

## Description of a new genus *Praephiline* gen. nov. (Gastropoda: Opisthobranchia: Philinidae)

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A new genus of opisthobranch mollusks *Praephiline* gen. nov. is described for *Philine finmarchica* M. Sars, 1858. *Philine finmarchica* differs significantly from the type of *Philine* – *Philine aperta* in the morphology of gizzard and male copulatory apparatus. The status of *Philine thurmanni thurmanni* Marcus & Marcus, 1969 and *Philine thurmanni chilla* Marcus & Marcus, 1969 is discussed; they are considered to be distinct species and assigned to the new genus – *Praephiline thurmanni* (Marcus & Marcus, 1969) and *Praephiline chilla* (Marcus & Marcus, 1969).

**Key words:** taxonomy, gastropod mollusks, Gastropoda, Philinidae, *Philine*, *Praephiline*, new genus

### INTRODUCTION

Family Philinidae has the greatest diversity of forms among cephalaspidean mollusks, so it is not surprising that several genera were described in this family. But “the genera *Hermania Monterosato*, 1884, *Laona A. Adams*, 1865, *Philinorbis Habe*, 1950, *Yokoyamaia Habe*, 1950 and *Globophilina Habe*, 1958 erected on differences of shell form and, in the case of *Laona*, on the loss of the gizzard, are considered to be unnecessary” (Rudman, 1972: 186). This view was supported by Gosliner (1980: 347). Based on this, Valdés (2008) provided a list of synonyms of *Philine* Ascanius, 1772 including almost all the described genera except *Spiniphiline* Gosliner, 1988. The latter genus has apomorphies in the shell form, morphology of the gizzard plates, and length of the visceral loop (Gosliner, 1988: 89). We agree that division of philinids based on differences of the shell form is artificial. However, accumulated data on the morphology of the Atlantic philinid species (Brown, 1933–34; Pruvot-Fol, 1930; Marcus & Marcus, 1968; Bouchet, 1975; Marcus, 1973; Chaban & Soldatenko, 2009) clearly indicate that at least *Philine aperta* (Linnaeus, 1767) and

*Philine finmarchica* M. Sars, 1858 belong to different genera, primarily because of the differences in the morphology of the gizzard and the copulatory apparatus. We describe a new genus *Praephiline* for *Philine finmarchica* and give an annotated diagnosis for *Philine*.

### RESULTS

#### *Philine* Ascanius, 1772

Type species: *Philine quadripartita* Ascanius, 1772 (= *Bulla aperta* Linnaeus, 1767).

**Diagnosis.** Shell flattened dorso-ventrally, almost circular in outline. Radula 1:0:1. Gizzard plates strongly calcified with two holes on outer surface; paired gizzard plates larger, of the same size, triangular with extended front and rear ends; unpaired plates narrower. Plates bound by continuous sheath consisting alternately of muscle and thin horny layer. Copulatory apparatus includes a bag with a hammer shaped penis, incurrent and ejaculatory ducts, coming out of the penial sheath; together they form an extension – seminal vesicle. Long prostate with smooth walls begins from seminal vesicle. Tip of prostate connected

with penis sheaths by a connective band. Incurrent duct with thin dense shiny walls. Long transparent ejaculatory duct divided lengthwise by a partition into 2 equal channels and ends in the distal appendages of penis, its hole closed with muscular folds.

***Philine aperta* (Linnaeus, 1767)**

(Figs 1a–c, 2a, c, d)

*Bulla aperta* Linnaeus, 1767: 1183.

*Philine aperta*: Vayssi re, 1880: Pl. 8, Figs 70–72, Pl. 9, Figs 73–82, Pl. 10, Figs 83, 84; Guiart, 1901: 29 (synonymy), 33–42 (biology), Figs 40–42 (gizzard plates), 105–111, Figs 58–62 (central nervous system), 146–148, Figs 86, 88 (reproductive system), 159–178 (development); Pruvot-Fol, 1930: 45–49, Figs 4–5 (morphology); Brown, 1934: 179–210, Figs 1–38 (morphology, development); Lemche, 1948: 90–91 (synonymy); Thompson, 1976: 132, Figs 68–69; Chaban & Soldatenko, 2009: 6, Figs 1a, b, 2a–f, 4a, b (shell, penial morphology).

**Diagnosis.** Corresponds to that of the genus. Distal end of penial papilla appears smooth with optic microscope, but is actually covered with small warts and short longitudinal folds (Chaban & Soldatenko, 2009).

***Praephiline* gen. nov.**

Type species: *Philine finmarchica* M. Sars, 1858.

**Diagnosis.** Shell well developed, pear shaped, from 2.5 whorls, apex flattened. Shell sculpture consists of thin dense spiral grooves. Radula (1): 1:0:1: (1). Gizzard plates strongly calcified, identical in size and shape, large, rod-shaped, slightly flattened with truncated tips, with outer crest, about three times as long as wide. Annular musculature of gizzard consists of an outer entire layer, surrounding the gizzard, and an interrupted inner one, connecting the crests of the plates. Gizzard wall covered with a solid ring of connective tissue. Ejaculatory duct short, with strongly developed muscular wall; it has 2 unequal channels: the central one narrow, circular, and the peripheral one

semi-lunar in cross section. Penial papilla hammer-shaped, with spoon-shaped muscle mass around the papilla base; hole of ejaculatory duct not closed with muscular folds.

***Praephiline finmarchica* (M. Sars, 1858), new combination**

(Figs 1d–f, 2b, e)

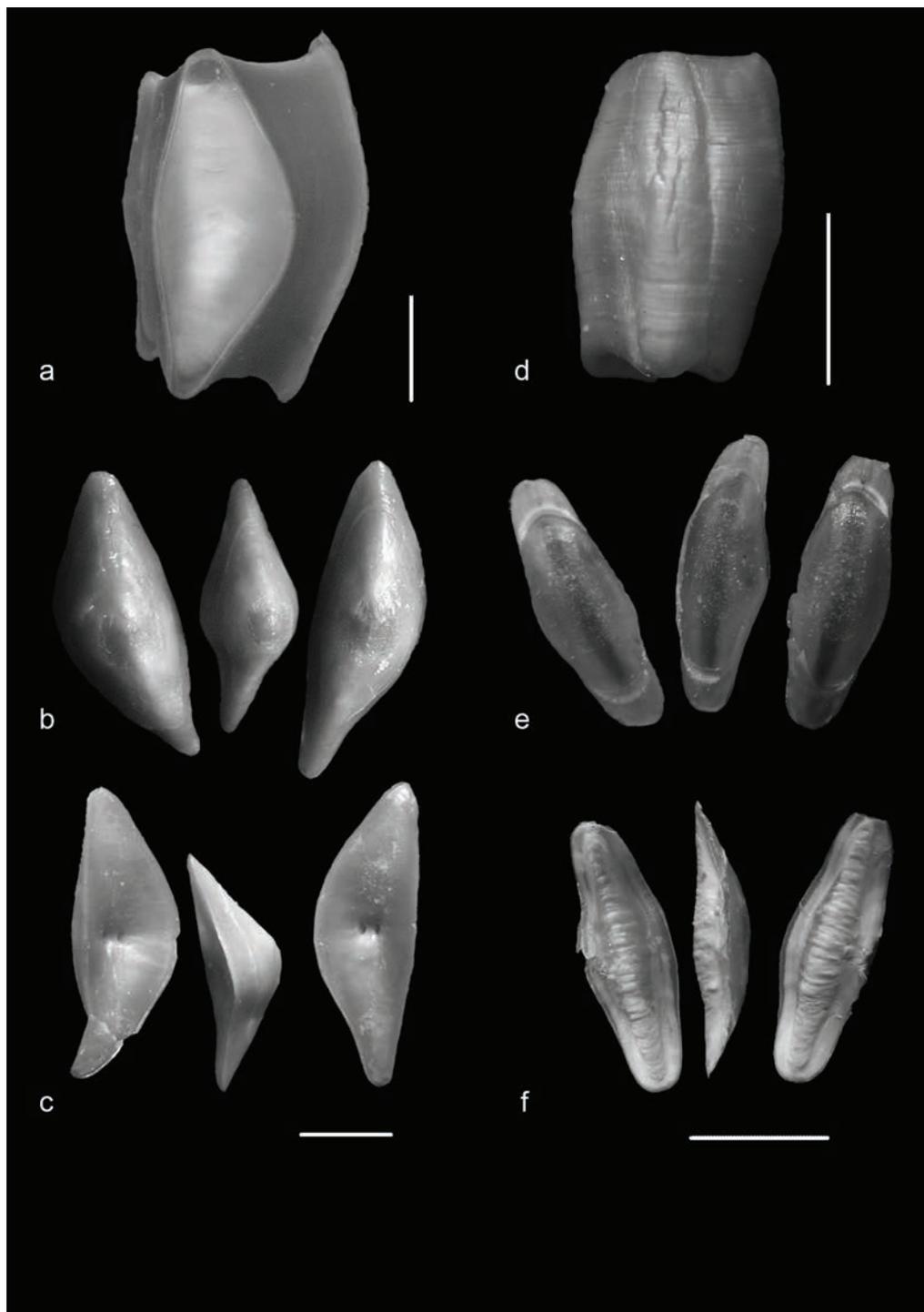
*Philine finmarchica* M. Sars, 1858: 49.

*Philine finmarchica*: G.O. Sars, 1878: Tab. 18, Figs 10a–c, 11 (shell), Tab. XII, Figs 1, 2, 3 (radula); Lemche, 1948: 96 (synonymy); Marcus & Marcus, 1969: 10, 12, Figs 13–16 (gizzard and penial morphology); Ivanov et al., 1985: Fig. 131 (gizzard); Gosliner, 1994: Fig. 58a (central nervous system, scheme); Golikov, 1994: 60, Fig. 117 (distribution), Fig. 139f (shell); Chaban & Soldatenko, 2009: 6, 8, Figs 1c–g, 3a–f, 4c, d (shell, penial morphology).

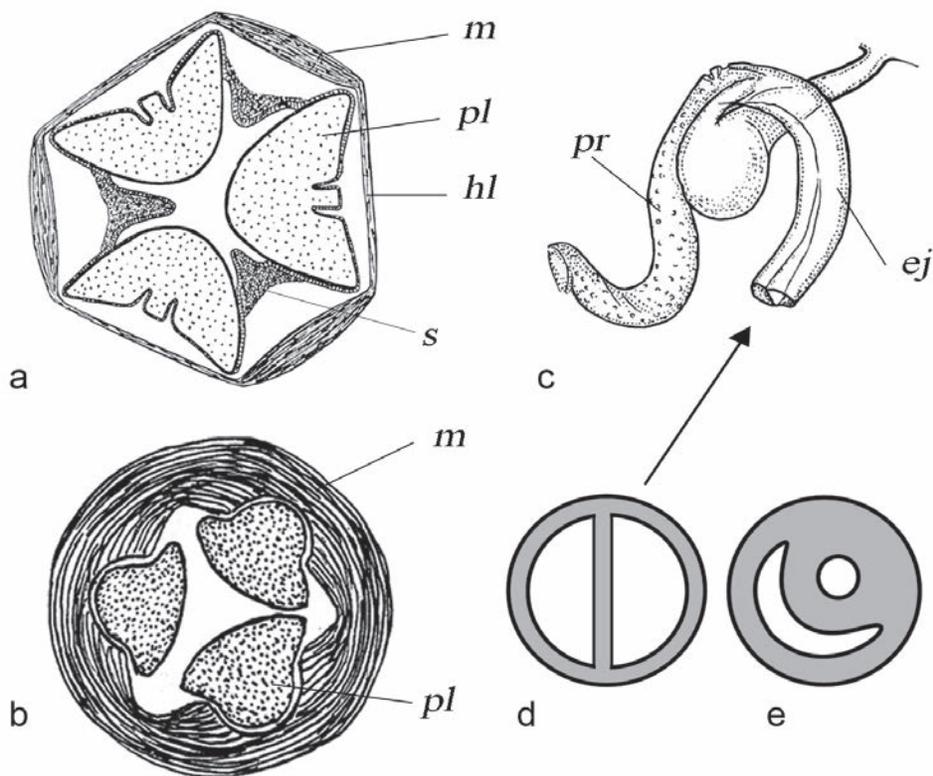
**Diagnosis.** Shell, gizzard plates and wall, and ejaculatory duct the same as in diagnosis of the genus. Radula 1:0:1. Penial papilla hammer-shaped, its distal appendage bearing transverse ridges and warts; penis with spoon-shaped muscle mass around the base of papilla. Ejaculatory duct ends at the base of penial papilla; the hole not closed with muscular folds. Prostate long, with shallow pocket protrusions in the middle part.

**Notes.** *Philine thurmanni thurmanni* Marcus & Marcus, 1969 is close to *P. finmarchica*. It was originally described from specimens collected in the South Atlantic Ocean off the Argentina coast. The two species are similar in the morphology of shell, gizzard wall and gizzard plates, and both have a muscular spoon-shaped flap. *Philine thurmanni thurmanni* resembles *P. finmarchica* in having the orifice not closed with muscular folds but differs from the latter in the presence of marginal teeth, the absence of crests on penial papilla, and the ejaculatory duct ending in the distal appendages of penis. We consider *Philine thurmanni thurmanni* as a distinct valid species assigned to the new genus *Praephiline thurmanni*.

Another former subspecies, *Philine thurmanni chilla* Marcus & Marcus, 1969 from



**Fig. 1.** *Philine aperta*: gizzard (a); gizzard plates, inner view (b); gizzard plates: paired plates, outer view, unpaired plate, lateral view (c); *Praephiline finmarchica*: gizzard (d); gizzard plates, inner view (e); gizzard plates, two plates in outer view, one plate, lateral view (f). Scale bar (a–d, f): 3 mm.



**Fig. 2.** *Philine aperta*, cross section of gizzard, scheme after Brown (1934) (a); *Praephiline finmarchica*, cross section of gizzard, scheme after Marcus & Marcus (1969) (b); part of copulatory apparatus of *Philine aperta*, after Pruvot-Fol (1930) (c); cross section of ejaculatory duct, scheme: *Philine aperta*, based on Pruvot-Fol (1930) (d), *Praephiline finmarchica*, based on Chaban & Soldatenko (2009) (e).

*Abbreviations:* ej, ejaculatory duct; hl, horny layer connecting muscle sheets; m, gizzard muscle sheet; pl, gizzard plate; pr, prostate; s, stomodeal lining.

the South Pacific Ocean off the middle of Chile differs from *Praephiline thurmanni* in the absence of marginal teeth and a different form of muscular bulge around the base of the penial papilla (see Marcus & Marcus, 1969: 18, Fig. 29). We consider it as a valid species assigned to the new genus, *Praephiline chillia*.

## DISCUSSION

It follows from the works by Brown (1934), Marcus and Marcus (1969), and Pruvot-Fol (1930) that *Praephiline finmarchica* and related species differ significantly from *Philine aperta* in a number of morphological characters: 1) shell form; 2) morphology of gizzard plates; 3) morphology of the gizzard wall (table). We also found significant differences in their apparently very similar copulatory apparatus, namely 4) in the morphology of the ejaculatory duct and 5) in the morphology of the penis (Chaban & Soldatenko, 2009). There are also differences 6) in the degree of concentration of ganglia in

the central nervous system: the suprainestinal and pleural ganglia of *Praephiline finmarchica* are connected with a short connective (see Gosliner, 1994: Fig. 58a), while those of *Philine aperta* lie very close together (see Vayssi re, 1880: Pl. 9, Fig. 81; Guiart, 1901: Fig. 59; Brown, 1934: Fig. 23).

*Praephiline* **gen. nov.** differs from the type species of both known valid genera close to it and the genera regarded as synonyms of *Philine*. *Spiniphiline* as described by Gosliner (1988) has apomorphies in the form of shell and gizzard plates (which are unpaired, rudimentary, and round) and the male copulatory system (the prostate is simple and the penis is finger-shaped) (Gosliner, 1988).

*Philine scutulium* Loven, 1846, the type of *Ossiania* Monterosato, 1887, is a synonym of *Philine quadrata*. Due to reduction of the gizzard plates, the body of this species can be drawn into the shell, contrary to what is observed in the new genus. There are significant differences in morphology of the male copulatory apparatus: *Philine quadrata* has

**Table.** Comparison of characters of the type species of *Philine* and *Praephiline* **gen. nov.**

Species	Gizzard plates	Gizzard wall	Morphology of ejaculatory duct	End of ejaculatory duct	Penis
<i>Philine aperta</i>	almost triangular paired plates with two holes on outer surface; the unpaired plate is partially reduced (1)	3 separate muscle strips connected by a horny layer (1)	divided by a longitudinal partition into 2 equal semicircular parts (2), its walls are composed of a single-layered ciliated epithelium (1)	is in the distal appendage of penis (2), its hole is closed with muscular folds (4)	hammer-shaped penis without crests, without a muscle mass around the base of penial papilla (1)
<i>Praephiline finmarchica</i>	uniform rod-shaped (3)	thick sheath of circular muscles covered with a solid ring of connective tissue (3)	consists of two channels with thick muscular walls and ciliated epithelium inside, the inner channel is narrow, cylindrical, the external one is semi-lunar in cross section (4)	at the base of penial papilla, the hole is not closed with muscular folds (4)	hammer-shaped penis with crests and warts, with a muscle mass around the base of penial papilla (4)

Data from: 1 – Brown (1934); 2 – Pruvot-Fol (1930); 3 – Marcus & Marcus (1969); 4 – Chaban & Soldatenko, 2009.

a short prostate and a penial sac with a digitiform penial papilla (Rudman, 1972, Chaban, 1999).

*Philine scabra* (Muller, 1776), the type species of *Hermania* Monterosato, 1884, has an elongate shell, rather cylindrical in outline in apertural view, with a very unusual form of sculpture (Thompson, 1976) and a different male copulatory system, with a complex penis but a simple prostate (Bouchet, 1975).

*Yokoyamaia ornatissima* (Yokoyama, 1927), the type species of the genus *Yokoyamaia* Habe, 1950, has a similar gizzard plate but a strongly reduced shell that only incompletely covers the visceral sac; the morphology of the male copulatory apparatus is closer to that of the genus *Philine* (Chaban, 1999).

*Philine pygmaea* Yokoyama, 1922, the type species of *Choshiphiline* Habe, 1958, is considered a synonym of *Philine japonica* Lischke, 1872 (Valdes, 2008). The latter is a typical representative of the genus *Philine*.

*Globophilina kawamurai* Habe, 1958, the type species of *Globophilina* Habe, 1958, has a different copulatory system: compact, with a very short prostate and a finger-shaped penis (Chaban, 1999).

*Pseudophilina hayashii* Habe, 1976, the type of *Pseudophilina* Habe, 1976, has no plates and a strongly reduced radula (Kिताo et Habe, 1982). The morphology of *Philinorbis teramachii* Habe, 1950, the type species of the genus *Philinorbis* Habe, 1950, is unknown, but its shell is very similar to that of *Pseudophilina hayashii*, as noted by Habe (1976: 154).

*Philine monterozati* Jeffreys in Monterozato, 1874, the type of the genus *Philingwynia* Nordsieck, 1972, is closer to the genus *Philine* in the morphology of the copulatory apparatus and gizzard (Bouchet, 1975).

*Retusophilina* Nordsieck, 1972 with the type species *Bulla lima* Brown, 1827, has outgrowths on the posterior edge of the head shield and no gizzard plates (Nordsieck, 1972).

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