

## On the identity of *Bithynia graeca* Westerlund, 1879 with the description of three new *Pseudobithynia* n. gen. species from Iran and Greece (Gastropoda: Bithyniidae)

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**Abstract.** To analyze the type material of *Bithynia graeca* Westerlund, 1879 we received from the collection Westerlund two lots labelled with *B. leachii* var. *graeca* (from the Museum in Göteborg) and *B. troscheli* var. *graeca* (from the Museum in Stockholm). By means of malacological investigations in the Balkan region we found out that *Bithynia leachii* var. *graeca* does not belong to the genus *Bithynia* because a penial appendix and a flagellum are missing. Furthermore the egg capsules consist of solid capsules, which are laid in double rows onto the shells of members of the same species. These characters justify to introduce this species as a new genus: the *Pseudobithynia* n. gen. Because only *B. troscheli* var. *graeca* corresponds to the original description we give *B. leachii* var. *graeca* the new name *Pseudobithynia westerlundii* n. gen. n. sp. In Iran and Greece we found two species with the same characters as found in *Pseudobithynia westerlundii* n. gen. n. sp., *P. irana* n. gen. n. sp. and *P. falniowskii* n. gen. n. sp. Most details are known of the species living in Iran, *P. irana* n. gen. n. sp., so we designate it as the type species of the new genus.

**Kurzfassung. Zur Identität von *Bithynia graeca* Westerlund, 1879 mit der Beschreibung dreier neuer Arten der Gattung *Pseudobithynia* n. gen. aus dem Iran und Griechenland (Gastropoda: Bithyniidae).** – Um das Typusmaterial von *Bithynia graeca* Westerlund, 1879 zu untersuchen, erhielten wir aus der Sammlung Westerlund zwei Serien etikettiert mit *B. leachii* var. *graeca* (vom Museum Göteborg) und *B. troscheli* var. *graeca* (vom Museum Stockholm). Bei malakologischen Untersuchungen im Balkan stellten wir fest, dass *Bithynia leachii* var. *graeca* (Westerlund, 1879) nicht zur Gattung *Bithynia* gehört, da ein Penis appendix und ein Flagellum fehlen. Außerdem besteht der Laich aus festen Kapseln, die in Doppelreihen auf den Gehäusen der Artgenossen abgelegt werden. Diese Merkmale rechtfertigen die Einführung einer neuen Gattung, *Pseudobithynia* n. gen. Da nur *B. troscheli* var. *graeca* mit der Originalbeschreibung übereinstimmt, geben wir *B. leachii* var. *graeca* den neuen Namen *Pseudobithynia westerlundii* n. gen. n. sp. Im Iran und in Griechenland fanden wir zwei weitere Arten mit den gleichen Merkmalen, die wir bei *Pseudobithynia westerlundii* n. gen. n. sp. gefunden haben, *P. irana* n. gen. n. sp. und *P. falniowskii* n. gen. n. sp. Die meisten Informationen haben wir über die Art aus dem Iran, *P. irana* n. gen. n. sp., so dass wir diese Art zur Typusart des neuen Genus ernennen.

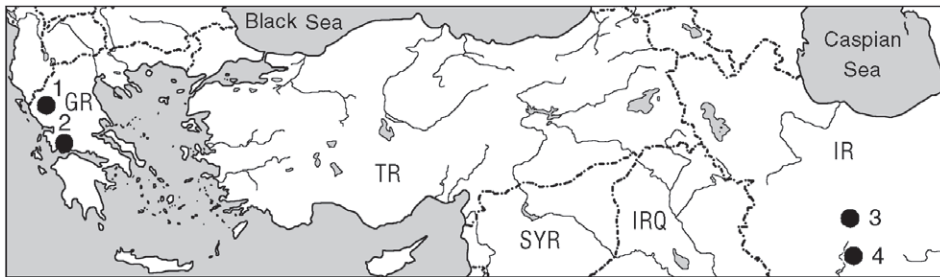
**Key words.** *Pseudobithynia irana* n. gen. n. sp., *Pseudobithynia falniowskii* n. gen. n. sp., *Pseudobithynia westerlundii* n. gen. n. sp., *Bithynia graeca*, Greece, Iran.

### Introduction

It is currently unclear which *Bithynia* species are living in the Balkan region. After BANK (Fauna Europaea: www.faunaeur., 15.12.2005) e. g. in Greece only *Bithynia graeca* (Westerlund, 1879) and *B. candiota* Westerlund, 1886 are known. BANK considers *B. prespensis* Hadžišće, 1963 to be synonymous with *B. graeca* (BANK, ibid.).

As a starting point for an identification of the *Bithynia* species from the Balkan region the identity of *Bithynia graeca* (Westerlund, 1879) and *B. prespensis* Hadžišće 1963 should be determined. Our investigations into that led us as far as the Iran.

Identifying topotypes of *B. prespensis* unambiguously was not a problem because HADŽIŠĆE mentioned in his original description not only the shells but the anatomy, too (HADŽIŠĆE 1963). For the identification of *B. graeca* (Westerlund, 1879) the original description was not sufficient because Westerlund only described the shells without adding any drawings. So on the one hand we had to borrow the type material from Göteborg (collection of Westerlund) and to gather topotypes to study the anatomy of this species on the other hand.



**Fig. 1.** The sampling sites of *Bithynia graeca*, and the new *Pseudobithynia* species. **1:** *Pseudobithynia westerlundii* n. sp. and *Bithynia graeca* Westerlund, 1879, Lake Pamvotis; **2:** *P. falniowskii* n. sp., Trichonis Lake; **3:** *P. irana* n. sp., Markazi Province, Eskan spring; **4:** *P. irana* n. sp., Lorestan Province, Dareh Takht stream in Dareh Takht village.

## Material and methods

The snails were gathered with a sieve from the banks of the waters. The samples were put into ethanol (75%). The dissections and measurements of the genital organs and the shells were carried out using a stereo microscope (Stemi SV 6, Carl Zeiss, Germany), the photographs were taken with a digital camera (Nikon D70), the SEMs with a Leitz TR 1600.

We examined 54 adult specimens of *Pseudobithynia irana* n. gen. n. sp., 33 adult specimens of *Pseudobithynia westerlundii* n. gen. n. sp., 65 adult specimens of *P. falniowskii* n. sp. and 1 specimen of *Bithynia graeca*.

## Results

The material of *Bithynia troschelii* var. *graeca* of Westerlund's collection corresponds to his original description (WESTERLUND & BLANC 1879, pp. 137–139, *Bithynia graeca*) and his later description (WESTERLUND 1886, p. 18, *B. troschelii* var. *graeca*). As we got only one empty shell and could not find this species recently in the Lake Pamvotis near Ioannina (Greece) no dissections could be made. So it is not clear if this species belongs to the genus *Bithynia* or *Pseudobithynia* n. gen.

While dissecting topotypes of "*Bithynia*" *leachii* var. *graeca* we saw that these snails had neither a penial appendix nor a flagellum (fig. 2). But this combination of a penial appendix and a flagellum besides the calcareous operculum are typical characters of the Bithyniidae (THIELE 1931, PONDER 2003). Species with a simple penis (and so missing a flagellum) we find within the Stenothyridae, a family closely related to the Bithyniidae, but the species in this family have a horny operculum (THIELE 1931) with calcareous occlusions (GÖTTING 1974), and the shells have a very different morphology. So we have to widen the definition of the family Bithyniidae by adding the characters of a simple penis and solid egg capsules.

On the search for further species of this family we advanced as far as the Iran. Here we found another species, up to now unknown, which had no penial appendix, not a flagellum either. We found very atypical egg capsules of this species. They are as solid as egg capsules of e. g. *Theodoxus* are, but laid in groups of two rows on the shells of the same species. A precise scrutiny of the shells of the type material of *Bithynia leachii* var. *graeca* from the collection WESTERLUND as well as of recently found specimens (fig. 6.11) revealed prints of these spawn capsules which had the same size (fig. 6.2, magnified detail). In contrast to the species of *Bithynia* s. str. the egg capsules of the species have no exit hole. So we have to introduce a new genus. Considering the similarity of the shells between the *Bithynia* species and our species we propose for the new genus the name *Pseudobithynia* n. gen.

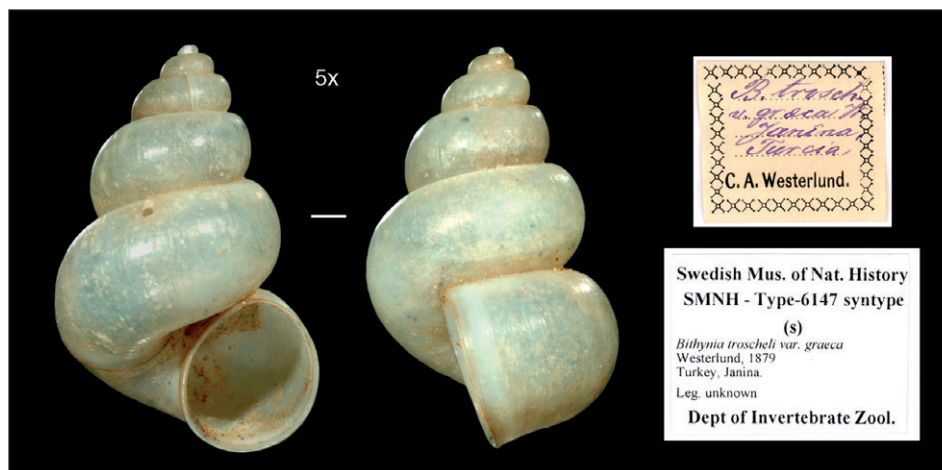


Fig. 2. *Bithynia graeca* Westerlund, 1879 with the labels of the Swedish Museum of Natural History, Stockholm.

**Original description:** [p. 138] “Testa perforata, ovata-turrita, spira elongata, tenuissime densissimeque spiraliter lineata; anfr. 5 ½ cylindranei, convexi, ad suturam profundam vix conspicue truncatuli, ultimus penul- [p. 139] timo paullo major; apertura ovalis, subverticalis; long. 11, diam 6 ¾ mm. Apert. 4. mm. longa, 3. mm. lata. Westerl.”

## Descriptions

### *Pseudobithynia* n. gen.

The shells are elongated conical to ovate, with slowly to rapidly enlarging whorls, the suture is deep to flat. The operculum is calcareous, the penis is simple with no flagellum. The egg capsules (fig. 1c, 6a) are solid, hexagonal and are laid in groups of two rows onto the shells of the same species. Besides these characters the outer lip is simple and oblique or sinuated. The bursa copulatrix lies on the outside of the capsule gland, and the receptaculum seminis is embedded in the middle part of the albumen gland.

The radula is taenioglossate with large central teeth, not different from the genus *Bithynia*.

### *Pseudobithynia irana* n. gen. n. sp.

**Material examined:** 32 adult specimens, Markazi Province, Eskan spring 30 km outside the city of Shahzand, ca. 1780 m altitude, 22.06.2005, leg. Pešić.

**Additional material examined:** 22 adult specimens, Lorestan Province, Dareh Takht stream in Dareh Takht village (13 km to Azna city), ca. 2800 m altitude.

**Holotype:** Shell 6.6 mm high, 4.2 mm wide. Zoologisches Museum Hamburg, ZMH 4878.

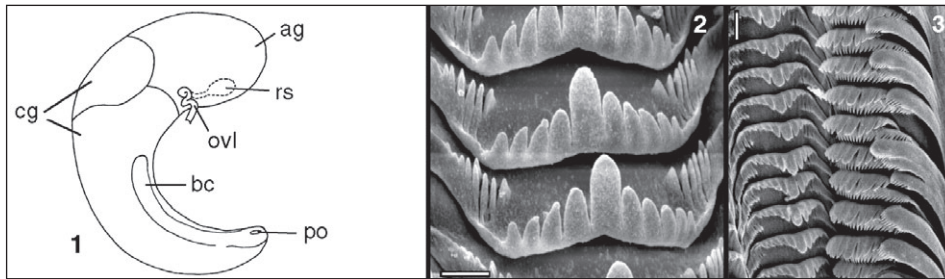
**Locus typicus:** Province Eskan, spring 30 km outside the city of Shahzand, ca. 1780 m altitude.

**Paratypes:** ZMH 4879 (3 empty shells), No. 4880 egg capsule, and collection of the senior author.

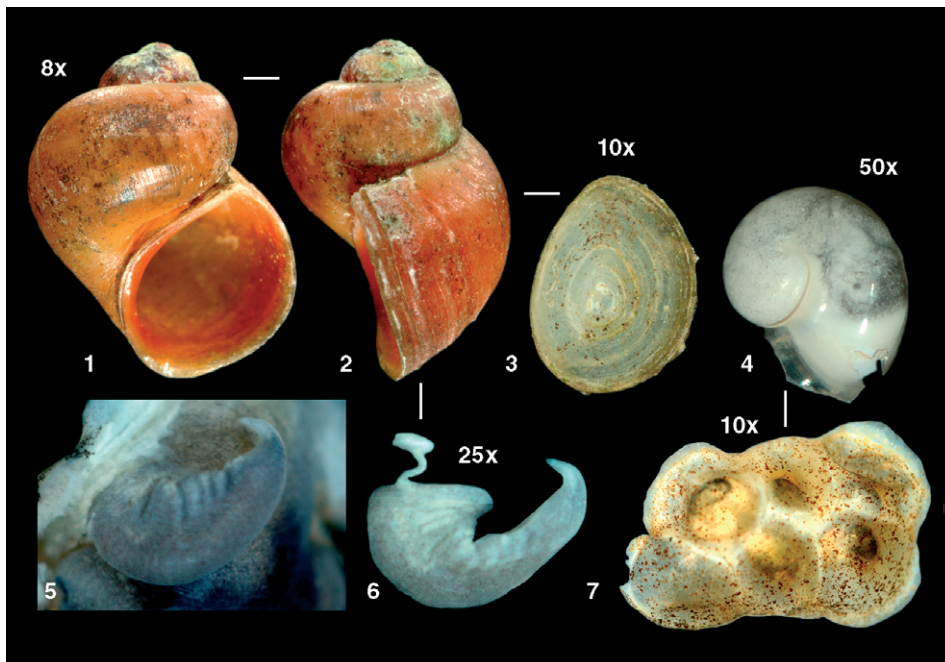
**Habitat:** It is a limnocrenic spring with well developed aquatic vegetation.

The specimens from the 2<sup>nd</sup> sampling site (Fig. 1.4) where gathered in a stream with well developed lentic habitats.

**Etymology:** Named after the country where the species lives.



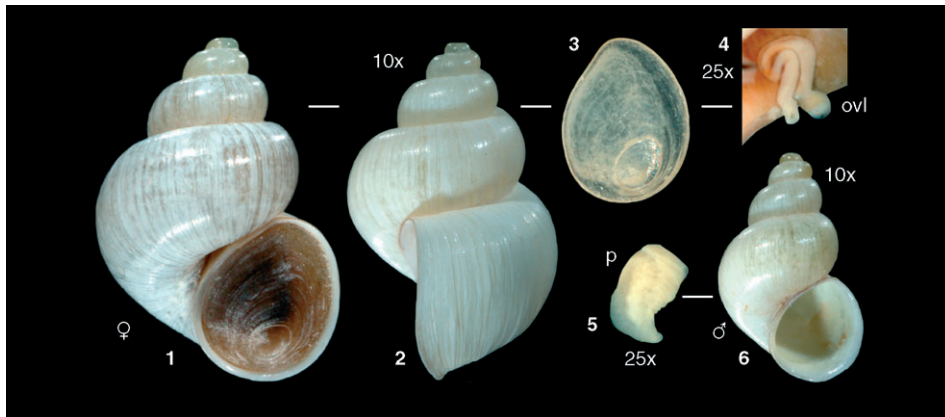
**Fig. 3.** *Pseudobithynia irana* n. gen. n. sp. **1:** female genital tract; **2–3:** Radula, scale bar = 10  $\mu$ m. – ag = albumen gland, bc = bursa copulatrix, cg = capsule gland, ovl = oviduct loop, po = pallial pore, rs = receptaculum seminis.



**Fig. 4.** *Pseudobithynia irana* n. gen. n. sp. **1–2:** shells; **3:** operculum; **4:** embryonic shell; **5:** penis; **6:** penis with vas deferens; **7:** egg capsules.

**Description:** The reddish brown shell consists of 3–4 convex whorls with a deep suture. The last whorl is very prominent and is 7 times higher than the spire. The aperture is oval with a rounded angle at the top without any contact to the body-whorl. The umbilicus is slit-like. The operculum is oval with no angle. The exterior edge of the aperture is oblique. The egg capsules are transparent. There is no sexual dimorphism visible. The shell is up to 6.6 mm high and 5.4 mm wide.

**Anatomy.** The Penis is simple without a flagellum (Fig. 4.6).



**Fig. 5.** *Pseudobithynia falniowskii* n. gen. n. sp. 1–4: female, 5–6: male. ovl = oviduct loop, p = penis.

***Pseudobithynia falniowskii* n. gen. n. sp.**

**Material examined:** 65 adult specimens from Lake Trichonida, Greece.

**Holotype:** Shell 6.0 mm high, 4.3 mm wide. Zoologisches Museum Hamburg, ZMH 37579.

**Paratypes:** ZMH 37580 and collection of the senior author.

**Locus typicus:** Lake Trichonida, close to the southern shore, Greece.

**Habitat:** It lives in the depth of about five metres, at the bottom composed of a gravel and covered with macrophytes, with rich beds of *Dreissena*.

**Etymology.** Named after the outstanding expert on freshwater prosobranch molluscs Andrzej Falniowski (Poland) who found this species.

**Distribution:** Also found in Kalamata, Peloponnes, Greece, by Falniowski (pers. comm.).

**Description:** The whitish conical elongated shell consists of 4.5 convex whorls with a deep suture. The aperture is oval with a rounded angle at the top without any contact to the body-whorl. The umbilicus is slit-like. The operculum is oval with a rounded angle at the top. The exterior edge of the aperture is sinuated (fig. 5.2). The shell of the females is up to 6.0 mm high and 4.3 mm, that of the males is 4.5 mm high and 2.9 mm wide, so a sexual dimorphism is visible.

**Anatomy.** The Penis is simple without a flagellum (Fig. 5.5).

***Pseudobithynia westerlundii* n. gen. n. sp.**

**Material examined:** 29 adult specimens from Lake Pamvotis, Greece, and 4 specimens from Westerlund's collection (Göteborg, Sweden).

**Holotype:** Shell 6.4 mm high, 4.2 mm wide. Natural History Museum Göteborg Gen. kat. no. 2006-21.632.

**Paratypes:** Natural History Museum Göteborg (No. 4338, *Bithynia leachii* var. *graeca*) and collection of the senior author.

**Locus typicus:** Lake Pamvotis, island in the lake, SE edge, Greece.

**Habitat:** Tectonic lake, eutrophic; lives on rocks in the littoral zone, 0.5–0.0 m depth.

**Etymology.** Named after Carl Agardh Westerlund.

**Description:** The yellowish conical elongated shell consists of 5.5 convex whorls with a flat suture. The aperture is oval with an angle at the top. The umbilicus is closed to slit-like.



**Fig. 6.** *Pseudobithynia westerlundii* n. gen. n. sp. 1–6: paratypes; 6: original label (1:1); 7–10: topotype; 10: penis; 11: spawn capsules on topotypes. vd = vas deferens.

The operculum is oval with a rounded angle at the top. The exterior edge of the aperture is sinuated (fig. 6.4). The shell is up to 6.0 mm high and 4.3 mm wide. A sexual dimorphism is not visible.

**Anatomy.** The Penis is simple without a flagellum (Fig. 6.10).

In the collection of Westerlund we found a large form of *Pseudobithynia westerlundii* (fig. 6.1–2) and smaller ones (fig. 6.3–4). Recently only the smaller specimen could be found. The larger one has one whorl more than the others, so may be it is the same phenomenon like we know from *Bithynia tentaculata* f. *producta*: that these specimens live a year longer while still growing (GLÖER 2002).

## Discussion

In order to find out whether our new *Pseudobithynia* sp. is a new species in fact, we had to compare it with all other species mentioned in the literature from Iran, Iraq (ISSEL 1863, ELIAZIN & al. 1979, MANSOORIAN 1994, MONSOORIAN 2000), the neighbouring country Turkey (YILDIRIM 1999), and Greece (WESTERLUND & BLANC 1879), as well as in the monographic papers about Bithyniidae (KÜSTER 1852, FRAUENFELD 1862, 1864, WESTERLUND 1886, KOBELT 1892, LOCARD 1894).

- Bythinia uzielliana* Issel, 1863 [after Issel (1863) a slim form, possibly a *leachii*-type]
- Bithynia rubens* Menke, 1830 [mentioned by ELIAZIAN & al. 1979; after KÜSTER 1852, p. 48, pl. 9, fig. 27-29 a high spired *Bithynia* of *tentaculata*-type; after KOBELT (1892, p. 71) this species is conspecific with *B. boissieri* Küster, 1852 (loc. typ.: region of Rom, Italy). Dissections of *B. boissieri* showed us that this species belongs to the genus *Bithynia*.]
- Bithynia tentaculata* Linnaeus, 1758 [mentioned by MANSOORIAN 1994 and 2000; *tentaculata*-type].
- Bithynia phialensis* (Conrad, 1852) [mentioned by YILDIRIM 1999; shell and anatomy mentioned by SCHÜTT 1983, a slim and high spired *Bithynia*.]
- Bithynia badiella* (Küster, 1852) [mentioned by YILDIRIM 1999; lectotype pictured by NEUBERT 1998, p. 347; shell and anatomy mentioned by SCHÜTT 1983, shell similar to *irana* n. sp., but it is a *Bithynia* with a flagellum.]
- Bithynia candiota* Westerlund, 1886, (*B. badiella* var. *candiota*, p. 22, loc. typ.: Candia). [See *B. badiella*.]
- Bithynia corcyrensis* (Letourneux, 1887), (*Digyreidium corcyrensis*, loc. typ.: Korfu, Greece). [After LOCARD (1894, p. 91, pl. vi. Fig. 8) a small (5 mm) and conical *Bithynia* which does not correspond to any species mentioned by us.]
- Bithynia goryi* Bourguignat, 1856, (p. 185, loc. typ.: Nil, Egypt). [After WESTERLUND & BLANC (1879, p. 137) material of this species is kept in the Natural History Museum of Vienna from Italy and Greece. We believe that this is a misdiagnose.]
- Bithynia hellenica* Kobelt, 1891, (p. 67, (*orsinii* var?); loc. typ.: on the islands of Greece). [After KOBELT (1892, p. 67) = *B. orsinii* sensu WESTERLUND & BLANC (1879, p. 136).]
- Bythinia michaudi* Duval, 1845 [After FRAUENFELD (1862, p. 1150; 1864, p. 625) a synonym of *B. ventricosa* Gray, 1821, while *B. ventricosa* is after KOBELT (1892, p. 65) a synonym of *B. leachii*, Sheppard, 1823.]
- Bythinia michaudi* Locard, 1883 [LOCARD (1894) depicted this species as an outline drawing (pl. V, fig. 23, var. major (shell height: 15 mm) from L'Erve près Chéméré), and mentioned the distribution (p. 84): "L'Erve près Chéméré (Mayenne); environs de Rennes (Ille-et-Vilaine); lac de Cirknitz près Adelsberg (Carniole); lac de Janina en Épire (Grèce). The pictured species looks a little similar to the large *Pseudobithynia westerlundii* (Fig. 2.1), but it is larger, and because species of the genus *Pseudobithynia* do not live in France, this name is not valid. For a *Bithynia* species the name is preoccupied by *B. michaudi* Duval 1845.]
- Bithynia orsinii* Küster, 1852 (p. 42, loc. typ.: "Ascoli im Kirchenstaat", plate 9, fig. 1, 2). [Shell conical with 5.5 whorls, height: 5 mm. This species does not correspond to any species mentioned by us.]
- Bithynia renei* (Letourneux, 1887), (*Digyreidium renei*, loc. typ. "Marais de Cressida près Corfou (Grèce); cited after LOCARD (1894, p. 89, plate VI, fig. 19). [Shell conical with 5.5 whorls, height: 7 mm. This species does not correspond to any species mentioned by us.]
- Bithynia servainiana* (Letourneux, 1887), (*Digyreidium servainiana*, loc. typ. "Marais de Cressida près Corfou, Vrachory au nord de Missolonghi, le Céphise et son affluent près Athènes (Grèce); cited after LOCARD (1894, p. 89, plate VI, fig. 23). [Shell conical with a short spire and 4.5 whorls, height: 4 mm. This species does not correspond to any species mentioned by us.]

Because no *Bithynia* species, mentioned in the literature is identical with any of our new described species, so we can say that they are up to now unknown.

### Acknowledgements

We would like to express our thanks to Dr Ted von Proschwitz (Göteborg Natural History Museum) for lending us the material of *Bithynia leachii* var. *graeaca* from the Collection of Westerlund, Karin Sindemark (Swedish Museum of Natural History, Stockholm) for lending us the type material of *Bithynia troschelii* var. *graeaca*, Prof. Dr Andrzej Falniowski for the material of *Pseudobithynia falniowskii*, Prof. Dr Thomas Wilke and Dr Christian Albrecht (Giessen) for the topotypes of *Pseudobithynia westerlundii* and *Bithynia prespensis*, and Dr Marco Bodon for the material of *Bithynia boissieri*, as well as Dr David Walker (Hamburg) for polishing our English.

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Received on January 20, 2006, accepted on February 16, 2006.