

Rotatrigonostoma reinholdkunzi, gen. nov., spec. nov., an elusive trigonostomid group unveiled (Gastropoda, Cancellariidae)

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LANDAU, B.M., BREITENBERGER, A.E. & HARZHAUSER, M., 2020. *Rotatrigonostoma reinholdkunzi*, gen. nov., spec. nov., an elusive trigonostomid group unveiled (Gastropoda, Cancellariidae). – *Basteria* 84 (4-6): 135-140. Leiden. Published 10 December 2020.

Based on newly collected material, we describe a new species belonging to an unusual group of planispiral trigonostomid species, including also *Pseudomalaxis boettgeri* Cossmann, 1916, and erect the genus *Rotatrigonostoma* gen. nov. for these species.

Key words: Cancellariidae, *Rotatrigonostoma*, new genus, Miocene, Badenian, Austria.

INTRODUCTION

The generic attribution of a very unusual trigonostomid species known from the Miocene of Central Europe has been subject of debate. The juvenile shell from the early Badenian of the Transylvanian Basin described by Boettger (1907: 138) as *Discohelix (Pseudomalaxis) calculiformis* was renamed *Pseudomalaxis boettgeri* Cossmann (1916: 143), as Boettger's name was preoccupied by Dunker (1847) (Harzhauser & Landau, 2012: 55), both of these being architectonid genera. Petit & Harasewych (2005: 31) placed it in the cancellariid genus *Trigonostoma* s.l., a position followed by Harzhauser & Landau (2012). Despite extensive historical collections from the type locality of Kosteĵ, (present name: Coșteiu de Sus), Romania being present in the Nat-

ural History Museum of Vienna (NHMW) and more recent collecting at the Grund locality by the authors, no further specimens have come to light. In their revision of the Paratethyan Cancellariidae, Harzhauser & Landau (2012) lamented not being able to further clarify the generic attribution of the species.

Since then four adult specimens of a similar planispiral trigonostomid species have been found from the Grund locality, Austria (Fig. 1), which we show to be closely affiliated to *Pseudomalaxis boettgeri*, but not conspecific. In this paper we describe this new species, and erect a new genus for this unusual trigonostomid group.

MATERIAL AND METHODS

The material described here is deposited in the Natural History Museum Vienna (NHMW). The specimens were all collected from the Grund Formation at the locality of Grund by Anton and Thomas Breitenberger in an excavation performed in 2017. Despite having performed many excavations in the area of Grund, all four specimens originate from the same dig and, as far as we are aware, no further specimens or fragments of this elusive species are known.

Abbreviations. — NHMW = Natural History Museum Vienna (Vienna, Austria); SMF = Senckenberg Museum (Frankfurt am Main, Germany).

GEOLOGICAL SETTING

The Grund Formation lies in the Austrian part of the North Alpine-Carpathian Foreland Basin north of the Danube

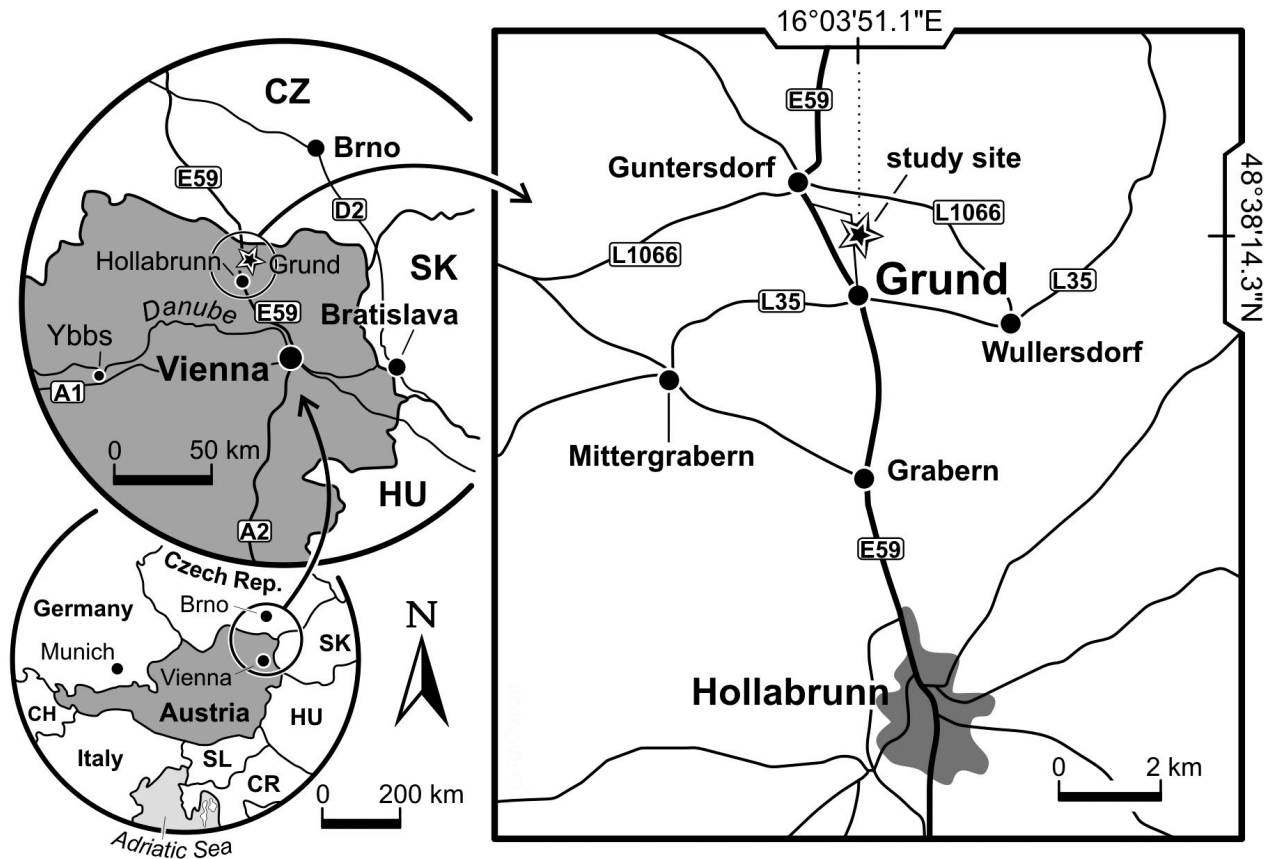


Fig. 1. Geographical map of locality.

(Alpine-Carpathian Foredeep), and the locality from which these specimens derive is 48°38'14.3"N, 16°03'51.1"E (Figure 1). The Grund Formation comprises up to 250 m of pelitic deposits with sand rich, fossiliferous channel fills, which formed in middle to outer neritic environments. Coquina layers in these channels bear rich allochthonous assemblages uniting coastal-mudflat faunas with inner neritic ones. The 'layers' are channels and the fossils derive from channel fills. These channels exploited during excavation cannot be correlated with the published sections. The age of the Grund Formation is early Badenian (= Langhian, Middle Miocene), corresponding to the nannoplankton Zone NN5 (Ćorić et al., 2004; Roetzel, 2009).

SYSTEMATIC PART

Superfamily Cancellarioidea Forbes & Hanley, 1851

Remarks. — Bouchet et al. (2017: 379) synonymised Cancellarioidea Forbes & Hanley, 1851 with Volutoidea Rafinesque, 1815. However, the most recent molecular phylogeny of Fedosov et al. (2019: fig. 2) suggests indeed that Cancellariidae are not nested with the rest of the Volutoidea, hence

Cancellarioidea is a valid superfamily.

Family Cancellariidae Forbes & Hanley, 1851

Subfamily Cancellariinae Forbes & Hanley, 1851

Genus *Rotatrigonostoma* gen. nov.

Type species. — *Rotatrigonostoma reinholdkunzi* spec. nov.

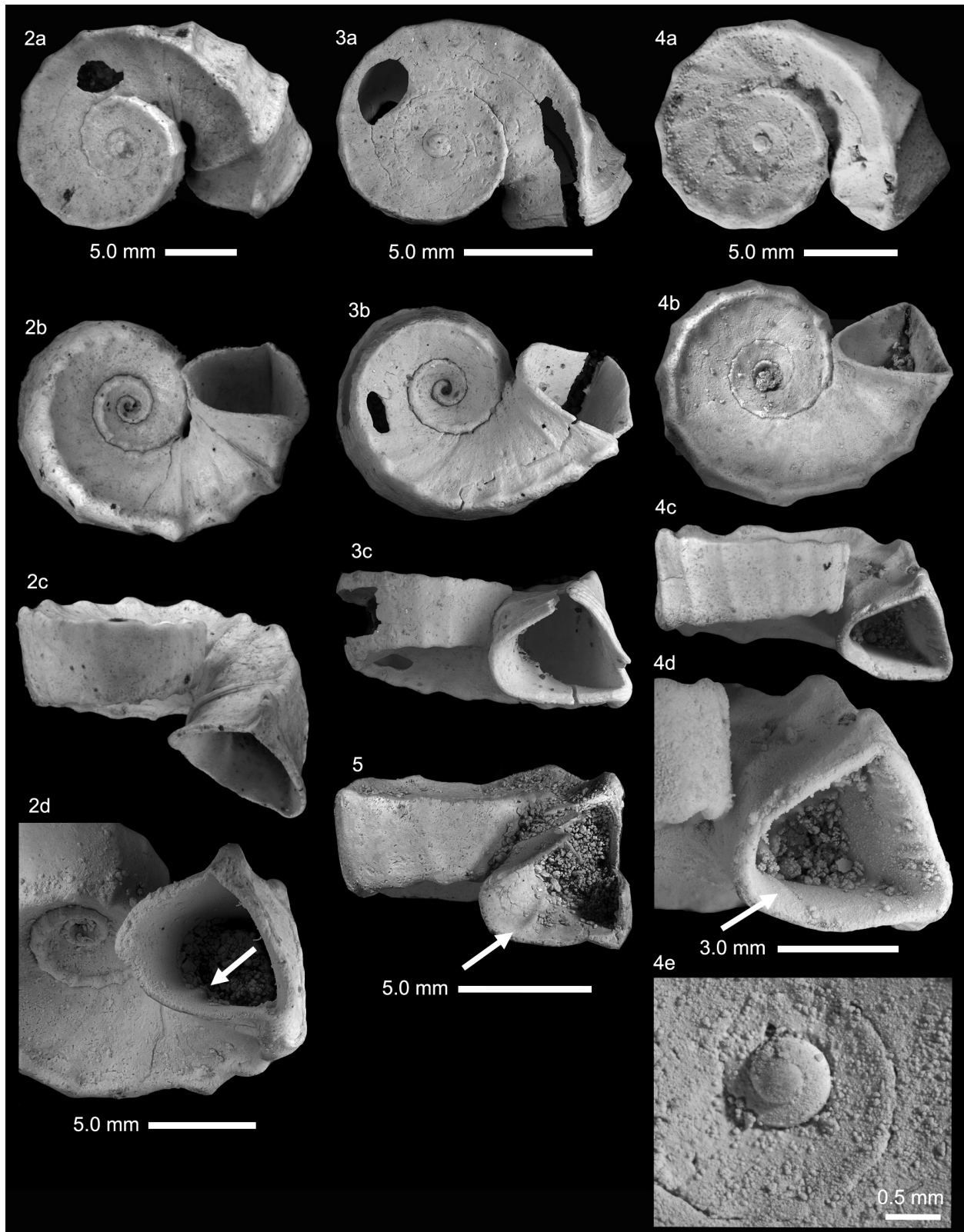
Etymology. — Combination Latin, 'rota, -ae', noun, meaning wheel, describing the planispiral wheel-like shell plan; Greek 'trigonostoma', describing triangular mouth. *Rotatrigonostoma* gender neuter.

Diagnosis. — Shell similar to that of the cancellariid genus *Trigonostoma* (i.e. whorls with triangular cross-section, axial ribs predominant, with tendency for last whorl to become disjunct, triangular aperture with weakly thickened outer lip, and prominent columellar folds), but with a flattened planispiral shell plan, and one or two columellar folds.

Other species included. — *Pseudomalaxis boettgeri* Cossmann, 1916 (middle Miocene, Paratethys).

Remarks. — See below under species remarks.

Distribution. — This genus is known only from the early Badenian of the Transylvanian Basin and the North Alpine Foreland Basin.



Figs 2-5. *Rotatrigonostoma reinholdkunzi* spec. nov. **2.** Holotype NHMW 2020/0045/0001, height 6.6 mm, maximum diameter 13.8 mm, **2d**, detail of aperture, arrow marks columellar fold. **3.** Paratype 1 NHMW 2020/0045/0002, height 6.6 mm, maximum diameter 10.9 mm. **4.** Paratype 2 NHMW 2020/0045/0003, height 11.9 mm, maximum diameter 18.8 mm, **4d**, detail of aperture, arrow marks columellar fold, **4e**, detail of protoconch. **5.** Paratype 3 NHMW 2020/0045/0004, height 7.2 mm, maximum diameter 13.8 mm, arrow marks columellar fold. Grund, Lower Austria, Austria, Grund Formation, early Badenian (= Langhian), Middle Miocene.

***Rotatrigonostoma reinholdkunzi* spec. nov.**

(Figs 2-5)

Type series and dimensions. — Holotype NHMW 2020/0045/0001, height 6.6 mm, maximum diameter 13.8 mm (Figs 2a-d); paratype 1 NHMW 2020/0045/0002, height 6.6 mm, maximum diameter 10.9 mm (Figs 3a-c); paratype 2 NHMW 2020/0045/0003, height 11.9 mm, maximum diameter 18.8 mm (Figs 4a-e); paratype 3 NHMW 2020/0045/0004, height 7.2 mm, maximum diameter 13.8 mm (Fig. 5).

Other material. — Known only from the type series.

Type locality. — Grund, Lower Austria, Austria.

Type stratum. — Grund Formation, early Badenian (= Langhian), Middle Miocene.

Etymology. — Named after the late Reinhold Kunz (Vienna), friend, colleague and mentor for many years who discovered the outcrop.

Description. — Shell small, thin, depressed. Protoconch paucispiral, composed of 1.75 whorls with large nucleus (diameter protoconch 0.83 mm; diameter nucleus 0.39 mm) (boundary with teleoconch not well preserved) (Fig. 4e). Teleoconch of three squarely shouldered whorls, strongly triangular in cross section, separated by weakly impressed crenulated suture. Coiling planispiral. On apical view, only smooth, weakly concave, tabulate subsutural platform exposed on spire whorls, axial sculpture obsolete over subsutural platform, represented only by crenulations at suture. Ventral view consists entirely of broad umbilicus, with narrow portion of most adapical part of spire whorls and axial sculpture exposed; base of each spire whorl delimited by prominent cord strongly crenulated by axials. Spiral sculpture absent. Last whorl sharply angular at shoulder and base, whorl profile straight between flattened, tapering adaxially, bearing 17 low, narrow, slightly prosocline axial ribs, forming rounded, horizontally-flattened tubercles at shoulder, making shoulder coronate. Last quarter whorl disjunct, distinctively bent abapically. Aperture small, triangular. Outer lip sharply angled at shoulder and base, slightly thickened by weak labial varix; short, spout-like siphonal canal, smooth to weakly liriate within. Columella bearing one fold mid-aperture; no columellar or parietal callus developed.

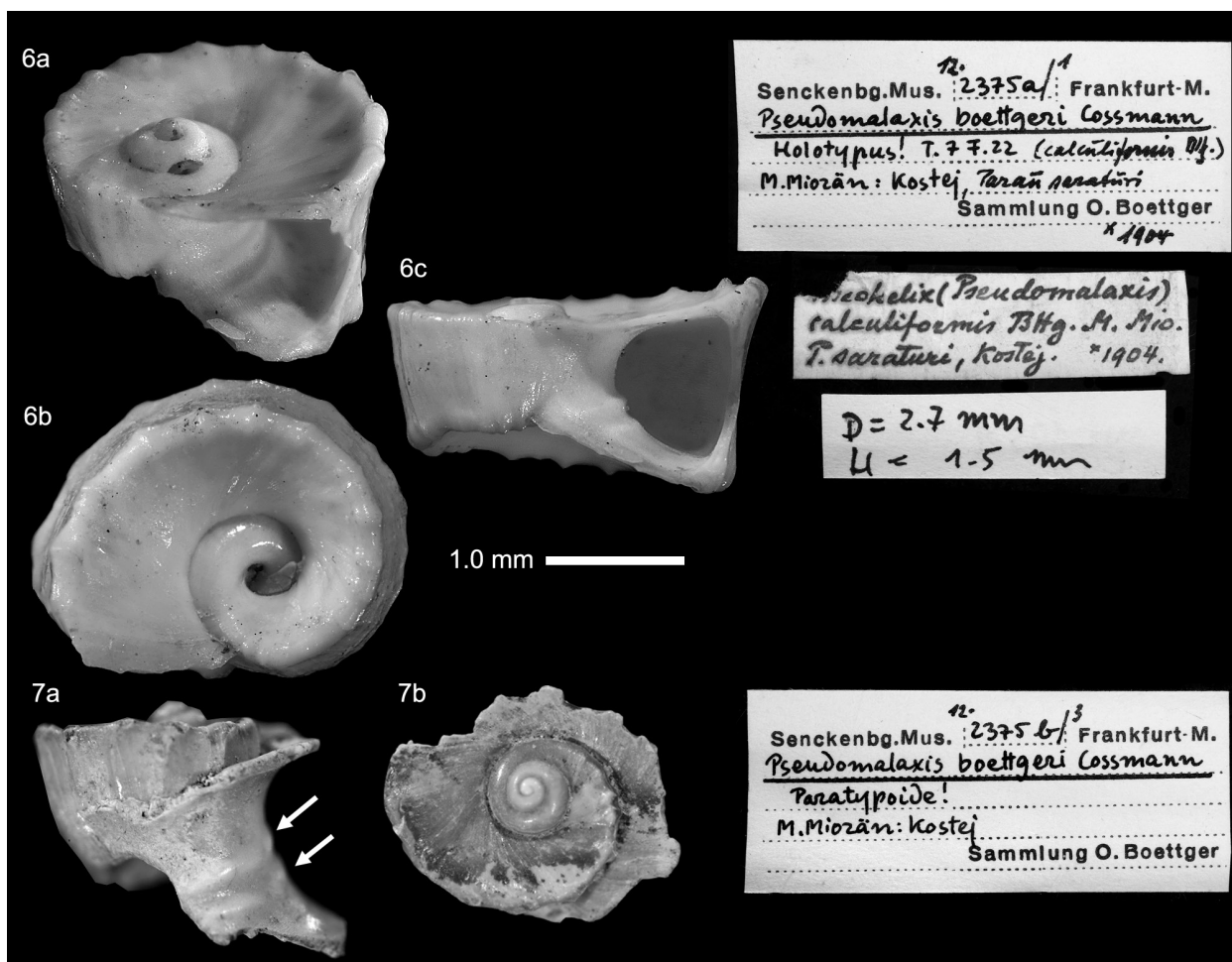
Variation. — The adult shell is planispiral, except for the last quarter whorl, which is disjunct and distinctively bent abapically. The disjunct portion adjacent to the aperture only develops in completely adult specimens (Fig. 2). Otherwise, there are no significant differences between the four specimens. One specimen has the outer lip weakly liriate within (Fig. 4d), whereas in the others the lip is smooth; presence or absence of labial liriations in cancellariids is an intraspecifically variable character. The ‘selenizone-like’ slit on the subsutural platform of the last whorl on one of the specimens (Fig. 3), extending from the lip edge for about

one-fifth of a whorl, is due to breakage. This sort of pattern extending from the lip edge inwards is perhaps the result of crab predation.

Remarks. — The new species from Grund is closely similar to *Pseudomalaxis boettgeri* Cossmann, 1916 from the middle Miocene Badenian of Coşteiu de Sus, Romania (Figs 6-7). Harzhauser & Landau (2012: 55) placed that species in the genus *Trigonostoma* with a question mark. This placement is problematic. Although it is clearly a cancellariid allied to the *Trigonostoma* group [subfamily Trigonostomatinae Cossmann, 1899 no longer accepted; Bouchet et al, 2017: 349], the type species *T. scalare* (Gmelin, 1791) and its present-day Indo-Pacific congeners reviewed by Petit & Harasewych (1987) differ from the Paratethyan species in having a strongly scalate, elevated spire, spiral sculpture, a deep but narrow umbilicus, and two columellar folds plus one siphonal fold on the inner lip. No other fossil or extant *Trigonostoma*, apart from the one described herein, follows the planispiral shell plan seen in Boettger’s species.

Other trigonostomid genera are even more dissimilar; *Ventrilia* Jousseume, 1887 [type species *Cancellaria tenera* Philippi, 1836, present-day, Caribbean] has more ovate shells, the spire whorls scalate, but less disjunct, the spiral sculpture is often tuberculous, and there are 2-3 columellar folds; *Extractrix* Korobkov, 1955 [type species *Pseudomalaxis extractrix* Boettger, 1906, Miocene, Romania] differs in having open coiled disjunct teleoconch whorls. Harasewych & Petit (2013) adopted a more restricted genus concept and excluded from *Extractrix* species in which only part of the teleoconch was disjunct rather than open coiled shells (e.g. ‘*Trigonostoma*’ *hoerlei* Olsson, 1967 and ‘*Trigonostoma*’ *protrigonostoma* Sacco, 1894). Indeed they suggested that *T. hoerlei* might be closer to some species of *Ventrilia* (Harasewych & Petit, 2013: 150). The relationship between *Trigonostoma* and *Ventrilia* is not clear, and unfortunately, the molecular phylogeny of Recent nutmeg shells by Modica et al. (2011) did not include any species of *Ventrilia*. We note that WoRMS synonymises both *Ventrilia* and *Extractrix* with *Trigonostoma* (MolluscBase, 2019). However, it is unlikely that species within these groups are monophyletic, and we prefer to follow Harasewych & Petit (2013). In any case, these planispiral species (*boettgeri* and *reinholdkunzi*) are distinct and impossible to include in any described genus. We therefore erect the genus *Rotatrigonostoma* gen. nov. for them.

Rotatrigonostoma boettgeri (Cossmann, 1916) is based on juvenile and/or incomplete specimens. It was originally described by Boettger (1907: 138) as *Discohelix* (*Pseudomalaxis*) *calculiformis*, but renamed into *Pseudomalaxis boettgeri* by Cossmann (1916: 143) because of homonymy with *Discohelix calculiformis* Dunker, 1847. At first glance we considered the Grund shells to represent adults of this species. However, new photographs of the types kindly sup-



Figs 6-7. *Rotatrigonostoma boettgeri* (Cossmann, 1916) **6.** Lectotype (inadvertently selected by Zilch, 1934: 219, 286, pl. 7 figs 22a-c) SMF 360509 (old number SMF XII 2375a) of *Discohelix (Pseudomalaxis) calculiformis* O. Boettger, 1907, Părău sărături, Coșteiu de Sus, Romania, Badenian (Middle Miocene). **7.** Paralectotype SMF 360510 (old number SMF XII 2375b), arrows mark columellar folds, Coșteiu de Sus, Romania, Badenian (Middle Miocene) (photos courtesy Sigrid Hof, Senckenberg Forschungsinstitut, Frankfurt am Main, Germany).

plied by Sigrid Hof of the Senckenberg Forschungsinstitut show this not to be the case. The Romanian species has a multispiral low dome-shaped protoconch composed of three convex whorls, whereas *Rotatrigonostoma reinholdkunzi* spec. nov. has a paucispiral protoconch, with only the nucleus protruding, all other whorls are flat. The teleoconch of the two species seems to be indistinguishable, apart from the Romanian species having two columellar folds, whereas all the specimens of *R. reinholdkunzi* have a single fold. We cannot exclude the possibility of a second fold present deep within, on the early teleoconch whorls of *R. reinholdkunzi*, but we are unwilling to destroy one of these very scarce specimens to find out, as the protoconch clearly separates the two species.

Thus, *Rotatrigonostoma boettgeri* and *R. reinholdkunzi* seem to be sibling species, one with a multispiral protoconch suggesting planktotrophic development, the other a paucispiral protoconch and a large nucleus inferring

direct development. This phenomenon has been recorded in numerous gastropod groups, including the Cancellariinae (Landau et al., 2012: 919).

Distribution. — This is an extremely rare species known only from the Paratethys—early Badenian of the North Alpine Foreland Basin (Austria: Grund).

ACKNOWLEDGEMENTS

We would like to thank Thomas Breitenberger for making his specimen available to us. Sigrid Hof of the Senckenberg Forschungsinstitut for providing photographs of the type material of *Pseudomalaxis boettgeri*. Our thanks to Frank Wesselingh of the Naturalis Biodiversity Center (Leiden, The Netherlands) and André Verhecken of the Royal Belgian Institute of Natural Sciences (Brussels, Belgium) for acting as referees.

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