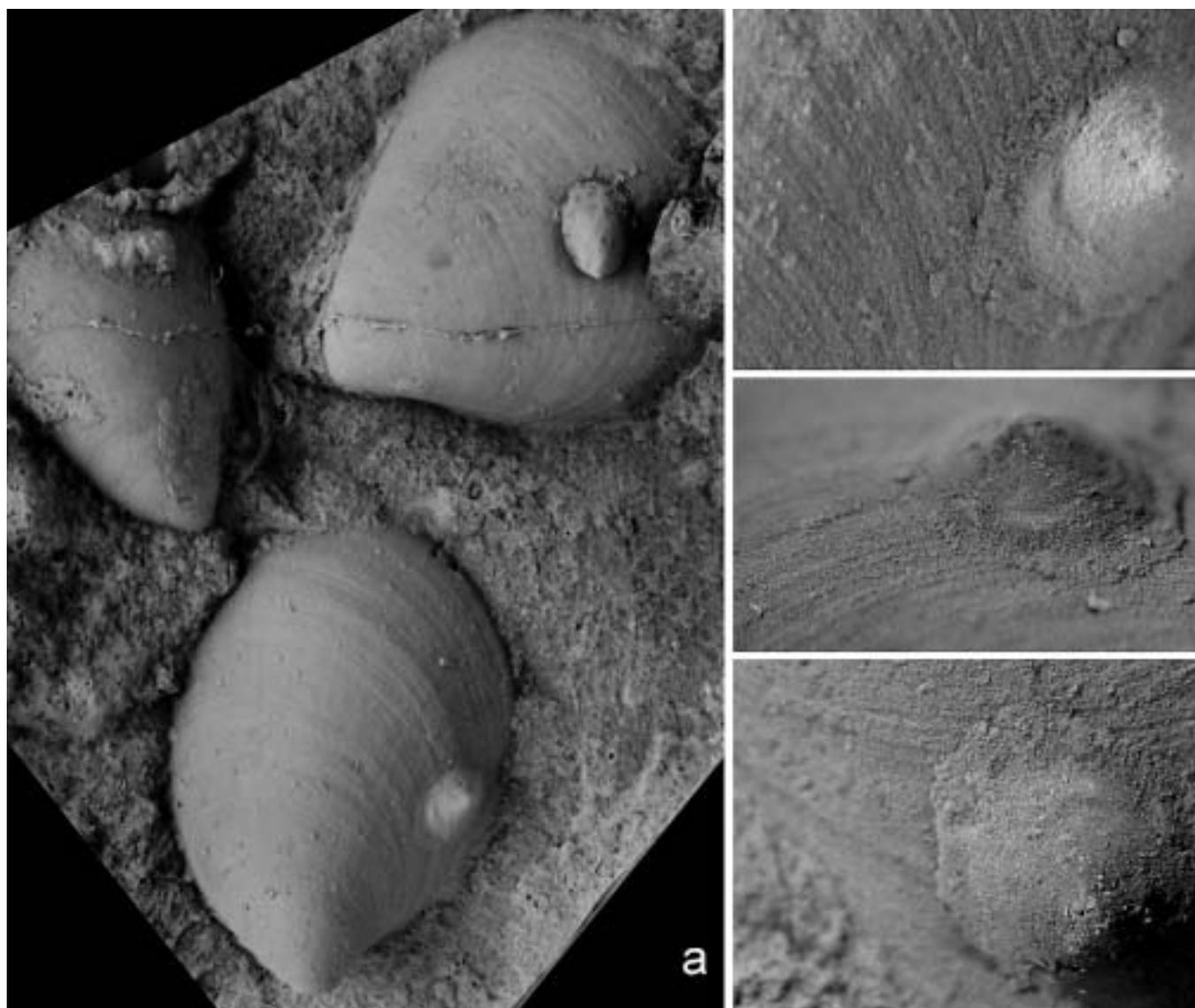


**Text-fig. 8.** *Mytoconula vonkai* sp. n. Specimen NM L 38914, internal mould with patches of shell. **A** – apical view,  $\times$ ..... ; **B** – oblique posterior view showing radial ribs on internal mould,  $\times$ ..... ; **C** – anterior part with a large patch of shell with irregular incremental structures,  $\times$ ..... ; **D** – left lateral view,  $\times$ ..... ; Dobrotivá F., Malé Přílepy.

structures indicate that the early shell aperture had an almost rounded outline (NM L 38764b). The apex is shifted towards the apertural margin, interpreted as anterior. The early shell has steeper sides, about 90° (NM L 38768); apical angle of mature shells reaches 120°. Both the anterior and posterior apertural margins are rounded. The anterior side is steeper than the posterior, which is shallowly convex between the apex and posterior margin in mature specimens. The apertural margin is planar, sharp, periodically slightly flaring in mature specimens (NM L 38914). The shell wall is very thin, maximum thickness being about 0.05 mm. Its composition and structure are unknown, being weathered and substituted by limonite. External sculpture consists of simple, somewhat irregular and unequal growth lines (NM L 38914, Text-fig. 5d). Two or three periodical rugae corresponding to the location of concentric muscle zones are developed predominantly in the posterior area of

shell (NM L 38914); these structures are weak or absent in the majority of specimens studied.

As the shells are small and the shell wall is thin, the muscle insertions are rather small and indistinct. Furthermore, the weathered structure of the surface of internal moulds is not smooth enough to reflect such fine details. Several specimens preserved as internal moulds showed numerous fine radial ridges (grooves on the internal shell surface) running from the periphery of the early shell and almost reaching the apertural margin (NM L 38914, NM L 38767, NM L 31983; Text-fig. 5). When crossing the periodical rugae of the shell, these weak ridges increase in strength and breadth and have the character of short muscle scars (NM L 31893, NM L 38764c, Text-fig. 7). Two slightly stronger diverging ribs were developed in the posterolateral area (NM L 31893, NM L 31894, NM L 38765; Text-fig. 6). The pallial line and associated structures have not been ascertained.



**Text-fig. 9.** Revultex impression of a siliceous concretion NM L 31967. **A** – an assemblage of three specimens of *Barrandicella* cf. *tarda* (PERNER, 1903); **a** – indeterminate early shell (? *Barrandicella* sp.), **b** – *Mytoconula* sp., ×..... **B** – *Mytoconula* sp., oblique left lateral view of an early shell just after landing on the *Barrandicella* surface, with a narrow flat rim of initial teleoconch shell, probably pressed down by sediment, ×.....; **C** – the same, oblique left lateral view, ×.....; **D** – the same, oblique right posterolateral view showing increments in the early shell, ×..... . Dobrotivá F., Praha-Šárka.

## Mode of life

All specimens of *Patelliconus primulus* and *Mytoconula vonkai* come from siliceous concretions containing taphocoenoses of abundant and often fragmentary, mostly nekto-benthic and benthic fauna (for more details see Havlíček and Vaněk 1966, 1990, Havlíček et al. 1994, Budil et al. 2003, 2007, Horný 2006a, b). Both species were probably slow or even stationary inhabitants of various hard objects of organic origin lying on muddy sea bottom. Horný (2006b) expected that *Peelipilina latiuscula* (BARRANDE in PERNER, 1903) grazed on bacterial or algal films. According to the almost rounded outline of the aperture in *P. primulus* (l/w ratio 1.10–1.25), this species may have been a filter feeder adapted to a more limited area than the slightly more elongate *Mytoconula vonkai* with a l/w ratio 1.12–1.39 (Peel 1977). An important specimen of *M. vonkai*, NM L 31894 (Text-fig. 7), shows a contour of an elongate object (a fragment of a trilobite exoskeleton?) on which the animal settled. Later it overgrew its margins and continued growth in a regular shape. This find may indicate that even *Mytoconula* preferred a stationary mode of life as a filter feeder, similar to *Pygmaeoconus porrectus* (BARRANDE in PERNER, 1903).

A concretion from the Dobrotivá Formation, found by F.Hanuš in Praha-Šárka, contains several counterparts of *Barrandicella cf. tarda* (PERNER, 1903) (Text-fig. 8a). Two of them bear counterparts of early juvenile shells, one probably *Barrandicella* sp. and the other *Mytoconula* sp., in life position (Text-figs 8b–d). While poor preservation of *Barrandicella* sp. does not warrant exact determination, *Mytoconula* is clearly identified. The early shell is fixed on a well-preserved, striated surface of *Barrandicella cf. tarda* (PERNER, 1903). The projecting early shell is about 1.3 mm long and 1.1 mm wide with steep sides bearing fine, irregular incremental structures. The periphery of this shell is surrounded by a narrow, thin, flat, radially striated shell margin of the early teleoconch, closely pressed to the *Barrandicella* surface (Text-figs 8b–d). The position of the young *Mytoconula* (which is probably *M. vonkai*) testifies that its shell was firmly adjusted to the surface of the host shell and that it was slightly deformed by sediment pressure before diagenetic processes occurred.

## Acknowledgements

Financial support from the Ministry of Culture of the Czech Republic, project DE 06P04 OMG 009, is gratefully acknowledged. Pino Benetti, Jan Ove R. Ebbestad and Vojtěch Turek reviewed the manuscript. Petr Budil discussed the stratigraphy of faunal associations. Jiří Kvaček helped with photography.

## References

- Billings, E. (1872): On some fossils from the Primordial rocks of Newfoundland. – *Canadian Naturalist and Quarterly Journal of Science*, n. s., 6: 465–479.
- Bouchet, P., Rocroi, J.-P., Frýda, J., Hausdorf, B., Ponder, W., Valdes, A., and Warén, A. (2005): A nomenclator and classification of gastropod family-group names. – *Malacologia*, 47(1–2): 1–368.
- Budil, P., Chlupáč, I. and Hradecký, P. (2003): Middle Ordovician at Praha – Červený vrch Hill (Barrandian area, Czech Republic). – *Bulletin of Geosciences*, 78(2): 91–98.
- Budil, P., Kraft, P., Kraft, J. and Fatka, O. (2007): Faunal associations of the Sarka Formation (Middle Ordovician, Darriwilian, Prague Basin, Czech Republic). – *Acta Palaeontologica Sinica*, 46 (Suppl.): 64–70.
- Doguzhaeva, L. A. (1972): Novye tremadokskie monoplakofory Yuzhnogo Urala [New Tremadocian Monoplacophora of the Southern Ural]. – *Paleontologicheskij Zhurnal*, 1972(1): 24–28. [In Russian.]
- Doguzhaeva, L. A. (1981): Sinus kolpachkovidnykh monoplakofor [Sinus in cap-shaped monoplacophorans]. – *Doklady Akademii Nauk SSSR*, 258(1): 208–211. [In Russian.]
- Frýda, J. (1998): Some new and better recognized Devonian gastropods from the Prague Basin (Bohemia). – *Věstník Českého geologického ústavu*, 73 (1): 41–49.
- Geyer, G. (1994): Middle Cambrian molluscs from Idaho and early conchiferan evolution. In: Landing, E. (ed.), *Studies in stratigraphy and paleontology etc.* – *New York State Museum Bulletin*, 481: 1–380.
- Havlíček, V., Vaněk, J. (1966): The biostratigraphy of the Ordovician of Bohemia. – *Sborník geologických věd, Paleontologie*, 8: 7–69.
- Havlíček, V., Vaněk, J. (1990): Ordovician invertebrate communities in black-shale lithofacies (Prague basin, Czechoslovakia). – *Věstník Ústředního ústavu geologického*, 65: 223–236.
- Havlíček, V., Vaněk, J. and Fatka, O. (1994): Perunica microcontinent in the Ordovician (its position within the Mediterranean Province, series division, benthic and pelagic associations). – *Sborník geologických věd, Geologie*, 46: 23–56.
- Horný, R. (1957): Problematic molluscs (? Amphineura) from the Lower Cambrian of South and East Siberia (U. S. S. R.). – *Sborník Ústředního ústavu geologického*, 23 [1956]: 397–432. (in Russian, Czech, and English).
- Horný, R. J. (1961): New Genera of Bohemian Monoplacophora and Patellid Gastropoda. – *Věstník Ústředního ústavu geologického*, 36: 299–302.
- Horný, R. J. (1963): Lower Paleozoic Monoplacophora and Patellid Gastropoda (Mollusca) of Bohemia. – *Sborník Ústředního ústavu geologického, oddíl paleontologický*, 28(1961): 7–83.
- Horný, R. J. (1965): On the systematical position of *Cyrtolites* CONRAD, 1838 (Mollusca). – *Časopis Národního muzea v Praze, Oddíl přírodovědný*, 134: 8–10.
- Horný, R. J. (1997): New, rare, and better recognized Ordovician Tergomya and Gastropoda (Mollusca) of Bohemia. – *Věstník Českého geologického ústavu*, 72(3): 223–237.
- Horný, R. J. (2000): *Barrandicellopsis*, a new Ordovician archinacelloid genus (Mollusca, Gastropoda). – *Věstník Českého geologického ústavu*, 75: 145–152.

- Horný, R. J. (2002): Ordovician *Tergomya* and isostrophic Gastropoda (Mollusca) of Bohemia: Types and referred specimens in the collections of the National Museum, Prague, Czech Republic. – *Acta Musei Nationalis Pragae, Series B, Historia Naturalis*, 57 [2001]: 69–102.
- Horný, R. J. (2005): Muscle scars, systematics and mode of life of the Silurian family *Drahomiridae* (Mollusca, *Tergomya*). – *Acta Musei Nationalis Pragae, Series B, Historia Naturalis*, 61: 53–76.
- Horný, R. J. (2006a): The Middle Ordovician *tergomyan* mollusc *Pygmaeoconus*: an obligatory epibiont on hyolithids. – *Acta Musei Nationalis Pragae, Series B, Historia Naturalis*, 62: 81–85.
- Horný, R. J. (2006b): Peelipilina, a new *tergomyan* mollusc from the Middle Ordovician of Bohemia (Czech Republic). – *Časopis Národního muzea, Řada přírodovědná*, 175: 97–108.
- Knight, J. B., Yochelson, E. L. (1960): Monoplacophora. – In: R. C. Moore (ed.), *Treatise on Invertebrate Paleontology, Part I (Mollusca 1)*, 177–184. – Geological Society of America and University of Kansas Press, Lawrence.
- Knight, J. B. (1956): New families of Gastropoda. – *Journal of the Washington Academy of Sciences*, 46: 41–42.
- Koken, E., Perner, J. (1925): Die Gastropoden den baltischen Untersilurs. – *Mémoires de l'Académie des Sciences de Russie, Série 8, Classe physico-mathématique*, 37(1): 1–326.
- Lemche, H. (1957): A new living deep-sea mollusc of the Cambro-Devonian class Monoplacophora. – *Nature*, 179: 413–416.
- Peel, J. S. (1977): Relationship and internal structure of a new *Pilina* (Monoplacophora) from the late Ordovician of Oklahoma. – *Journal of Paleontology*, 51: 116–122.
- Peel, J. S. (1991): Functional morphology, evolution and systematics of Early Palaeozoic univalved molluscs. – The Classes *Tergomya* and *Helcionelloida*, and early molluscan evolution. – *Grønlands Geologiske Undersøgelse, Bulletin*, 161: 11–65.
- Peel, J. S., Horný, R. J. (1999): Muscle scars and systematic position of the Lower Palaeozoic limpets *Archinacella* and *Barrandicella* gen. n. (Mollusca). – *Journal of the Czech Geological Society*, 44: 97–115.
- Perner, J. (1903): Gastéropodes. – In: Barrande, J.: *Système Silurien du centre de la Bohême*, 4 (1): I–XI, 1–164. Prague.
- Rasetti, F. (1954): Internal shell structures in the Middle Cambrian gastropod *Scenella* and the problematic genus *Stenothecoides*. – *Journal of Paleontology*, 28: 59–66.
- Resser, C. E. (1945): Cambrian history of the Grand Canyon Region. Part II. Cambrian fossils of the Grand Canyon. – *Publications of the Carnegie Institution*, 563: 171–220.
- Rozov, S. N. (1968): Novy rod pozdněkembrijskikh mollyuskov iz klassa monoplakofor (yuzhnaja chast' Sibirskoy platformy). [A new genus of Late Cambrian molluscs from the class Monoplacophora (southern part of the Siberian platform).] – *Doklady Akademii Nauk SSSR*, 183: 1427–1430. [In Russian.]
- Rozov, S. N. (1975): Novy otrjad monoplakofor. [A new order of the Monoplacophora.] – *Paleontologicheskij Zhurnal*, 1975(1): 39–43. [In Russian.]
- Runnegar, B., Pojeta, J. Jr. (1974): Molluscan phylogeny: the paleontological viewpoint. – *Science* 186: 311–317.
- Shaw, A. B. (1962): Paleontology of northwestern Vermont. IX. Fauna of the Monkton Quartzite. – *Journal of Paleontology*, 36: 322–345.
- Starobogatov, J. I. (1970): K sistematike rannepaleozoiskikh Monoplacophora. [Systematics of Early Palaeozoic Monoplacophora.] – *Paleontologicheskij Zhurnal* 1970, 3: 6–17. [In Russian.]
- Stinchcomb, B. L. (1986): New Monoplacophora (Mollusca) from Late Cambrian and Early Ordovician of Missouri. – *Journal of Paleontology*, 60: 606–626.
- Stinchcomb, B. L., Angeli, N. A. (2002): New Cambrian and Lower Ordovician monoplacophorans from the Ozark Uplift, Missouri. – *Journal of Paleontology*, 76: 965–974.
- Webers, G. F., Pojeta, J., Jr., and Yochelson, E. L. (1992): Cambrian Mollusca from the Minaret Formation, Ellsworth Mountains, West Antarctic. In: Webers, G. F., Craddock, C., and Spletstoesser, J. F. (eds), *Geology and Paleontology of the Ellsworth Mountains*. – Geological Society of America, 170: 181–248.
- Wilson, A. E. (1951): Gastropoda and Conularida of the Ottawa Formation of the Ottawa-St. Lawrence Lowland: Bulletin of the Geological Survey of Canada, 17: 1–149.
- Yochelson, E. L. (1958): Some lower Ordovician monoplacophoran molluscs from Missouri. – *Journal of Washington Academy of Sciences*, 48: 8–14.
- Yochelson, E. L. (1977): Monoplacophora (Mollusca) from the Upper Ordovician of Norway. – *Norsk Geologisk Tidsskrift*, 47: 297–312.
- Wen, Yochelson, E. L. (1999): Some Late Cambrian molluscs from Liaoning Province, China. – *Records of the Western Australian Museum*, 19: 379–389.