



ANOMALOUS DEVELOPMENT OF APERTURAL MARGIN AND FAILED PREDATION IN THE LOWER DEVONIAN GASTROPOD *ANARCONCHA PULCHRA* FROM THE BARRANDIAN (CZECH REPUBLIC)

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Abstract. *Anarconcha pulchra* (BARRANDE in PERNER, 1903) is one of gastropods from the Lower Devonian Koněprusy reef, possessing a deviated last whorl. The majority of specimens of this species, including the types, have a pseudoselenizone developed throughout the whole teleoconch. Among the 32 observed specimens, two adults lack anal emargination in the outer lip. These specimens were more often, repeatedly, non-lethally predated, perhaps due to a different mode of life.

■ Gastropoda, *Anarconcha*, Lower Devonian, absence of pseudoselenizone, injury, Bohemia, Czech Republic

INTRODUCTION

Study of fauna from the Lower Devonian Koněprusy Limestone, carried out within the framework of the contract between the National Museum, Prague, and the Management of the VČS, brought several interesting discoveries – both in field and in the old collections, deposited in the Department of Palaeontology. One of them is a small collection of isolated gastropods collected by B. Bouček in 1931 in soft, yellowish, weathered limestones from an abandoned quarry on the southern slope of the Zlatý kůň Hill, containing, among others, 25 specimens of *Anarconcha pulchra* (BARRANDE in PERNER, 1903), so far known from four fragmentary types of Perner (1903) and three specimens figured by Horný (1964). Relatively good preservation of shells, however, showing less details than that from the localities in Prague, allowed the study of external shell surface throughout the ontogeny, as well as repaired shell after failed predatory attacks.

Most interesting is the find of two adult specimens of *Anarconcha pulchra*, which is a species with well-developed pseudoselenizone, lacking the anal emargination in outer lip of the teleoconch. Absence of the exhalant sinus probably did not affect the development of the shell, although both anomalous specimens show repeated fractures of outer lip which may be connected with the somewhat different mode of life of these individuals. Nevertheless, the reason for absence of the labral sinus is unclear and the higher frequency of predation in non-sinuate specimens may be just a chance event.

All specimens are deposited in the collections of the Department of Palaeontology, National Museum – Museum of Natural History, Prague.

NOTES ON SHELL MORPHOLOGY AND SYSTEMATICS

Anarconcha pulchra (BARRANDE in PERNER, 1903) is a small (max. 17 mm high), dextral, narrowly phaneromphalous, many-whorled (9–11), high-spired, transversely ribbed gastropod with a narrow, short slit or sinus in outer lip of teleoconch culminating at the rounded whorl periphery and generating not sharply limited pseudoselenizone. At least two isolated specimens from Bouček's collection show a slightly corroded protoconch consisting of 4 whorls with simple orthocone ribs combined with spiral threads. Out of the 32 observed specimens, two lack insinuation of outer lip in teleoconch, and in spite of this phenomenon, the shell fully developed in comparable shape. Their external shell sculpture consists of almost straight, orthocone or slightly prosocline ribs.

There is no fracture visible between the protoconch and teleoconch which would indicate an injury, possibly causing the absence of insinuation. The final whorl of teleoconch turns sideways, upwards, and forwards.

The systematic position of this genus is not clear, and its location within Murchisoniidae is only tentative. The genus may be related to the contemporary *Vladanella* HORNÝ, 1992, possessing an identical type of protoconch with collabral and spiral elements, and characterized with peculiar development and morphology of selenizone throughout the ontogeny. A protoconch with similar sculpture appears also in *Decorospira* BLODGETT et JOHNSON, 1992 (= *Dongiovannia* HORNÝ, 1992) which, however, is a representative of microdomatoideans without the selenizone. The Middle Devonian *Brilonella* KAYSER, 1873 has lower shell, sharply limited selenizone with lunulae, and similarly deviated final whorl.

SHELL BREAKAGE AND REPAIR

Out of the 32 observed specimens of *A. pulchra*, four show repaired fractures, two of them lacking the anal re-entrance. Regarding that many specimens are incomplete, the original number of the failed predatory attacks may have been higher. Some specimens are partly corroded (often on one side along the whole height of the shell), and these places may also hide fractures.

Specimens with labral sinus: Specimen L 36835, adult, 15.7 mm high, 7 whorls, apical part missing. Two repaired injuries in different stages of growth: 7th and 8th whorls (estim.) (Text-fig. 1a, b).

Specimen L 06404, adult, 10.9 mm high, 7 whorls, apical part missing. One repaired injury on the penultimate whorl (Text-fig. 1c).

Specimens lacking labral sinus: Specimen L 36836, adult, 10.3 mm high, 8 whorls, apical whorls partly missing. Two repaired injuries in different stages of growth: 7th and 9th whorls (estim.) (Text-fig. 1a, Pl. I., fig. 6).

Specimen L 36837, adult, 11.2 mm high, 9 whorls, apical whorls partly missing. Five repaired injuries in different stages of growth: 6th, 7th, and 8th whorls (Text-fig. 1b, c, Pl. I., figs 2–5).

Attacks were always directed on the outer apertural margin, including the labral sinus, if developed. Some fractures were quite deep, comprising even one third of a whorl. Most resistant was the upper part of the whorl along the upper suture. The course of fractures on the basal parts of whorls are hidden under the following whorl. New shell was always growing from below the remaining fractured shell, and usually was characteristically inflated. For some distance (for about 6–8 ribs) the new ribs were much thicker than the previous ones and strongly prosocline. All these cases fully agree with the observa-

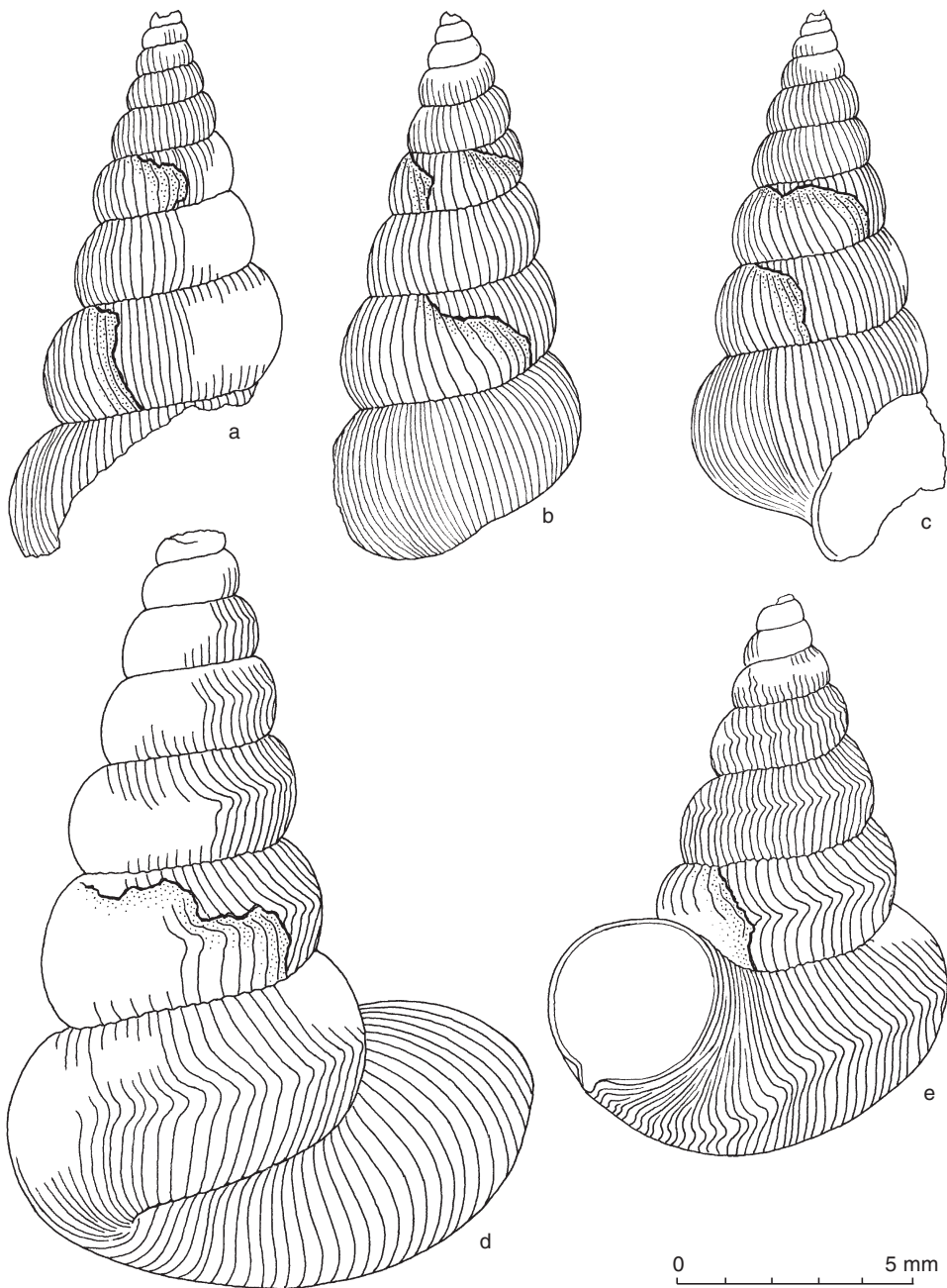


Fig. 1. *Anarconcha pulchra*. a – specimen NM L 36836; b, c – specimen NM L 36837, opposite sides with five repaired injuries; d – NML 36835, the largest known, adult specimen with aperture; e – specimen NM L 06404 with preserved aperture. Orig.

tions published by Peel (1984) and Lindström and Peel (1997). Similar repaired fractures in Palaeozoic high-spired gastropods were described and figured e.g. by Hoare, Atwater,

and Sparks (1980) in a Pennsylvanian *Microdoma*, by Schindel, Vermeij, and Zipser (1982) in various Pennsylvanian gastropods, or by Horný (1992, 1994) in Devonian *Komenskyspira* and *Branzovya*; in trochiform and similar shells were described, classified and discussed in detail particularly by Peel (1984) in a Silurian *Euomphalopterus*, by Lindström and Peel (1997) in a Silurian *Poleumita*, or by Ebbestad and Peel (1997) in various Ordovician gastropods (for a brief review see Horný 1997).

MODE OF LIFE

Anarconcha is one of the gastropod genera adapted to specific conditions of the Koněprusy reef, characterized by deviated or variably distorted or strangulated final whorl (*Goniotremus* HORNÝ, 1992, *Prokopelia* HORNÝ, 1992, *Mitchelia* DE KONINCK, 1877). This morphology testifies to a considerable reduction of locomotion in the final phases of life; the premature animal with regularly coiled shell may have lived as “shell-draggers” (No. 7e of Linsley 1979). The original assemblage is unknown, but the limited collection separated by B. Bouček comprises small or juvenile, mostly complete shells, e.g. *Tubina knighti* HORNÝ, 1992, *Ptychocaulus verneuli* (KOKEN, 1889), *Agnesia invertens* BARRANDE in PERNER, 1903. The micritic limestone with Perner’s types contains fragments of small phyllocarid (*Aristozoe* sp.). As the shells of gastropods show no signs of transport, the assemblage with numerous bryozoans probably lived in a shelter within the reef core. Similar depressions and cavities contained numerous scutelluid exuviae, proetids, phyllocarids, and ostracods (Chlupáč 1955, 1994).

As far as potential predators are concerned, Hoare, Atwater, and Sparks (1980) considered echinoids, fish, or nautiloid cephalopods responsible for failed predation on the Pennsylvanian *Microdoma*. Peel (1984), Clarkson, Harper, and Peel (1994), and Lindström and Peel (1997) considered as the most probable predators the orthoconic nautiloids attacking the Silurian *Eomphalopterus*, *Pterotheca*, and *Poleumita*. Horný (1997), studying shell breakage and repair in Czech Ordovician explanate bellerophonotoideans, speculated on juvenile or small orthoconic cephalopods but admitted also juvenile ophiurids.

In the conditions of the Koněprusy reef, various potential predators may be considered. These may have been most likely small or juvenile phyllocarids. Other groups, present in the reef facies, were ophiuroids, nautiloids, and even diverse fish-like vertebrates. Regarding rather small attacked individuals (10 mm and less), which repeatedly survived predation, the potential predator must have been quite small, unable to crush and vanquish the prey.

→ Plate I. – *Anarconcha pulchra* (BARRANDE in PERNER, 1903). Lower Devonian, Pragian, Praha Formation, Koněprusy Limestone; Zlatý Kůň near Koněprusy.

Fig. 1 – specimen L 06406 with well-developed labral sinus and pseudoselenizone. × 7.

Fig. 2 – specimen L 36837 lacking the labral sinus and pseudoselenizone. Note the fragment of deviated final whorl. × 7.

Figs 3–5 – the same specimen, enlarged injuries on 6th–8th whorls. Note the prosocline, at first thick ribs in new shell repairing the injuries. × 11.

Fig. 6 – specimen L 36836 lacking the labral sinus and pseudoselenizone. × 7.

Fig. 7 – An almost complete specimen L 36849 with a fragment of deviated final whorl and with relatively well-preserved apical whorls. × 7.

Fig. 8 – The same specimen, apical part with protoconch showing transversal ribs combined with fine, spiral threads. × 10.



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***KROLMUSIUM*, A NEW GENUS OF THE SUBFAMILY AGNESIINAE (GASTROPODA) FROM THE LOWER DEVONIAN OF BOHEMIA (CZECH REPUBLIC)**

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Abstract. *Krolmusium chlupaci* gen. et sp. n. is a rare, sinistral gastropod found in the Lower Devonian (Pragian) Koněprusy Limestone. So far, it is the oldest described Devonian representative of the Subfamily Agnesiinae KNIGHT.

■ Gastropoda, Agnesiinae, *Krolmusium chlupaci* gen. et sp. n., Lower Devonian, Bohemia, Czech Republic

INTRODUCTION

Investigation of the Lower Devonian fauna from the Koněprusy Limestone, connected with the extensive quarrying of these resources near Koněprusy and supported by a contract between the National Museum, Prague and the Management of VČS, brought numerous interesting findings – both in field and in the old collections. These finds concern mainly diverse new or rare crinoids and bryozoans; among the gastropods, most interesting are *Praenatica gregaria* BARRANDE in PERNER, 1903 with colour patterns (Horný and Henry 1999), specimens of *Anarconcha pulchra* (BARRANDE in PERNER, 1903) lacking the anal emargination (Horný, published in this volume), and a unique specimen of a new agnesiini genus and species, *Krolmusium chlupaci*.

K. chlupaci is a unique shell, coming from the old museum collections and, according to the attached label, observed, but not published, by J. Perner. So far, it is the oldest Devonian genus of the Subfamily Agnesiinae.

The unique specimen of *Krolmusium chlupaci* is deposited in the collections of the Department of Palaeontology, National Museum – Museum of Natural History, Prague.

SYSTEMATIC PART

Gastropoda CUVIER, 1797

Archaeogastropoda THIELE, 1925

Agnesiinae KNIGHT, 1956

***Krolmusium* gen. n.**

Type species: *Krolmusium chlupaci* sp. n.; Lower Devonian, Czech Republic.

E t y m o l o g y : Named in honour of Václav Krolmus (1787–1861), Czech priest and historian, admirer of romantic rocks, fossils, and caves in the Czech Karst, and collector of old artefacts, myths, and tales.

Diagnosis: Genus of the Subfamily Agnesiinae with a trochiform, sinistrally coiled teleoconch; whorls with an angulation at the whorl periphery, lying just above a wide, flat selenizone with lunulae located at the edge of almost flat base. External shell sculpture consists of rough spiral and collabral elements.

Discussion: Although the initial part of the shell is missing, *Krolmusium* gen. n. is included into the Subfamily Agnesiinae, as established by Knight (1956), and reinterpreted by Frýda (1997, 1999) and Frýda and Blodgett (1998). It differs from all the so far described genera by a flat, wide selenizone located below the whorl angulation, at the edge of almost flat base. This character, however, extends the diagnosis of the subfamily. Somewhat similar taxon is *Antitrochus nodulosus* (SANDBERGER, 1842) from the Middle Devonian (Givetian) in Unterthal near Cologne, as described by Bandel 1993, p. 48. (For the history of *Antitrochus* WHIDBORNE, 1891 and synonymy of its type species see and compare Knight (1941), Knight et al. (1960), Bandel (1993), and Frýda and Blodgett (1998).) Nevertheless, *Antitrochus nodulosus* differs from *Krolmusium* mainly in the shape and position of the selenizone, which is narrow, depressed, located at the lower edge of each whorl, bordered by spiral lines and with an additional line in its centre (Bandel, p. 48). The type species of *Antitrochus*, *A. arietinus* WHIDBORNE, 1891 from the Middle Devonian of Devonshire, as described, figured, and interpreted by Knight (1941, p. 41, 42, and Pl. 53, figs 1a–c), has a rounded base of the final whorl and a different course of the collabral increments. All the mentioned taxa need a thorough, detailed study.

Occurrence: Lower Devonian (Pragian), Praha Formation, Koněprusy Limestone, Barrandian Area, Czech Republic.

Species included: *Krolmusium chlupaci* gen. et sp. n.

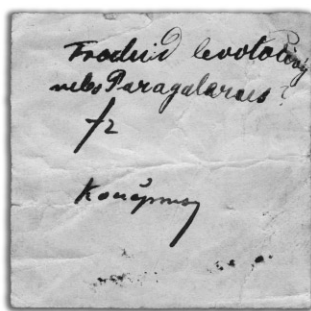


Fig. 1. A label written by J. Perner: A sinistral trochid or *Paragalerus*? f2 Koněprusy.

***Krolmusium chlupaci* gen. et sp. n.**

Pl. I., figs 1–5

Holotype: Specimen NM L 36833, figured here on Pl. I, figs 1–5.

Stratum typicum: Lower Devonian, Pragian, Praha Formation, Koněprusy Limestone.

Locus typicus: Zlatý Kůň Hill near Koněprusy.

Etymology: Named in honour of Ivo Chlupáč for his contribution to the knowledge of the Devonian stratigraphy and fauna.

Material: The holotype.

Diagnosis: See the genus.

Description: The shell is preserved in biolithmic micritic limestone. The initial part of the shell and parts of the aperture are missing, mostly due to the old, rough preparation. Height of the incomplete specimen, consisting of three whorls, is 13.0 mm, width 14.3 mm. The whorls of teleoconch are asymmetrically convex, with maximum convexity in their lower parts near the base. The base is almost flat, anomphalous, with a wide selenizone running along the periphery. Sutures are shallow, the sutural slope in teleoconch is about 15° , pleural angle is about 60° . The specimen has partly exfoliated shell, which is 0.5 mm thick on the final whorl periphery. External sculpture, consisting of labral and spiral elements, is pronounced and coarse. The labral ribs are prosocline, containing an angle of about 50° with the upper suture and about 30° with the lower suture, being crossed with sharp grooves and thus disintegrated into irregular, coarse tubercles or nodes. At the base, the labral ribs contain an angle of about 90° with the lower margin of selenizone and pass onto the flat base to the umbilical area. Again, they are crossed with numerous spiral grooves. The selenizone is slightly depressed, flat, 0.8–0.9 mm wide on the final whorl, with distinct, slightly asymmetrical lunulae and without any median structure. It is not visible on the previous whorls of teleoconch. A distinct columellar lip covers the external sculpture.

Discussion: See the genus.

ADDENDUM

In the old collections of the Department of Palaeontology, National Museum, Prague, a single specimen (NM L 36888) of a considerably large, trochiform, sinistral gastropod has been found in a box containing diverse fossils bearing characteristic small blue labels “Coll. Zeidler”, stuck on their surface. Unfortunately, the shell has neither the label, nor any indication concerning its locality or formation. Because of its highly interesting shape, we observed it together with I. Chlupáč, R. J. Prokop, and V. Turek and came to a conclusion that it a) very probably originates from the Barrandian Area, b) the rock does not resemble any Barrandian Devonian strata, c) it probably comes from the Silurian, the *Scyphocrinites* horizon of the Požáry Formation (Přidolí) as developed at the “Lobolite slope” near Řeporyje. According to R. J. Prokop, the weathered, light grey, and partly dolomitized limestone filling the shell contains numerous fragments of crinoid columnals, brachials, and other ossicles which indicate the camerate genera *Scyphocrinites* or *Carolicrinus*, both of upper Pridolian age.

The shell is trochiform, large (height 41 mm, width 29 mm), sinistral, probably phaneromphalous, very slightly coeloconoid, consisting of 6 whorls. The initial part of the shell and the aperture are missing. The whorls of teleoconch are almost symmetrically convex, with biggest convexity in their lower parts. The base of the last whorl is rounded, with ill-defined, spiral, groove-like structure of unknown origin at the periphery. Sutures are deep, the sutural slope in teleoconch is about 15° , pleural angle is about 60° . The specimen is mostly preserved as an internal mould with patches of weathered shell without sculpture. The shell thickness is 0.5 mm at the 5th whorl periphery. The specimen is figured here on Pl. 1, fig. 6.

Because the fossil lacks data necessary for a serious systematic determination, we bring only this short note and illustration in hope that other exactly localized and better preserved specimens will be found. Several features indicate that this shell may belong or may be related to *Alaskacirrus*, described by Frýda and Blodgett (1998) from the Emsian of Alaska.

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→ **Plate I.** – *Krolmusium chlupaci* gen. et sp. n. Lower Devonian, Pragian, Koněprusy Limestone; Zlatý kůň near Koněprusy. The holotype, L 36833.

Fig. 1 – apical, 2 – lateral, 3 – basal, 4 – oblique basal, and 5 – oblique lateral views. All $\times 5$.

Indeterminate genus and species, possibly related to *Alaskacirrus* sp. Probably uppermost Silurian, Přírodní, Požáry Formation, perhaps Lobolítová stráň near Řeporyje.

Fig. 6. Lateral view, $\times 2$.

