

Nagyelma n. gen. for *Ennea aliena* Bavay and Dautzenberg, 1912 (Gastropoda: Eupulmonata: Streptaxidae)

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Nagyelma n. gen. is erected for the northern Vietnamese *Ennea aliena* Bavay and Dautzenberg, 1912. The most closely related genus is probably *Elma* H. Adams, 1866, which also has a high-spired shell but differs from the new genus in the absence of a parietal tooth, the pointed-ovoid shell shape, and the penial sheath, which covers only half of the penis.

Keywords: Taxonomy, systematics, Vietnam, anatomy, conchology, shell.

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The Streptaxidae are pantropical carnivorous terrestrial snails (“hunter snails”), represented in mainland Southeast Asia with ten genera Siriboon et al. (in press). Among them, only *Elma* H. Adams, 1866 (Fig. 1A–C) possesses a high-spired shell. All other genera are characterized by flattened or globular shells (Páll-Gergely et al., 2015). Members of the speciose genus *Sinoennea* Kobelt, 1904 are also high-spired see Páll-Gergely et al. (2020), and had been classified in the Streptaxidae until the family Diapheridae Panha and Naggs, 2010 was introduced based on anatomical and molecular information (Sutcharit et al., 2010).

Ennea aliena Bavay and Dautzenberg, 1912 (Fig. 1D–G) is an enigmatic species from northern Vietnam. Despite having a high-spired shell, it differs from all *Elma* species by the presence of a parietal tooth, and the cylindrical shell (i.e. domed, rather than pointed apex). In contrast, *Elma* species lack a parietal tooth and have pointed-ovoid shells. *Ennea aliena* has been classified in the genus *Indoennea* Kobelt, 1904 by Schileyko (2011). However, *Indoennea* is a junior synonym of *Sinoennea*, a genus with three to six (in most cases four), characteristically arranged apertural barriers (Peile, 1935; Páll-Gergely et al., 2020). Thus, based on the apertural barriers, *E. aliena* is clearly not a member of *Sinoennea*. Based on the somewhat similar shell, we hypothesized that *E. aliena* is probably the closest relative of *Elma*, and probably deserves its own genus. However, in

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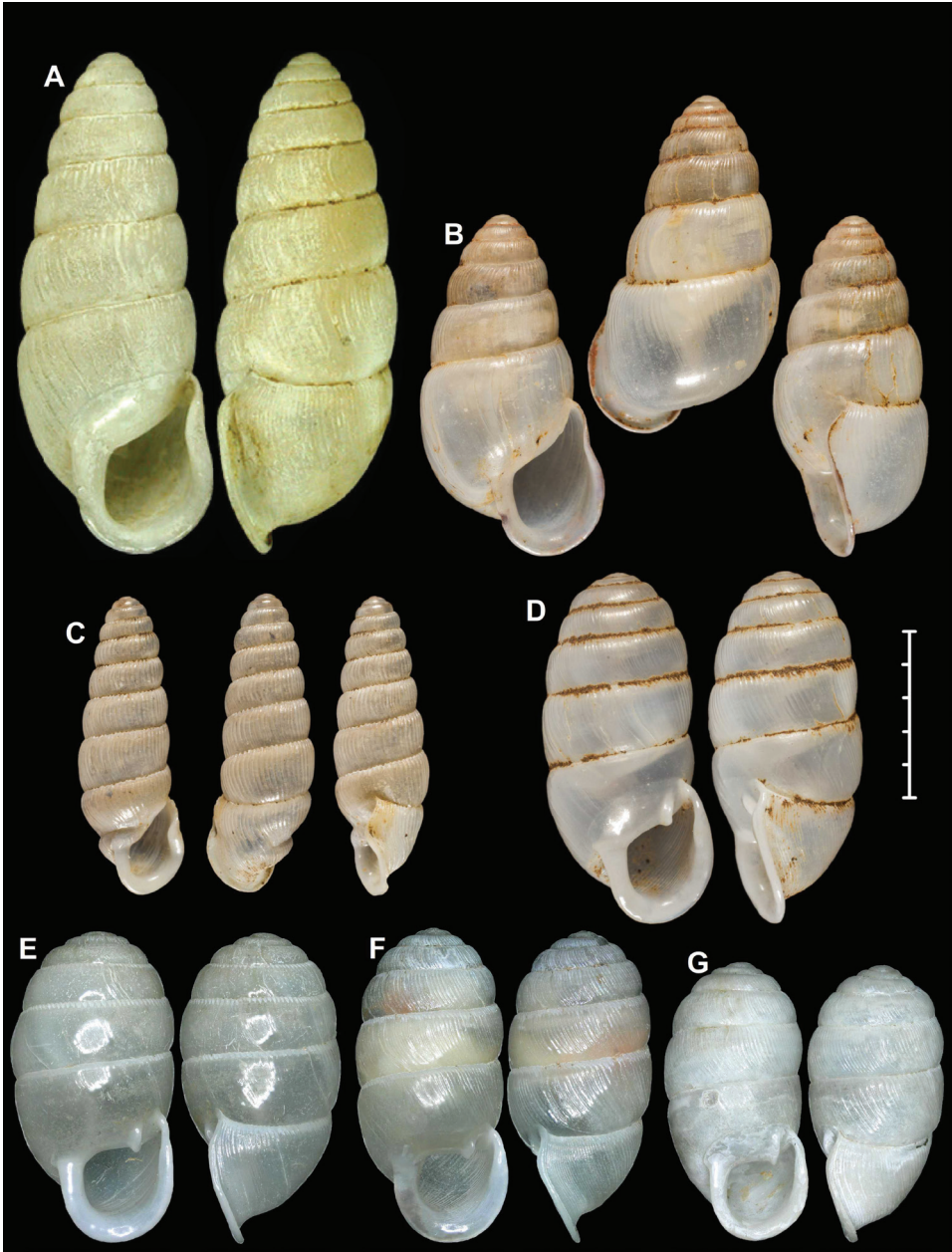


Fig. 1. Shells of *Elma* H. Adams, 1866 (A–C) species and *Nagyelma aliena* (Bavay and Dautzenberg, 1912) (D–G). A: *Elma swinhoei* (H. Adams, 1866), lectotype (NHMUK 1866.5.9.14/1) (from Hwang 2014); B: *Elma tonkiniana* (Bavay and Dautzenberg, 1904), (syntype, MNHN-IM-2000-30988); C: *Elma fultoni* (Bavay and Dautzenberg, 1912), syntype (MNHN-IM-2000-30938); D: *Nagyelma aliena* (Bavay and Dautzenberg, 1912), syntype (MNHN-IM-2000-30879); E: *N. aliena*, Vn12-225; F: *N. aliena*, 2020/38; G: *N. aliena*, Vn12-268. Scale represents 5 mm. Photos: M. Caballer (B–D), B. Páll-Gergely (E–G)

the absence of anatomical information, we refrained from erecting a genus for *E. aliena* (Páll-Gergely et al., 2015). In the present paper we first describe the anatomy of *Ennea aliena* based on newly-collected material, and erect a new genus for that species based on the anatomical and conchological differences from *Elma*.

Materials and Methods

Ten to 30 photographs were taken of each shell using Keyence LHX5000 digital microscope and merged to create a single image using Photoshop. The ethanol-preserved specimen was dissected under a Zeiss stereomicroscope, and photographs were taken using a Keyence LHX5000 digital microscope. Abbreviations: HA: Collection András Hunyadi, (Budapest, Hungary); HE: Collection Christa Hemmen (Wiesbaden, Germany); HNHM: Hungarian Natural History Museum (Budapest, Hungary); MNHN: Muséum National d'Histoire Naturelle (Paris, France).

Taxonomy and Systematics

Family Streptaxidae Gray, 1860

Streptaxidae Gray, 1860: 268.

Subfamily Streptaxinae Gray, 1860

Remarks: In an earlier publication, we discussed the systematic position of *Elma* (Páll-Gergely et al., 2015), which has similar anatomical traits to that of *Nagyelma* n. gen. Based on the morphology of the reproductive anatomy, *Elma* can be classified either in the subfamily Streptaxinae or in Gibbinae sensu Schileyko (2000). The former group ranges through tropical Asia, Africa and South America. In contrast, the Gibbinae (at least the group probably containing *Gibbus* Montfort, 1810, see Rowson et al., 2010 and Páll-Gergely et al., 2015) are mostly distributed in the Seychelles and the Mascarene islands, while the extinct type genus *Gibbus* is known from Mauritius. An *Indoartemon* Forcart, 1946 species from Sri Lanka clustered together with the South American *Streptartemon* Kobelt, 1905, and *Streptaxis* Gray, 1837 in the phylogenetic tree of Rowson et al. (2010). *Indoartemon* ranges to SE Asia, and several genera of similar conchological and anatomical traits inhabit that area. Thus, it is highly probable that at least some of the Southeast Asian streptaxid genera are members of Streptaxinae. Accordingly, it is more likely that *Elma* and *Nagyelma* n. gen. belong to the Streptaxinae than to the Gibbinae.

Nagyelma Páll-Gergely, n. gen.

Type species: *Ennea aliena* Bavay and Dautzenberg, 1912.

Diagnosis: Shell cylindrical, apex domed, surface glossy with fine ribs or simply a mamillated suture; aperture subcircular with pointed sinulus, peristome almost discontinuous, parietal callus only with thin calcareous layer; parietal lamella short and relatively

low; upper margin of aperture curved backwards. Penis slender, long, its entire length covered by a penial sheath, internally with brown papillae bearing brown hooks; vas deferens enters penis after forming a loop under the penial sheath; penial retractor muscle inserts at the penis-vas deferens junction; vagina relatively long, internally with elevated folds converging towards atrium, and tiny horizontally arranged tiny pockets.

Differential diagnosis: *Nagyelma* n. gen. is probably most closely related to *Elma* (Fig. 1A–C; see Varga, 2012 and Páll-Gergely et al., 2015), which is similar in shell size and sculpture. However, shells of *Elma* species are all pointed-ovoid, whereas *Nagyelma* n. gen. is clearly ovoid with a blunt (domed) apical part. Furthermore, *Elma* species lack the short parietal lamella present in *Nagyelma* n. gen. Regarding the reproductive anatomy, the bursa copulatrix starts in a more proximal position in *Elma*, making the vagina shorter than in *Nagyelma* n. gen. The penial sheath covers only the distal half of the penis in *Elma*, whereas the entire penis is covered in *Nagyelma* n. gen.

Sinoennea is characterized by numerous (mostly four), apertural barriers (1 parietal, 2 palatal, 1 columellar), and they are built during the juvenile stages as well. In contrast, *Nagyelma* n. gen. has only a weak, short parietal lamella, and no apertural dentition is built during the juvenile stage.

Etymology: This new genus is dedicated to Barnabás Nagy (1921–2020), a prominent agrozoologist and orthopterologist, who worked in our institute for 63 years. The generic name *Nagyelma* is a combination of the family name Nagy (pronunciation: 'nɒj) and *Elma*, referring to the probably most closely related genus. Grammatical gender: feminine.

Remarks: The African *Ennea*, in which *N. aliena* has been classified, is certainly not closely related to *N. aliena* due to morphological dissimilarities and biogeographical reasons. The most closely related genus is the also Southeast Asian *Elma*. *Nagyelma* n. gen. is erected here in order to avoid *Elma* becoming a wastebasket taxon (Páll-Gergely, 2017). The reproductive anatomy of *Elma* indicates that it does not belong to the Diapheridae, but to the Streptaxidae, although its classification in one of the subfamilies defined by Schileyko (2000) is questionable (Páll-Gergely et al., 2015).

***Nagyelma aliena* (Bavay and Dautzenberg, 1912)**

(Fig. 1D–G, Figs 2, 3, 4)

Ennea aliena Bavay and Dautzenberg, 1912: 3, plate 1, figs 4, 5

Indoennea (?) *aliena*, — Schileyko, 2011: 26.

“*Ennea*” *aliena*, — Páll-Gergely et al., 2015: 162, fig. 11.

Type locality: “Ny-Nham et Nui-Moc (Than-Hoa), Tonkin.”

Types examined: syntype, MNHN-IM-2000-30879.

Additional material examined: Vietnam, Thanh Hóa Prov., road no. 15 Ngoc Lac to Lang Chanh, 4.8 km to Land Chanh, 20°07.734'N, 105°16.315'E (code of coll. site: Vn12-225), leg. Hemmen, 19 October 2011, HE/4+1 live collected shell; Same locality (code of coll. site: Vn12-225A), leg. Ch. and J. Hemmen, 14 April 2012, HE/4; Vietnam, Thanh Hóa Prov., km 585 on road no. 15, Yen Cat to Ngoc Lac, 1 km right off road no. 15, 19°45.589'N, 105°25.521'E (code of coll. site: Vn12-268), leg. Hemmen, 14.04.2012, HE/3; Vietnam, Thanh Hóa Prov., road no. 15 Ngoc Lac to Lang Chanh, 7.3 km to Land Chanh, 20°07.315'N, 105°17.997'E (code of coll. site: Vn12-269), leg.

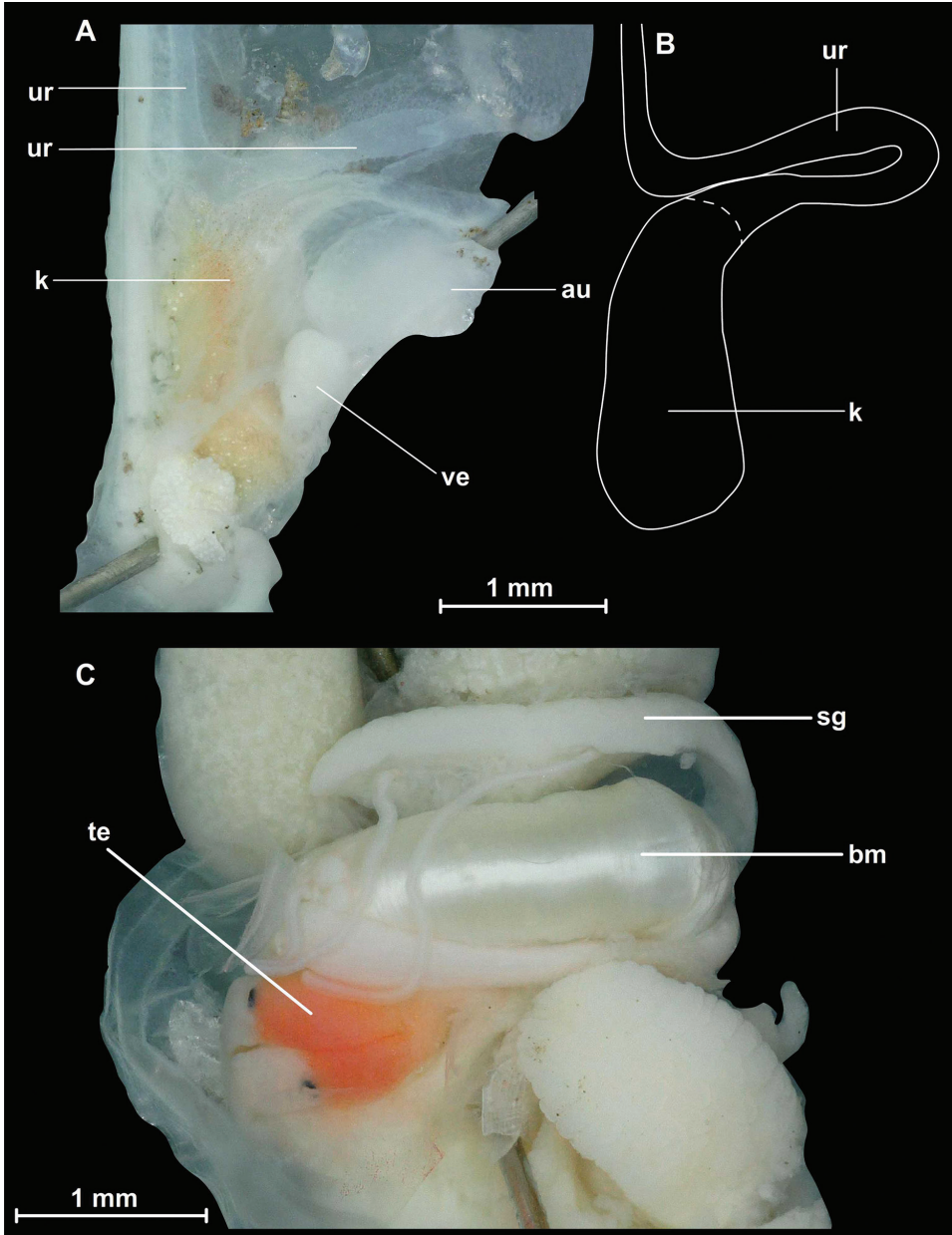


Fig. 2. Excretory system (A–B) and salivary gland and buccal mass (C) of *Nagyelma aliena* (Bavay and Dautzenberg, 1912). Note that the ureter has been broken during preparation (A). Abbreviations: au: auricle; bm: buccal mass; k: kidney; SG: salivary gland; ve: ventricle; te: tentacles; ur: ureter

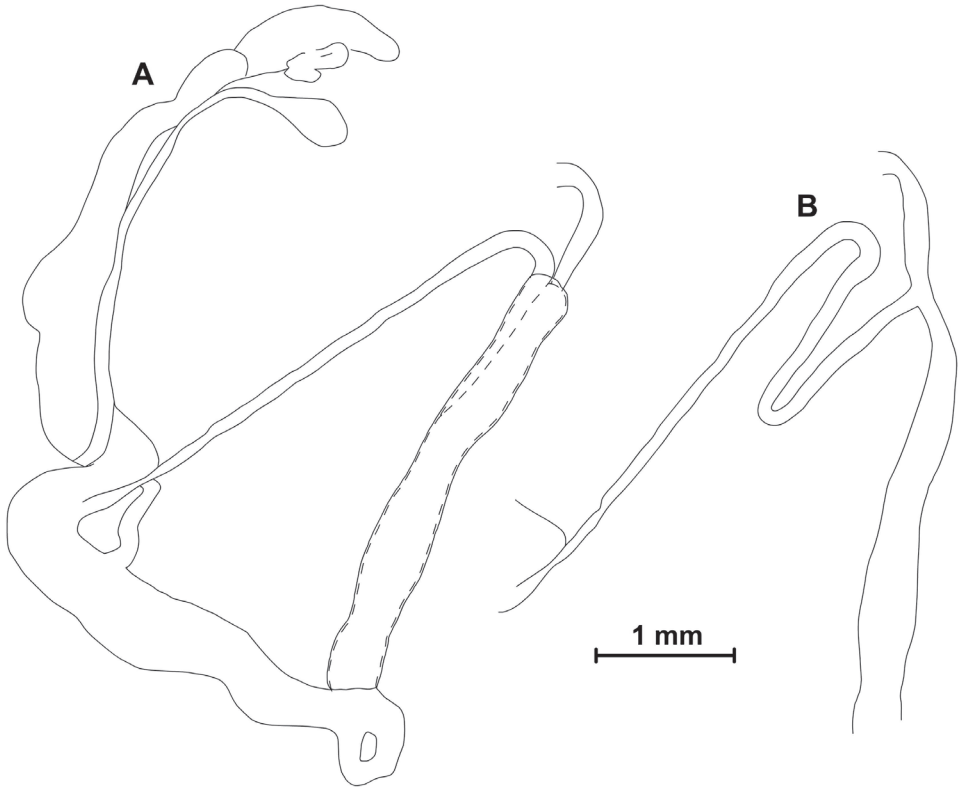


Fig. 3. Reproductive anatomy of *Nagyelma aliena* (Bavay and Dautzenberg, 1912). A: distal genitalia with intact penial sheath; B: penis and vas deferens after removal of penial sheath

Hemmen, 14.04.2012, HE/1; Vietnam, Thanh Hóa Province, 23.7 km south of Ngọc Lặc, Phúc Thịnh, Làng Miêng, limestone rock above the village, 65 m a.s.l., 19.93115°N, 105.36993°E (code of coll. site: 2020/38), leg. A. Hunyadi, 13.02.2020, HA/1 (photographed), HNHM 104873 (dissected specimen).

Remarks: We were unable to locate Ny-Nham on the map. Schileyko (2011) identifies Nui-Moc (=Thanh Hoa) at the following point within Thanh Hoa city: 19°47'N, 105°49'E.

We examined newly collected samples from four sites. The samples Vn12-225 and Vn12-269 are situated close to each other in central Thanh Hóa Province, and possess glossy shells, some with a mamillated suture (Fig. 1E). The sample 2020/38 was collected ca. 23 km southeast from the first two sites, and the shells are somewhat finely ribbed (Fig. 1F). The sample Vn12-268, which was collected ca. 20 km further southeast (ca. 86 km from the first two sites) is also ribbed (Fig. 1G). At the moment we consider this to be intraspecific variation.

Pallial complex (Fig. 2A–B): Sigmurethrous, similar to that of *Discartemon* (see: Siriboon et al., 2014), with kidney sub-rectangular, being ca. twice as long as wide.

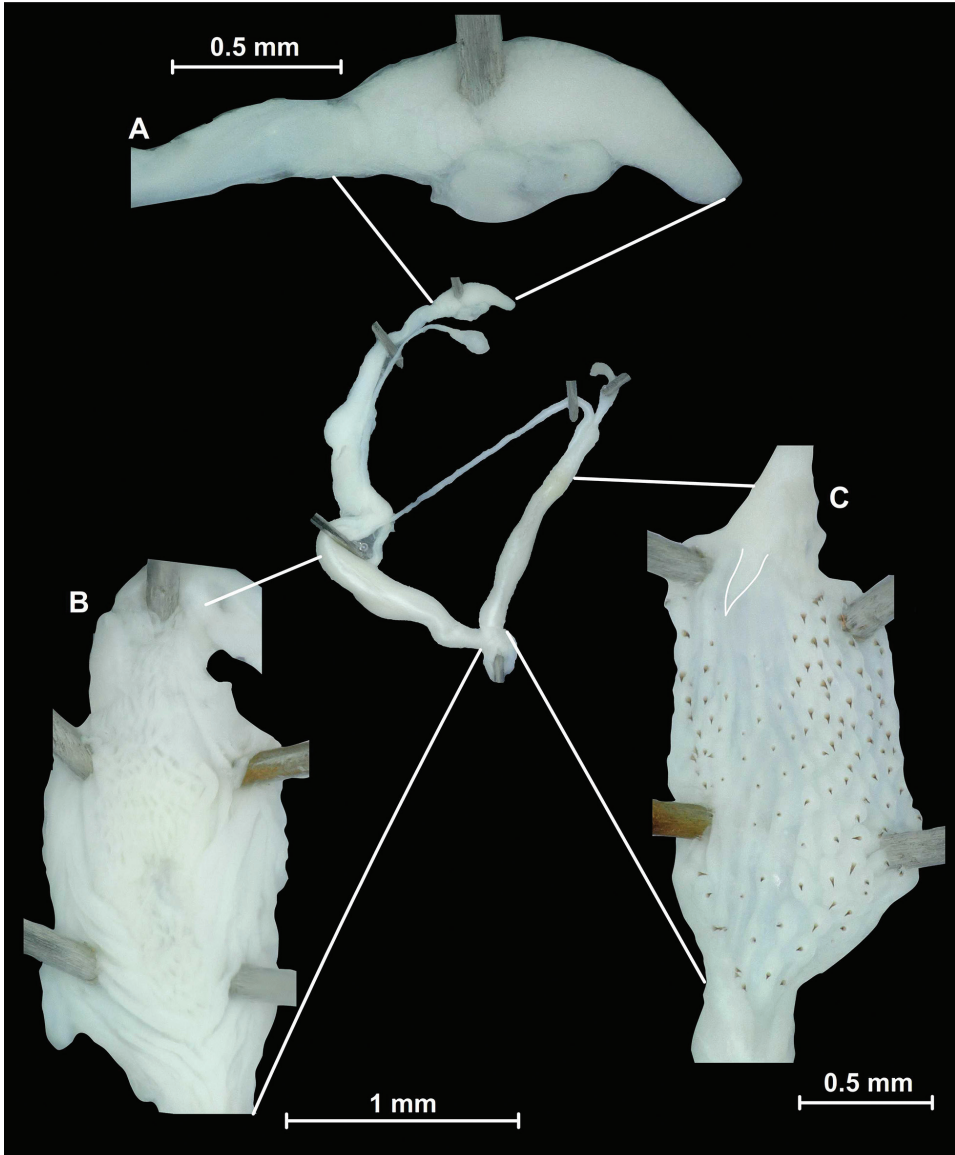


Fig. 4. Reproductive anatomy of *Nagyelma aliena* (Bavay and Dautzenberg, 1912).
 A: albumen gland and talon; B: inner wall of the vagina; C: inner wall of the penis
 (pointed, fleshy finger-like structure outlined)

Tentacles (Fig. 2C): Bright orange in colour.

Salivary gland (Fig. 2C): Single, soft, elongated, with two ducts leaving separately (rather than together as in *Huttonella*; Simone, 2013), each duct of even thickness throughout its length (overall similar to that of *Elma*, see Páll-Gergely et al., 2015).

Genitalia (Figs. 3, 4): Atrium short; penis long, slender and cylindrical, nearly equally thick throughout; a yellowish knob situated slightly proximal from the centre of penis; between the atrium and the yellowish knob the inner penial wall is covered with scattered papillae, with brown penial hooks in each papilla (Fig. 4C); hooks are largest and more numerous towards the yellowish knob; hooks with sharp tips curved towards the atrium; an elongated, pointed, fleshy finger-like structure is situated on the penis wall at the yellow knob's position, reminiscent of, but not homologous with the penial verge of other stylommatophoran snails (outlined on Fig. 4C); a thin penial sheath present, covering entire penis and the descending and ascending part (loop) of the vas deferens; no epiphallic differentiation observed; vas deferens enters proximal end of penis laterally after forming a loop under the penial sheath; loop ending approximately at the middle of penial sheath, distal from the yellowish knob; diameter of vas deferens somewhat greater where it enters under penial sheath than elsewhere; penial retractor muscle long, thick, inserting at the penis-vas deferens junction and attached to the diaphragm. Vagina relatively long, slightly thicker towards spermooviduct; bursa copulatrix duct long, slender, with ovoid reservoir, reaching the albumen gland; free oviduct short, thicker than penis; inner wall of the vagina and the free oviduct with elevated folds converging towards atrium, and between the folds a longitudinal area with horizontally elongated tiny pockets (Fig. 4B); oviduct enlarged and folded; albumen gland relatively small, pointed; talon small (Fig. 4A), thickened and curved.

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