

NEW *BYTHINELLA* SPECIES FROM NORTHERN ROMANIA (GASTROPODA: RISSOOIDEA)

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ABSTRACT: Recent samples of freshwater molluscs from Romania contained six new *Bythinella* species: *B. blidariensis* n. sp., *B. georgievi* n. sp., *B. falniowskii* n. sp., *B. feheri* n. sp., *B. sirbui* n. sp., and *B. szarowskiae* n. sp. Since *B. molcsanyi* H. Wagner, 1941 sometimes co-occurred with *B. grossui* Falniowski, Szarowska et Sirbu, 2009 or with *B. feheri* n. sp., differences between these species were studied, to identify diagnostic features. Apart from shell morphology, also the tubular gland proved to be important for identification of *Bythinella* spp.

KEY WORDS: *Bythinella*, new species, Romania, tubular gland, identification

INTRODUCTION

Species of the genus *Bythinella* Moquin-Tandon, 1856 are distributed from Europe to Turkey and North Africa. They inhabit springs and caves in the mountains (BOETERS 1998). The highest species richness is known from France and the Balkan Peninsula (GEORGIEV & STOYCHEVA 2011). Passive dispersal of photophobic species is difficult due to their habitat preferences, thus most of the species are locally endemic (GLÖER & GEORGIEV 2011).

While BIELZ (1863) and KIMAKOWICZ (1883) did not report on *Bythinella* spp. from Romania, GROSSU (1956: 99–102) listed the following *Bythinella* taxa: *B. molcsanyi* H. Wagner, 1941, *B. dacica* Grossu, 1946, *B. austriaca* (v. Frauenfeld, 1859), and *B. austriaca* var. *melanostoma* Brančsik, 1889. BRANČSIK (1889) described four new *Bythinella* spp. from Trenčsín (Slovakia), and GROSSU (1956: 102) believed that one of them (*B. austriaca* var. *melanostoma*) occurs in Romania (Valea Arieșului), more than 600 km away from Trenčsín. However, in his checklist published in 1986 (GROSSU

1986: 245) he deleted *B. austriaca* var. *melanostoma*. GLÖER (2002: 166) cited JAECKEL (1962: 46), who mentioned *B. ehrmanni* Pax, 1938 from Herkulesbad (W Romania), but this species was described from Poland (PAX 1938: 380) and should not be present in Romania. GLÖER & SÎRBU (2006) listed only *B. austriaca* and *B. molcsanyi* from the Inner Carpathian Basin. In summary, I agree with FALNIOWSKI et al. (2009a, b) that only *B. molcsanyi* H. Wagner, 1941 and *B. dacica* Grossu, 1946 were known from Romania prior to recognition of four new species in the Romanian fauna: *B. grossui* Falniowski, Szarowska et Sîrbu 2009, *B. radomanii* Falniowski, Szarowska et Sîrbu 2009, *B. calimanica* Falniowski, Szarowska et Sîrbu 2009, and *B. viseuiana* Falniowski, Szarowska et Sîrbu 2009.

This paper is intended to improve the knowledge of *Bythinella* spp. in Romania and to describe new *Bythinella* spp.

MATERIAL AND METHODS

Dr. ZOLTÁN FEHÉR (Hungarian Natural History Museum, Budapest) collected 19 samples of *Bythinella* spp. in Romania in May 2009 (Fig. 1, Table 1). The

snails were collected by hand and with a sieve from freshwater habitats. The samples were put into 75% ethanol. The dissections and measurements of genital

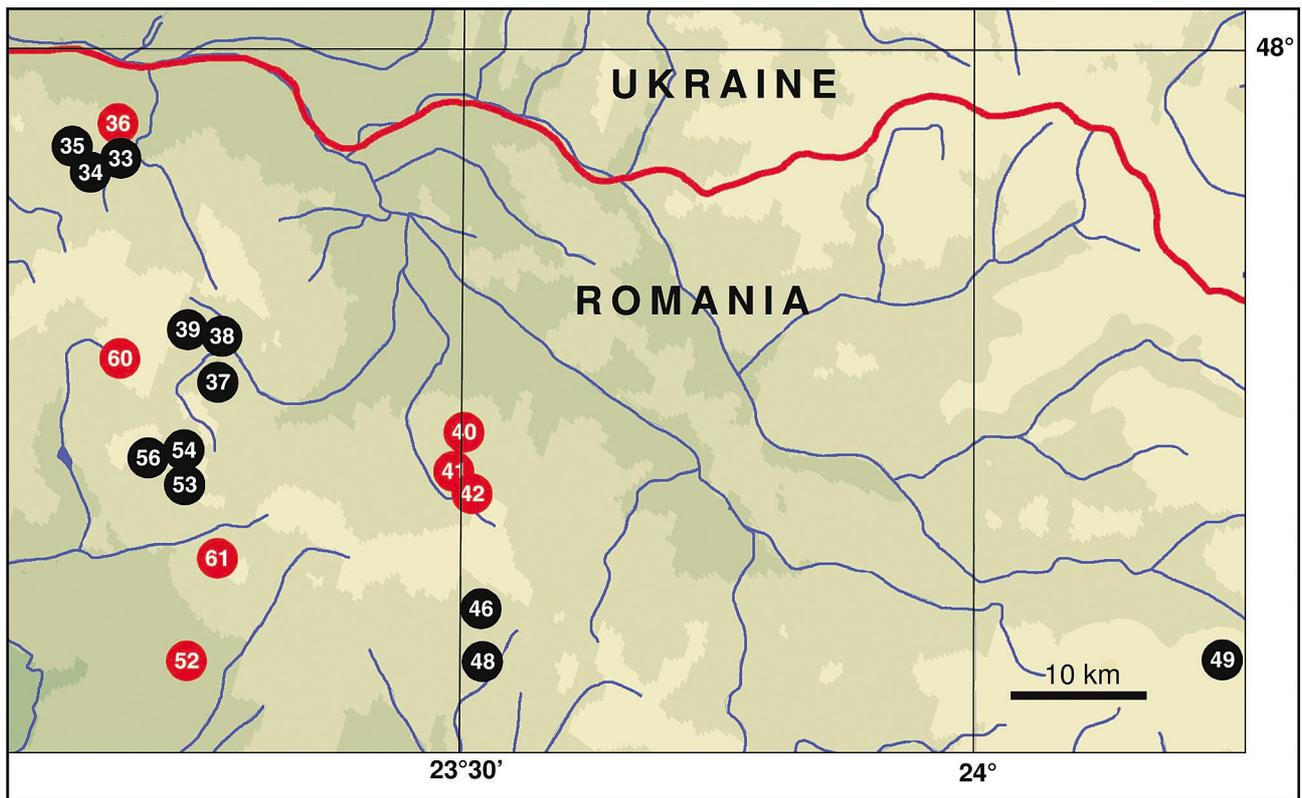


Fig. 1. Sampling sites of *Bythinella* spp. from Romania. The numbers refer to Table 1 (red dots – new species): 33 – *B. grossui*, 34 – *B. grossui*, 35 – *B. grossui*, 36 – *B. georgievi* n. sp., 37 – *B. molcsanyi*, 38 – *B. grossui* + *B. molcsanyi*, 39 – *B. grossui*, 40 – *B. falniowskii* n. sp., 41 – *B. feheri* n. sp., 42 – *B. falniowskii* n. sp., 46 – *B. grossui*, 48 – *B. grossui*, 49 – *B. viseuiana*, 52 – *B. sirbui* n. sp., 53 – *B. molcsanyi* + *B. grossui*, 54 – *B. molcsanyi* + *B. feheri* n. sp., 56 – *B. molcsanyi*, 60 – *B. blidariensis* n. sp., 61 – *B. szarowskae* n. sp.

Table 1. Sampling sites of *Bythinella* spp. in N Romania

Site no.	Taxon (no. of specimens)	Sampling site	Altitude (m)	Geographic coordinates
033 RO	<i>B. grossui</i> (44)	6 km S of Săpânța, mineral water spring	388	47°56'N, 23°41'E
034 RO	<i>B. grossui</i> (68)	Săpânța, 1 km upstream of Sipot waterfall	651	47°55'N, 23°38'E
035 RO	<i>B. grossui</i> (27)	Săpânța, Sipot waterfall	730	47°56'N, 23°37'E
036 RO	<i>B. georgievi</i> n. sp. (37)	Săpânța	398	47°55'N, 23°41'E
037 RO	<i>B. molcsanyi</i> (2)	Mara Tatargorge	680	47°48'N, 23°46'E
038 RO	<i>B. grossui</i> (21) <i>B. molcsanyi</i> (48)	Ignis plateau, Pleca	845	47°49'N, 23°44'E
039 RO	<i>B. grossui</i> (31)	Ignis plateau, Plesca	843	47°50'N, 23°45'E
040 RO	<i>B. falniowskii</i> n. sp. (54)	Barsana Mori valley	463	47°45'N, 24°03'E
041 RO	<i>B. feheri</i> n. sp. (35)	Barsana	614	47°44'N, 24°03'E
042 RO	<i>B. falniowskii</i> n. sp. (23)	Poieni de Miron	867	47°43'N, 24°02'E
046 RO	<i>B. grossui</i> (52)	Botzia	563	47°39'N, 24°08'E
048 RO	<i>B. grossui</i> (99)	Botzia Hudipeak	906	47°36'N, 24°08'E
049 RO	<i>B. viseuiana</i> (36)	Statiunea Borsa	1001	47°36'N, 24°47'E
052 RO	<i>B. sirbui</i> n. sp. (45)	Sighetu Marmăției, Baia Mare	953	47°43'N, 23°45'E
053 RO	<i>B. molcsanyi</i> (85) <i>B. grossui</i> (4)	Sighetu Marmăției, Baia Mare, Izvoare	1028	47°43'N, 23°45'E
054 RO	<i>B. feheri</i> n. sp. (14) <i>B. molcsanyi</i> (11)	7 km of Sighetu Marmăției, Baia Mare	947	47°44'N, 23°45'E
056 RO	<i>B. molcsanyi</i> (21)	Sighetu Marmăției, Baia Mare, Izvoare	916	47°45'N, 23°43'E
060 RO	<i>B. blidariensis</i> n. sp. (54)	Blidari V. Neagra junction	528	47°48'N, 23°37'E
061 RO	<i>B. szarowskae</i> n. sp. (71)	Mogosa	714	47°40'N, 23°46'E

organs and shells were carried out using a stereo microscope (Zeiss); photographs of the shells and the genital anatomy were taken with a digital camera system (Leica R8).

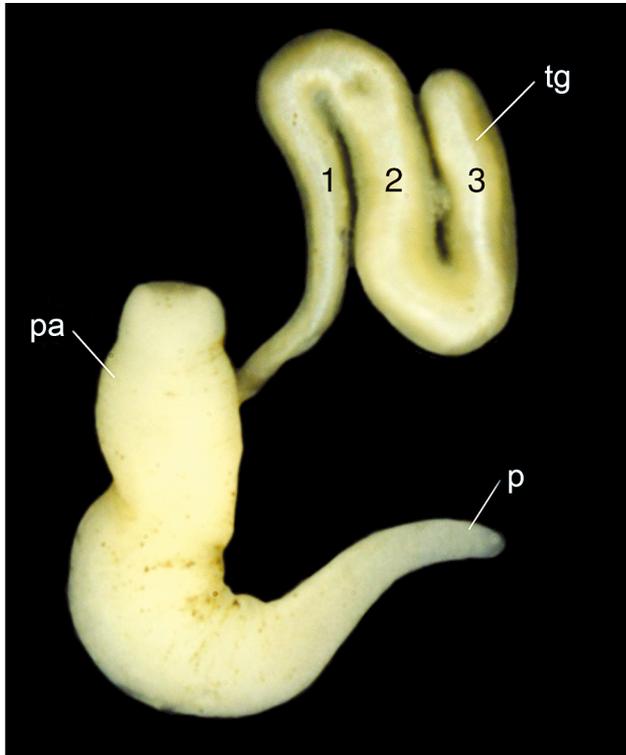


Fig. 2. Male genital organ of *Bythinella*: p – penis, pa – penial appendix, tg – tubular gland with 3 half loops

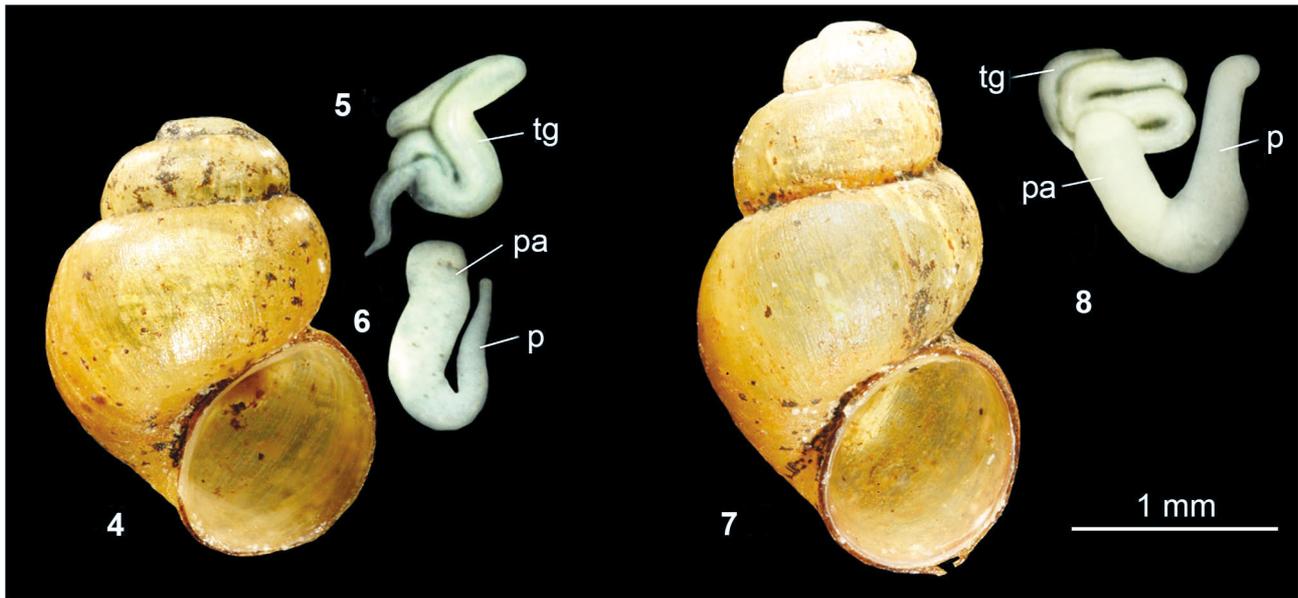
To identify *Bythinella* spp., the following features have been applied: (i) shell morphology: height, ratio of shell height to the width of the last whorl (H:W), aperture height to shell height ratio (A:H), umbilicus type, aperture shape, and (ii) the male copulatory organ (Fig. 2): length ratio of the penis to the penial appendix, number of half loops of the tubular gland, and width of the proximal and distal parts of the tubular gland. The tubular gland is not considered by many authors, but it is an important feature to distinguish *Bythinella* spp. To select constant features of the male copulatory organ, it was studied in at least three specimens from every sample. Shell variability was assessed on the basis of measurements.

The female reproductive system is not considered here because the differences did not provide any useful features to distinguish between the *Bythinella* spp. under discussion.

For species delimitation, I had to work with the morphological species concept (QUEIROZ 2005, SINGH 2012), based on features that are intraspecifically constant but interspecifically different. A good test was that there were three samples in which the *Bythinella* specimens could be separated into two distinct clusters each, identified as *B. molcsanyi* and *B. grossui* (038RO, 053RO: Fig. 3, Table 1), or *B. molcsanyi* and *B. feheri* n. sp. (054RO: Table 1), respectively. Sympatric populations confirm indirectly the biological species concept, which could support the morphological species concept in this case. In addition, morphological distinctness of *B. molcsanyi* and *B. grossui*



Fig. 3. Sampling site of syntopic populations of *Bythinella molcsanyi* and *B. grossui*



Figs 4–8. Syntopic specimens of *Bythinella molcsanyi* (4–6) and *B. grossui* (7–8); p – penis, pa – penial appendix, tg – tubular gland

(Figs 4–8) has already been confirmed by sequencing of the mitochondrial cytochrome oxidase subunit I (*COI*) gene (FALNIOWSKI et al. 2009a).

All materials are stored in the Hungarian Natural History Museum (HNHM) and some paratypes in my own collection.

RESULTS

Identification of *Bythinella* spp. is not easy because these species have only few distinguishing features. Therefore, only the differentiating features have been used for species description. The following diagnostic features were recognized in this study: (i) shell size, (ii) morphometry of the tubular gland, and (iii) proportions of the penis and penial appendix. The main feature is the tubular gland, which can be (i) evenly thick

over the whole length; (ii) thinner or thicker in the proximal part, and (iii) evenly thick or bulbed in the distal part. In addition, the number of half loops of the tubular gland is a good distinguishing feature (Fig. 2).

Apart from the main features, some further features were also analysed (Table 2), as they were also suitable for species delimitation. They were used in the identification key and the multivariate cluster analysis.

Table 2. Distinguishing features of *Bythinella* spp. in N Romania

Species	H	H:W	A:H	Umbilicus	Aperture shape	Penis/penial appendix	Tubular gland prox.	Tubular gland dist.	Tubular gland half loops
<i>B. blidariensis</i> n. sp.	1	1.8	0.37	0	0	2	0	2	5
<i>B. falniowskii</i> n. sp.	2	1.8	0.40	0	2	3	0	1	3
<i>B. feheri</i> n. sp.	1	1.8	0.43	0	2	2	0	1	3
<i>B. georgievi</i> n. sp.	1	1.6	0.43	0	0	3	0	2	4
<i>B. grossui</i>	1	1.8	0.43	0	0	4	0	2	6
<i>B. molcsanyi</i>	0	1.4	0.45	0	1	2	1	2	5
<i>B. sirbui</i> n. sp.	2	1.6	0.41	1	0	1	2	2	5
<i>B. szarowskiae</i> n. sp.	1	1.7	0.36	1	0	2	1	3	3
<i>B. viseuiana</i>	1	1.7	0.45	0	2	2	0	2	7

H – mean shell height: < 2.5 – 0; 2.5–3.0 – 1; >3 – 2; H:W – shell height to width ratio; A:W – aperture height to shell height ratio; umbilicus: closed – 0, slit-like – 1; aperture shape: oval – 0, circular – 1, oval angled – 2; penis to penial appendix ratio: 0.25:1 – 1, 1:1 – 2, 0.75:1 – 3, 1.25:1 – 4; tubular gland proximally: slightly thinner than middle part – 0, much thinner – 1, thread-like – 2; tubular gland distally: thickened – 1, of similar thickness as middle part – 2, club-shaped – 3; tubular gland half loops: number is given.

IDENTIFICATION KEY OF *BYTHINELLA* SPP.
OF NORTHERN ROMANIA

For identification, mainly the features presented in Table 2 are used. For nomenclature of the male

copulatory organ, see Fig. 2. Abbreviations: tgl – tubular gland half loops, H:W – shell height to width ratio, A:H – aperture height to shell height ratio.

- | | | |
|-----|---|--|
| 1. | 6–7 tgl, shell medium-sized (height 2.5–2.9 mm), umbilicus closed | 2 |
| 1'. | < 6 tgl | 3 |
| 2. | 6 tgl, penial appendix shorter than penis, tg nearly evenly thick | <i>B. grossui</i> (Figs 7–8) |
| 2'. | 7 tgl, penial appendix as long as penis, tg nearly evenly thick, slightly thinner proximally | <i>B. viseuiana</i> |
| 3. | shell small but broad (height 1.9–2.4 mm, width 1.4–1.7 mm, H:W = 1.4), umbilicus closed, tg much thinner proximally, 5 tgl | <i>B. molcsanyi</i> (Figs 4–6) |
| 3'. | shell higher than 2.4 mm | 4 |
| 4. | 5 tgl, shell medium-sized (2.6–3.1 mm) | 5 |
| 4'. | <5 tgl, tg thinner proximally | 6 |
| 5. | shell broad (height 2.9–3.1 mm, width 1.7–2.0 mm), H:W = 1.6, A:H = 0.41, umbilicus slit-like, tg thread-like proximally | <i>B. sirbui</i> (p. 65, Figs 24–25) |
| 5'. | shell slim (height 2.8–3.3 mm, width 1.5–1.7 mm), H:W = 1.8, A:H = 0.37, umbilicus closed, tg nearly evenly thick | <i>B. blidariensis</i> (p. 65, Figs 26–27) |
| 6. | 4 tgl, shell large and broad (height 2.8–3.5 mm, width 1.8–2.0 mm), H:W = 1.6, A:H = 0.43, tg as long as penis | <i>B. georgievi</i> (p. 62, Figs 17–18) |
| 6'. | 3 tgl, shell height 2.7–3.5 mm | 7 |
| 7. | shell large (height 3.2–3.5 mm), umbilicus closed, penial appendix longer than penis, tg slightly thinner proximally | <i>B. falniowskii</i> (p. 59, Figs 11–13) |
| 7'. | shell medium-sized (2.7–3.1 mm) | 8 |
| 8. | shell slim (width 1.5–1.7 mm), A:H = 0.36, umbilicus slit-like, tg club-shaped distally | <i>B. szarowskiae</i> (p. 62, Figs 14–16) |
| 8'. | shell broader (1.5–2.0 mm), A:H = 0.43, umbilicus closed, tg not club-shaped distally | <i>B. feheri</i> (p. 62, Figs 19–22) |

SPECIES DESCRIPTIONS

Genus *Bythinella* Moquin-Tandon, 1856

Diagnosis: Shell cylindrical with a blunt apex. Penis bearing a penial appendix with a tubular gland (Fig. 2).

Bythinella falniowskii n. sp.

Holotype: height 3.3 mm, width 1.6 mm, HNHM 97588

Paratypes: 54 specimens from type locality, HNHM 97589, 6 specimens coll. GLÖER; 23 specimens from 042RO Poieni de Miron, 867 m. a.s.l., 47°43'N, 24°02'E, HNHM 97578

Locus typicus: 040RO Barsana Mori valley, 463 m a.s.l., 47°45'N, 24°03'E (Figs 9, 10)

Etymology: Named after ANDRZEJ FALNIOWSKI, an outstanding Polish expert on freshwater molluscs, who did so much for the research on Rissosoidea.

Description: Shell horn-coloured, cylindrical (Figs 11, 12), its 4.5 whorls regularly convex, with a deep suture. Surface silky and finely striated. Apex obtuse, umbilicus closed. Aperture oval, its top angled. Shell height 3.2–3.5 mm, mean 3.35 mm ($\sigma = \pm 0.14$, $n = 6$), width 1.8–2.1 mm, mean 1.9 mm ($\sigma = \pm 0.1$), aperture height to shell height ratio 40 ($\sigma = \pm 0.09$). Penis shorter than penial appendix, tubular gland with 3 half loops, broad in middle part and attenuated proximally (Fig. 13).

Differentiating features: This species differs from the other Romanian species in its shell height and the short tubular gland with 3 half loops, which is similar to those of *B. feheri* and *B. szarowskiae* but in the latter species the distal end of the tubular gland is bulbed.

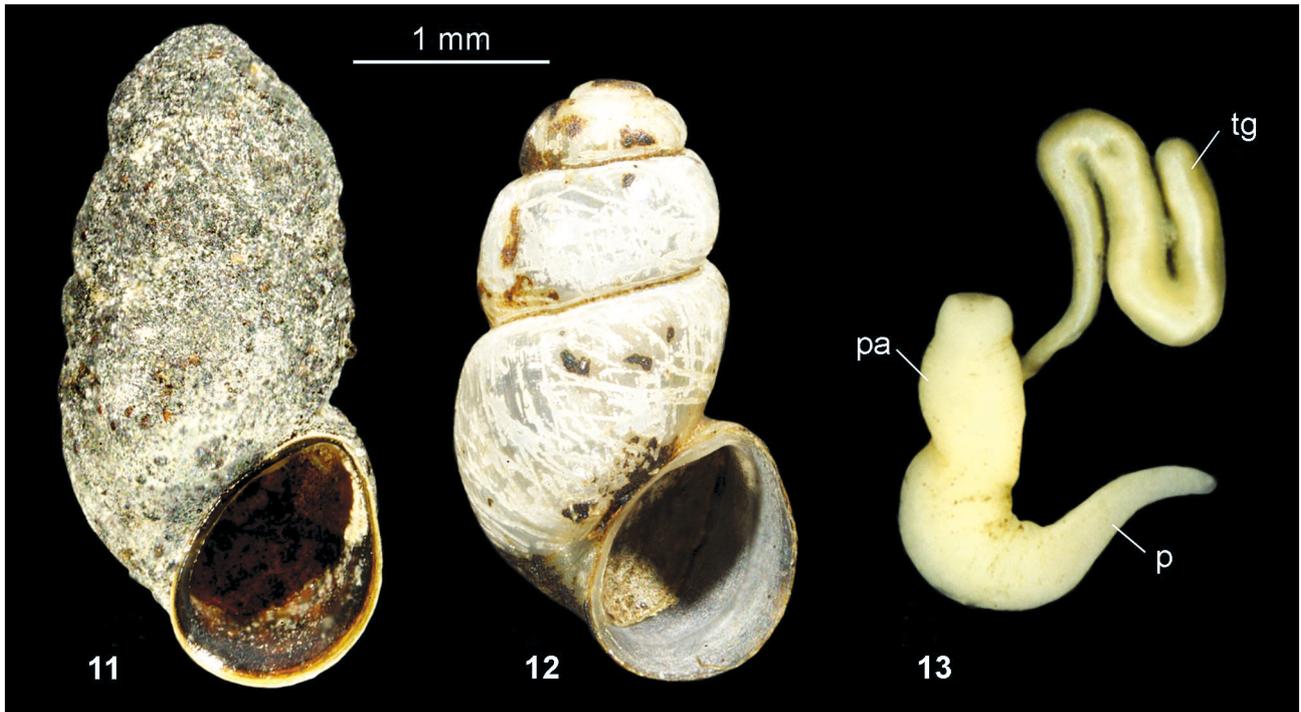


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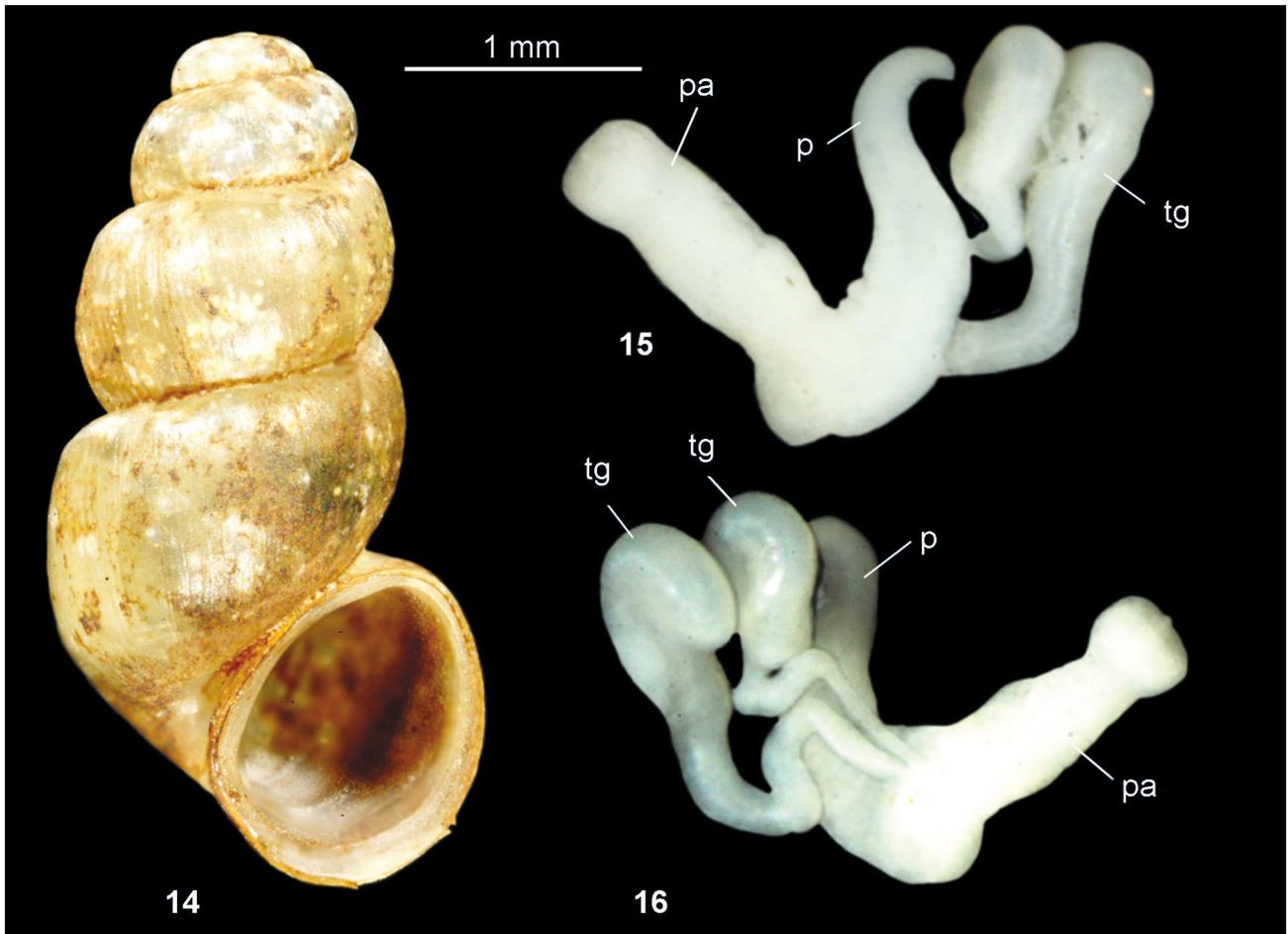


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Figs 9–10. Type locality of *Bythinella falniowskii* n. sp. (Photo: ZOLTÁN FEHÉR)



Figs 11–13. *Bythinella falniowskii* n. sp.: 11–12 – shell (2 – holotype), 13 – penis with tubular gland; p – penis, pa – penial appendix, tg – tubular gland



Figs 14–16. *Bythinella szarowskiae* n. sp.: 14 – shell, 15 – penis with tubular gland, 16 – penis with 2 tubular glands; p – penis, pa – penial appendix, tg – tubular gland

***Bythinella szarowskae* n. sp.**

Holotype: height 3.6 mm, width 1.9 mm, HNHM 97592

Paratypes: 71 specimens, HNHM 97593, 10 specimens coll. GLÖER, from locus typicus

Locus typicus: 061RO Mogosa, 714 m a.s.l., 47°40'N, 23°46'E

Etymology: Named after MAGDALENA SZAROWSKA, an outstanding Polish expert on Risssooidea, who did so much for the research on the Balkans.

Description: Shell horn-coloured, cylindrical and slim (Fig. 14), its 4.5 whorls regularly rounded, with a deep suture. Surface silky and finely striated. Apex broad and obtuse, umbilicus slit-like. Aperture oval. Shell height 2.7–3.1 mm, mean 3.0 mm ($\sigma = \pm 0.17$, $n = 11$), width 1.5–1.7 mm, mean 1.6 mm ($\sigma = \pm 0.17$), aperture height to shell height ratio 0.36 ($\sigma = \pm 0.11$). Penis as long as penial appendix (Fig. 15), tubular gland short, with 3 half loops, thin proximally and bulbed distally. In one specimen, the penial appendix had 2 tubular glands (Fig. 16).

Differentiating features: The ratio of aperture height to shell height is 0.36 and the tubular gland is short and club-shaped at the distal end. The aperture is oval and not angled, as it is in *B. falniowskii* and *B. feheri*.

***Bythinella georgievi* n. sp.**

Holotype: height 3.5 mm, width 2.0 mm, HNHM 97581

Paratypes: 37 specimens, HNHM 97582, 6 specimens coll. GLÖER, from locus typicus

Locus typicus: 036RO Sapanta, 398 m a.s.l., 47°56'N, 23°41'E

Etymology: Named after DILIAN GEORGIEV, an outstanding expert on freshwater molluscs of Bulgaria, who found many new Risssooidea in his country.

Description: Shell horn-coloured, cylindrical (Fig. 17), its 4.5 whorls regularly convex, with a deep suture. Apex obtuse, umbilicus closed. Aperture oval, with a sharp peristome. Shell height 2.8–3.5 mm, mean 3.0 mm ($\sigma = \pm 0.14$, $n = 6$), width 1.8–2.0 mm, mean 1.9 mm ($\sigma = \pm 0.1$), aperture height to shell height ratio 0.43 ($\sigma = \pm 0.12$). Penis as long as penial appendix. Tubular gland long, with 4 half loops, not very broad but attenuated proximally (Fig. 18).

Differentiating features: The aperture of this species is oval and not angled. It has a long tubular gland with 4 half loops, slightly thinner proximally.

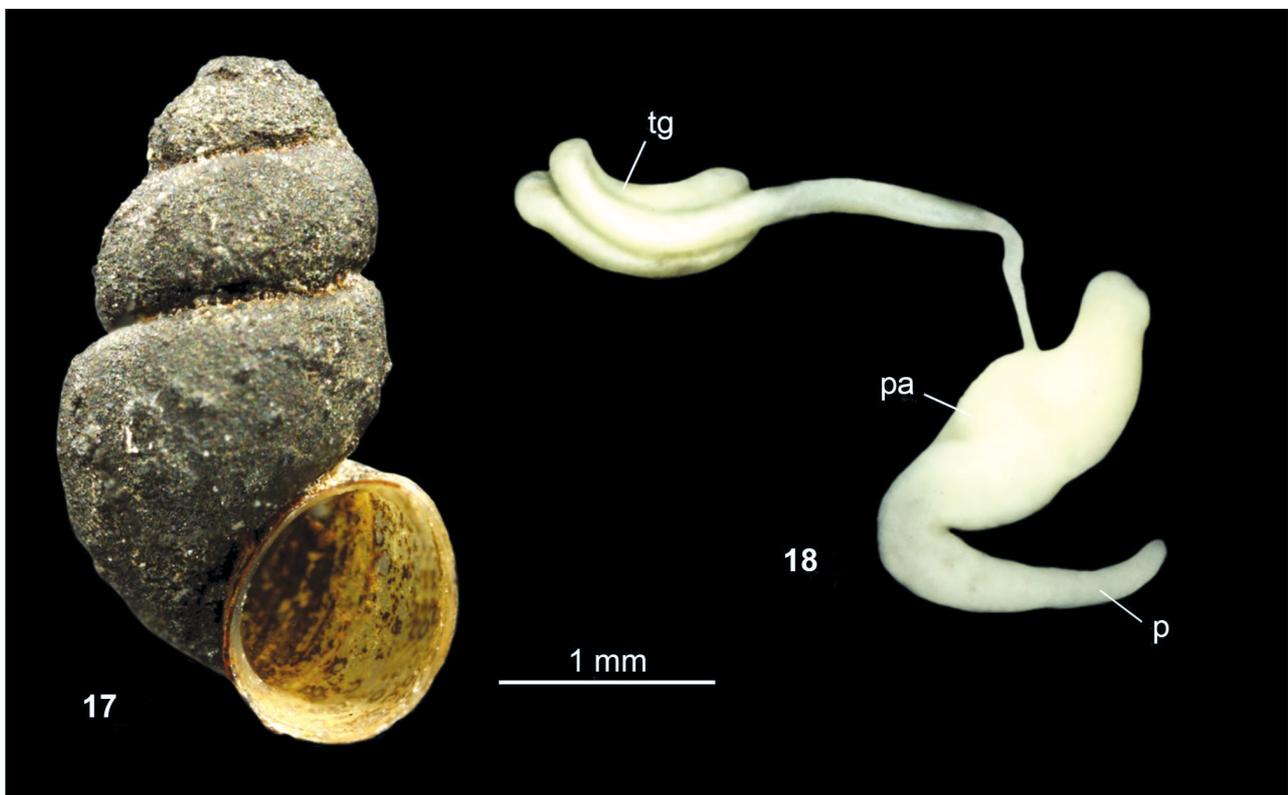
***Bythinella feheri* n. sp.**

Holotype: height 2.2 mm, width 1.5 mm, HNHM 97583

Paratypes: 35 specimens, HNHM 97584, 6 specimens coll. GLÖER

Locus typicus: 041RO Barsana, 614 m a.s.l., 47°44'N, 24°03'E

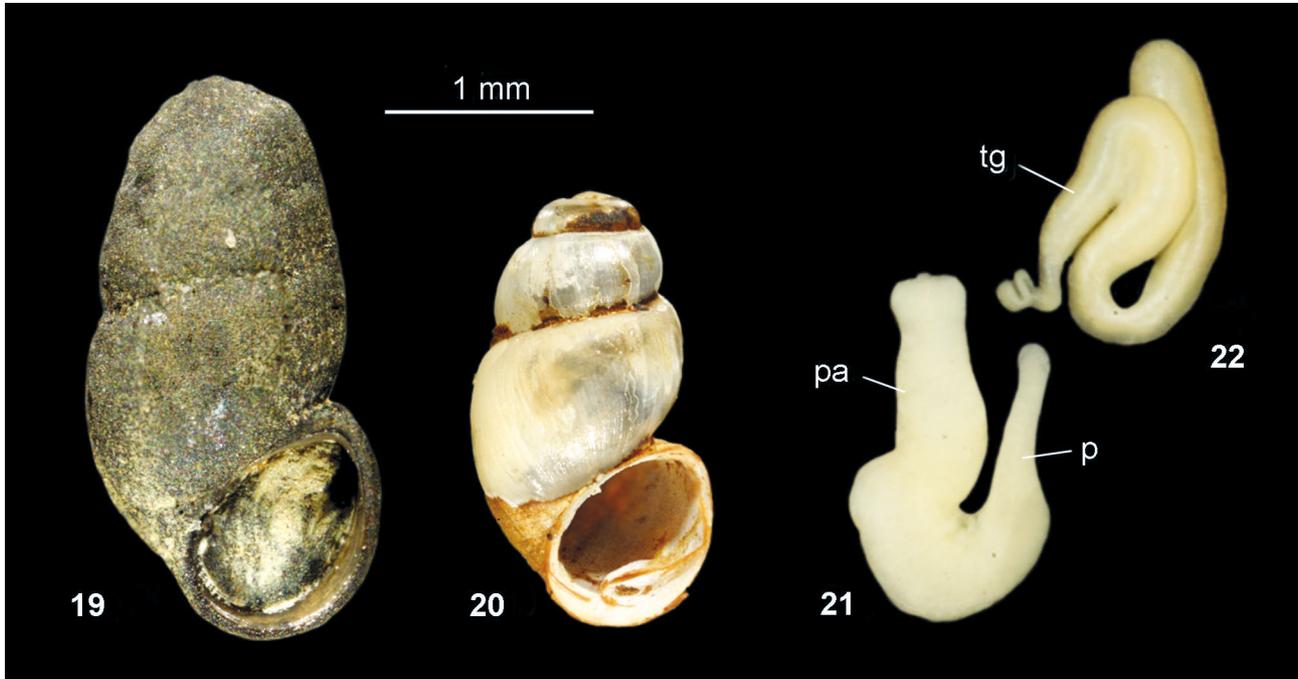
Etymology: Named after ZOLTÁN FEHÉR, an eminent Hungarian malacologist who collected the materials.



Figs 17–18. *Bythinella georgievi* n. sp.: 17 – shell (holotype), 18 – penis with tubular gland; p – penis, pa – penial appendix, tg – tubular gland

Description: Shell horn-coloured, cylindrical (Figs 19, 20), its 4.5 whorls slightly rounded. Surface silky and finely striated. Apex small and obtuse, umbilicus closed. Aperture oval, with a sharp peristome and angled top. Shell height 2.7–3.0 mm, mean 2.9 mm ($\sigma =$

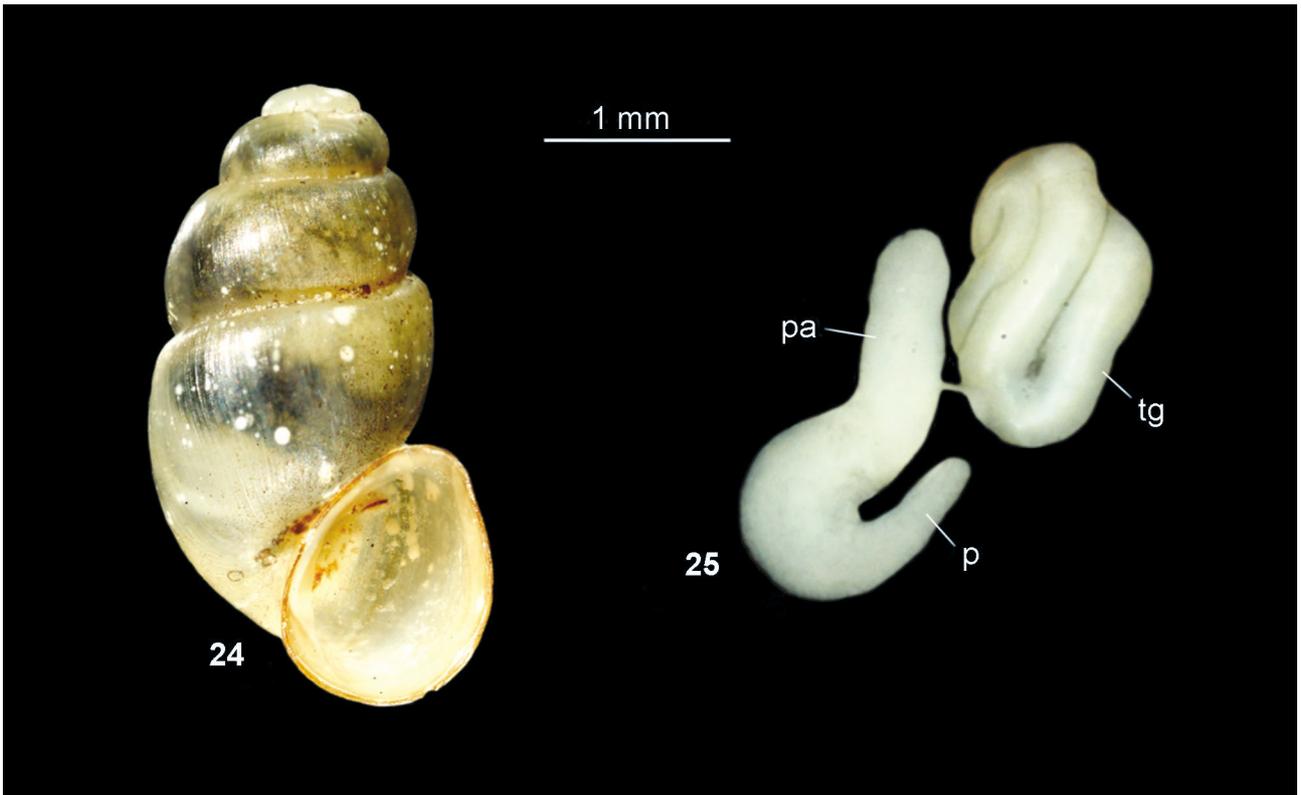
± 0.1 , $n = 6$), width 1.5–2.0 mm, mean 1.6 mm ($\sigma = \pm 0.14$), aperture height to shell height ratio 0.43 ($\sigma = \pm 0.14$). Penis (Fig. 21) as long as penial appendix, tubular gland short (Fig. 22), with 3 half loops, broad distally and thin proximally.



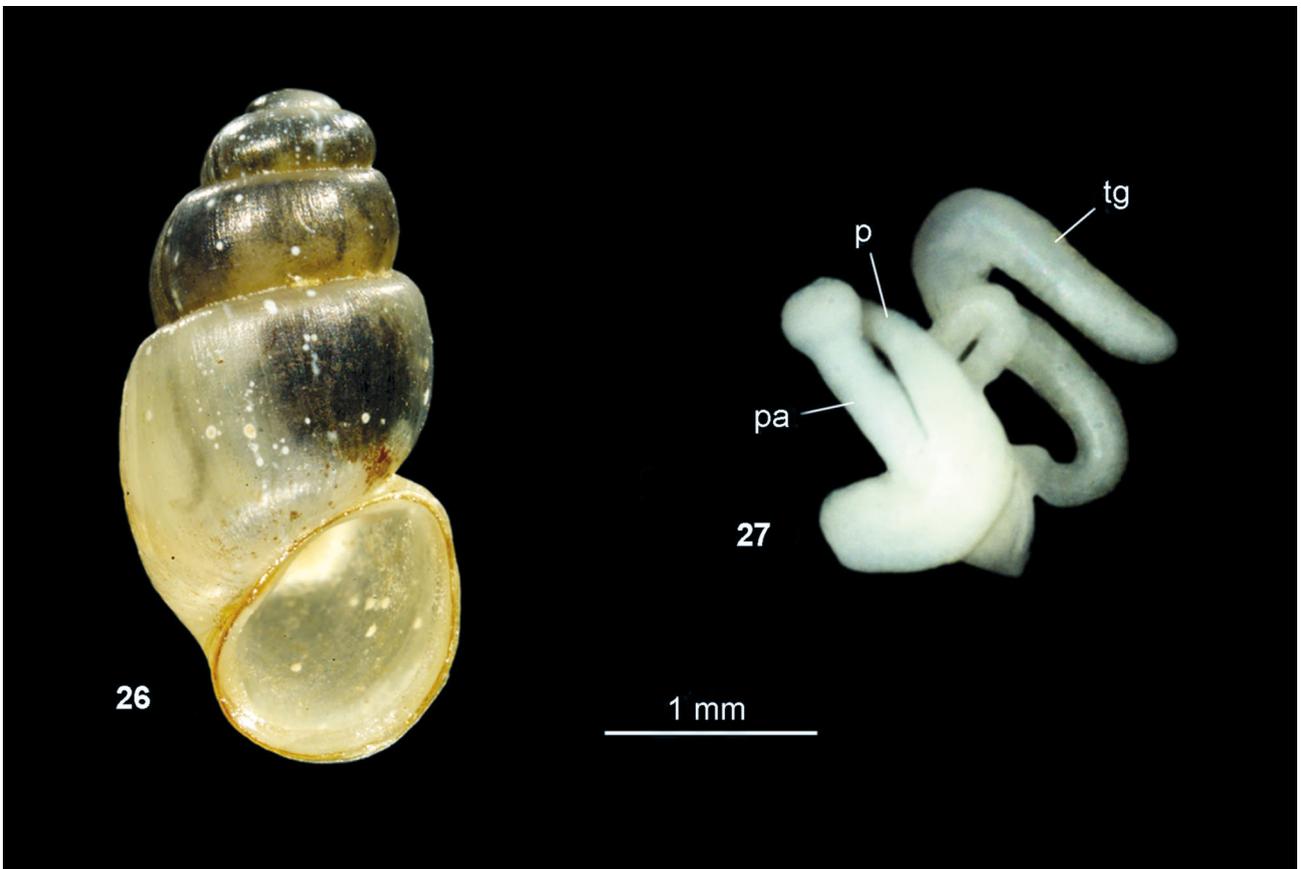
Figs 19–22. *Bythinella feheri* n. sp.: 19–20 – shell (20 – holotype), 21 – penis, 22 – tubular gland; p – penis, pa – penial appendix, tg – tubular gland



Fig. 23. Type locality of *Bythinella sirbui* n. sp.



Figs 24–25. *Bythinella sirbui* n. sp.: 24 – shell (holotype), 25 – penis with tubular gland; p – penis, pa – penial appendix, tg – tubular gland



Figs 26–27. *Bythinella blidariensis* n. sp.: 26 – shell, 27 – penis with tubular gland; p – penis, pa – penial appendix, tg – tubular gland



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