
Chlanidota (Paranotoficula) anomala, a new subgenus and species of Buccinulidae (Gastropoda: Neogastropoda) from the South Shetland Islands

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ABSTRACT. *Paranotoficula* is described as a new subgenus of *Chlanidota* Martens, 1878 to include a single species, *Chlanidota (Paranotoficula) anomala*, which is also described as new. *Paranotoficula* resembles both *Chlanidota sensu stricto* and *Chlanidota (Pfefferia)* in general shell and radular morphology, but differs from both in lacking an operculum, in having a narrowly tubular gland of Leiblein that lacks a terminal ampulla, in having a more complex stomach structure, including a cuticularized shield in the stomach, as well as in having a broader terminal papilla on the penis.

Chlanidota (Paranotoficula) anomala n. sp., the type species, is based on a single specimen collected off the South Shetland Islands at outer shelf depths.

Our ongoing studies on Buccinoidea represented in the collections of the United States Antarctic Program (USAP) continue to uncover taxa with novel combinations of anatomical features and shell morphology. Among these is a new species that is referable to the diverse and wide-ranging genus *Chlanidota* Martens, 1878 on the basis of its smoothly ovate shell, broad siphonal notch, as well as a radula with a rachidian tooth that has three equal sized cusps emerging from an arched base and distinctive tricuspid lateral teeth in which the middle cusp is short and closely adjacent to the innermost cusp. However, a number of anatomical features of this new species preclude its inclusion in either of the two presently recognized subgenera of *Chlanidota*, *Chlanidota sensu stricto* and *Chlanidota (Pfefferia)* [Harasewych, Kantor, 1999; 2004].

In this paper, we describe this species as new, and propose *Paranotoficula* as a new subgenus of *Chlanidota* to include it. We also review the nomenclatural history of several conchologically similar genera of Antarctic buccinulids.

Materials and Methods

This report is based on the extensive collections of buccinoideans collected by the United States Antarctic Program and housed at the National Museum of Natural History, Smithsonian Institution, and is a continuation of prior studies on this material [Harasewych, Kantor, 1999; 2004; Harasewych *et al.*, 2000; Kantor, Harasewych, 1999; 2000]. Methodology follows protocols set forth in these publications.

Systematics

Class Gastropoda Cuvier, 1797
Order Neogastropoda Wenz, 1938
Superfamily Buccinoidea Rafinesque, 1815
Family Buccinulidae Finlay, 1928
Subfamily Buccinulinae Finlay, 1928

Genus *Chlanidota* Martens, 1878
Subgenus *Paranotoficula* subgen. nov.

Type species: *Chlanidota (Paranotoficula) anomala* sp. nov. (designated here).

Description. Shell small for genus (24 mm), relatively thick, solid, broadly ovate in outline with short conical spire. Protoconch unknown. Teleoconch of 4+ smooth, evenly convex whorls. Shell sculpture predominantly of fine, axial growth lines. Aperture high, broad, rounded anteriorly, tapering posteriorly. Outer lip evenly rounded. Columella short, concave, with strong columellar fold. Siphonal notch broad, axial, not strongly recurved dorsally. Fasciole weak, smooth. Operculum absent. Digestive system is characterised by medium long proboscis, well developed valve of Leiblein and long and tubular gland of Leiblein without a terminal ampulla, stomach with a medium-sized, subtriangular, cuticularized shield. Rachidian radular teeth with

3 equal, closely spaced cusps, lateral teeth tricuspid, with outer cusp stoutest.

[Описание. Раковина небольшая для рода (24 мм), относительно толстая, прочная, широко овальная с коротким коническим завитком. Протоконх неизвестен. Телеоконх образован 4+ гладкими равномерно закругленными оборотами. Скульптура раковин из тонких осевых линий роста. Устье высокое, широкое, закругленное в передней части и заостренное сзади. Внешняя губа равномерно закруглена. Столбик короткий, вогнутый, с выраженной колумеллярной складкой. Сифональная вырезка широкая, слегка загнута на дорсальную сторону. Фасциола слабо выражена, гладкая. Крышечка отсутствует. Пищеварительная система характеризуется умеренно длинным хоботом, хорошо развитым клапаном Лейблеина и длинной трубчатой железой Лейблеина без терминальной ампулы, желудком с умеренного размера кутикулизованным гастрическим щитком. Центральный зуб радулы с тремя близко расположенными зубцами одинаковой длины, латеральные зубы трехзубцовые, внешний зубец самый мощный.]

Remarks. The prevalence of thin, smooth, broadly ovate, bulliform shells in high latitude and deep sea marine environments has been interpreted as a direct response to the reduced availability of calcium carbonate in these habitats [Graus, 1974]. Such convergence on shell morphology has on many occasions obscured taxonomic affinities, especially in the absence of anatomical data [see Kantor & Harasewych, 1999; 2000; 2003].

A number of genera have been proposed in Buccinoidea with the authors noting their affinities to *Chlanidota*. Thiele [1912: 270, pl. 19, fig. 13] described *Ficulina* as a subgenus of *Cominella* on the basis of a single shell that he named *Cominella (Ficulina) bouveti*. Later, Thiele [1917], proposed *Notoficula* as a replacement name for *Ficulina*, which was preoccupied by *Ficulina* Gray, 1867. Later still, Thiele [1929: 315] considered *Notoficula* to be a section of *Chlanidota*, a placement that was followed by Wenz [1943: 1201]. Powell [1951: 137] described *Notoficula problematica* on the basis of a single, subadult specimen, provisionally assigning it to the genus *Notoficula* with some question, on the basis of conchological similarity. Based on the morphology of the illustrated radula and operculum, Powell [1951: figs. K61, N125] suggested an affinity of the genus *Notoficula* to *Tromina*. After examining material “closely resembling” *Notoficula bouveti*, Powell [1958: 102] concluded that *N. bouveti* and *N. problematica* were not congeneric, “nor even members of the same family”, and proposed the genus *Parficulina* with *Notoficula problematica* as the type species. Oliver [1983] transferred the genus *Notoficula* to Eratoidae based on the anatomy and radular morphology of *Notoficula signyensis* Oliver, 1983, a species conchologically similar to *Notoficula bouveti*. Powell [1958: 193] proposed the genus *Chlanificula* based on a single, dead shell, noting that this genus is part of the “*Chlanidota* complex”,

but closer to *Notoficula* [now in Eratoidae] than *Chlanidota*.

Paranotoficula is clearly a buccinulid and closely related to *Chlanidota* based on its radular morphology, but differs in having: salivary glands that are separate, not fused; a gland of Leiblein that is long and tubular rather than posteriorly tapering, without a terminal ampulla. *Paranotoficula* lacks a thick, muscular posterior esophagus, but has a more complex stomach structure that includes a medium-sized, subtriangular, cuticularized shield that is absent in *Chlanidota* and *Pfefferia*.

Paranotoficula can readily be distinguished from *Parficulina*, which has lateral teeth that lack the intermediate cusp present in *Paranotoficula*. While the anatomy of *Chlanificula* remains unknown, the presence of a short but distinct siphonal canal is sufficient to distinguish it from *Chlanidota*, *Parficulina* and *Paranotoficula*.

Paranotoficula appears more similar to *Chlanidota* s.s. than to *Chlanidota (Pfefferia)* in terms of shell morphology, as it lacks the spiral cords prevalent in species of *Pfefferia* and many *Chlanidota*. *Pfefferia* has a large and diagnostic operculum, *Chlanidota* has an operculum that is reduced, while the operculum is absent in *Paranotoficula*.

Chlanidota (Paranotoficula) anomala n. sp.

(Fig. 1-3, 16)

Description. Shell (Figs. 1A-C) small (23.7 mm), thick, solid, broadly ovate in outline, with a short, conical spire. Protoconch unknown, early whorls eroded. Teleoconch of 4+ evenly rounded, convex whorls. Suture adpressed, weakly abutting. Axial sculpture limited to fine, weakly recurved, prosocline growth striae. Spiral sculpture absent. Aperture high, broadly rounded anteriorly, tapering posteriorly beneath suture, deflected from the coiling axis by 16°. Outer lip moderately thin, evenly rounded. Columella short, 1/3 aperture length, concave, with strong siphonal fold. Callus of thin transparent glaze overlying the parietal region, siphonal fasciole. Siphonal notch broad, axial, slightly dorsally recurved, with straight columellar and rounded apertural margins that form the borders of the fasciole. Shell colour whitish tan, with translucent whitish outer shell layer overlaying a caramel-colored inner layer that is evident on eroded early whorls and along margin of outer lip. Aperture with whitish glaze. Periostracum indiscernible due to abrasion. Operculum absent.

[Описание. Раковина (Figs. 1A-C) небольшая для рода (23.7 мм), толстая, прочная, широко овальная с коротким коническим завитком. Протоконх неизвестен, верхние обороты эродированы. Телеоконх образован 4+ гладкими равномерно закругленными оборотами. Шов прижатый. Осевая скульптура представлена толь-

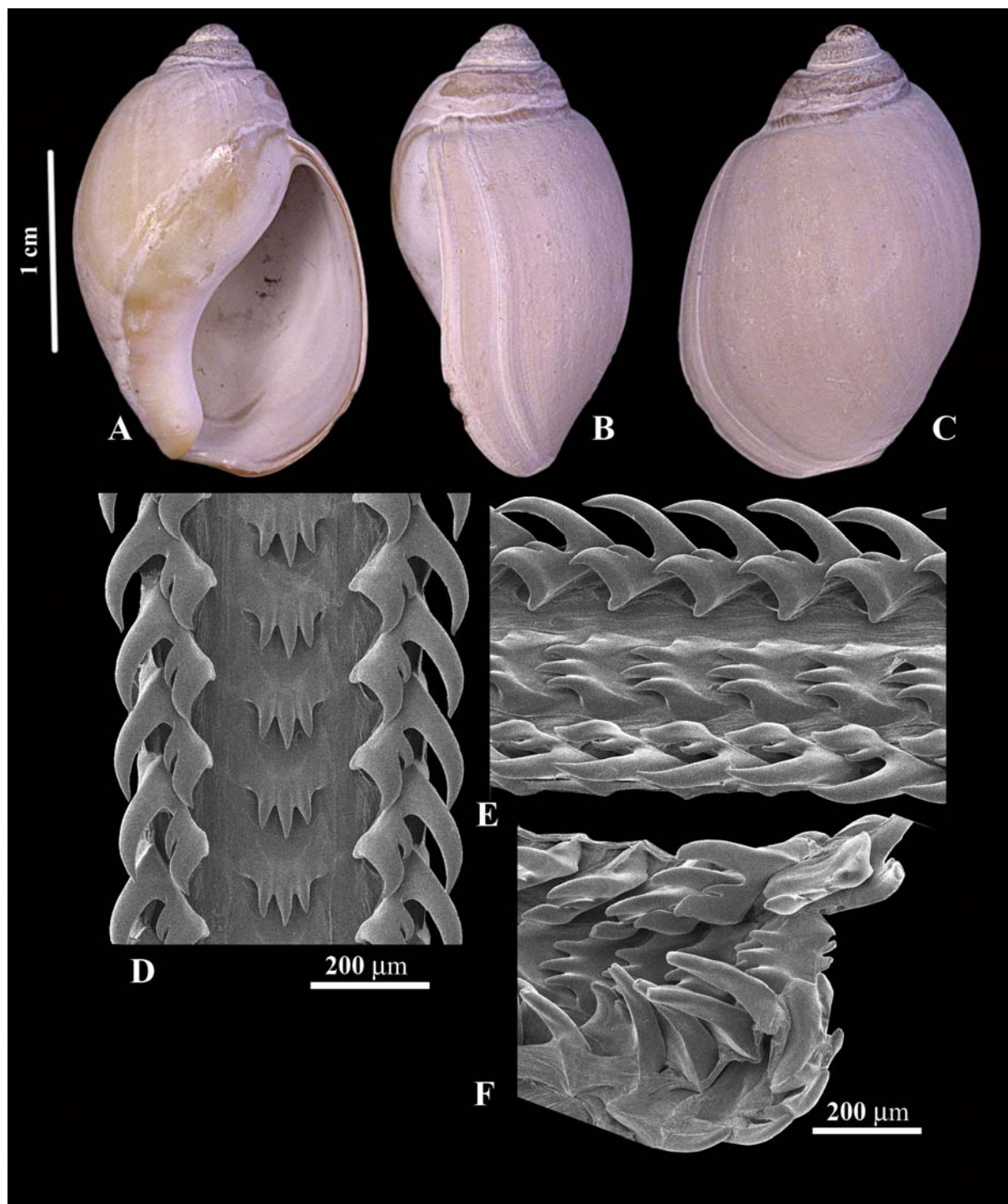


FIG. 1. *Chlanidota (Paranotoficula) anomala* sp. nov. A. apertural, B. lateral and C. adapertural views of the shell of holotype, USNM 1010542, Elephant Island, South Shetland Islands, Antarctica, 60°53'S, 55°32'W, 120-178 m (R/V *Polarstern*, Sta. 42/079). D. dorsal, E. right lateral (30°) views of the central portion of the radular ribbon of the holotype. F. right lateral (30°) view of bending plane showing wear on teeth.

РИС. 1. *Chlanidota (Paranotoficula) anomala* sp. nov. раковина голотипа, USNM 1010542. А. вид с устья, В. сбоку и С. с дорсальной стороны, Elephant Island, Южные Шетландские острова, Антарктика, 60°53'S, 55°32'W, 120-178 м (НИС *Polarstern*, ст. 42/079). D. дорсальный, E. правый латеральный (30°) вид центральной части радулярной мембраны голотипа. F. правый латеральный (30°) вид перегиба радулы для демонстрации изношенности зубов.

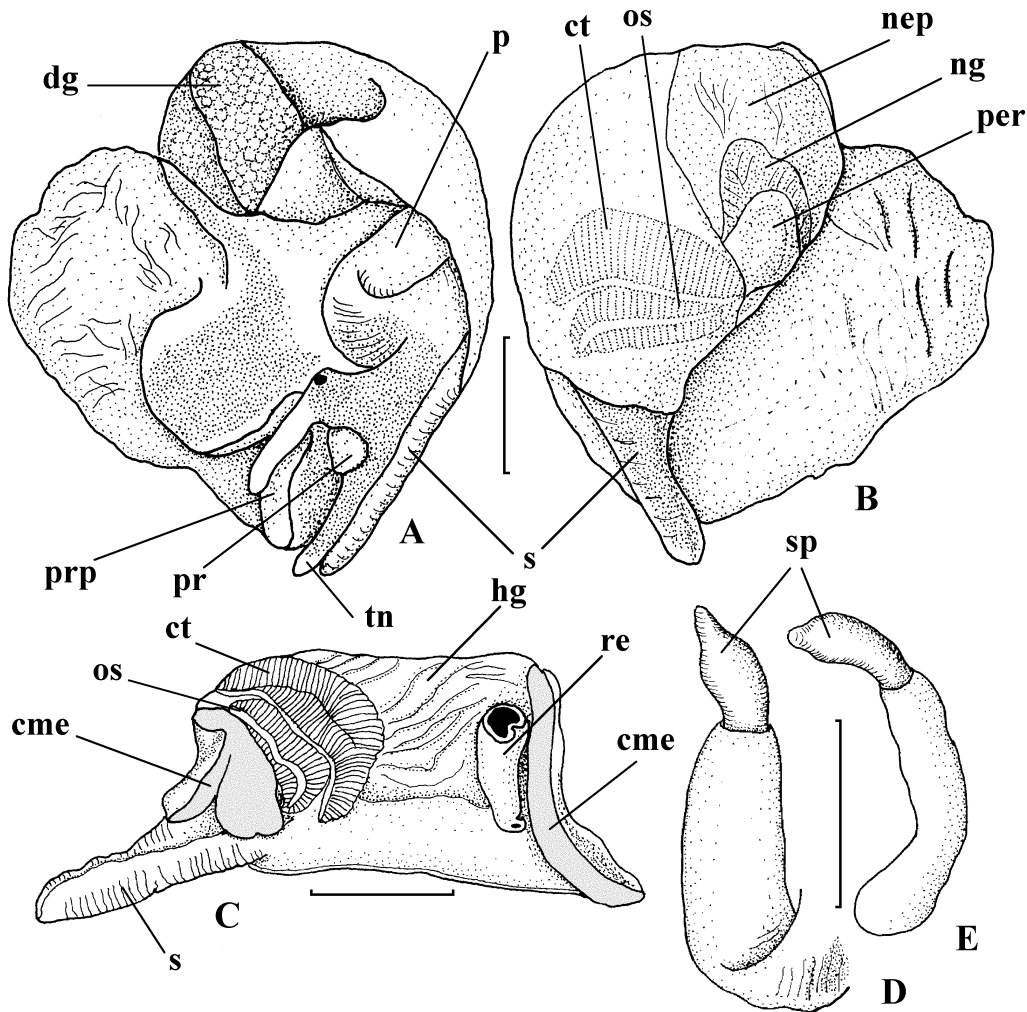


FIG. 2. *Chlanidota (Paranotoficula) anomala* sp. nov. A. Right, and B. left lateral views of the animal. C. Mantle complex of organs. D. lateral, and E. dorsal views of penis. Scale bars = 5 mm. cme, cut mantle edge; ct, ctenidium; dg, digestive gland; hg, hypobranchial gland; nep, nephridium; ng, nephridial gland; os, osphradium; p, penis; per, pericardium; pr, proboscis; prp, propodium; re, rectum; s, siphon; sp, seminal papilla; tn, tentacle.

РИС. 2. *Chlanidota (Paranotoficula) anomala* sp. nov. A. правый и B. левый латеральные виды мягкого тела. C. мантийный комплекс органов. D. латеральный и E. дорсальный виды пениса. Масштаб = 5 мм. cme, срезанный край мантии; ct, ктенидий; dg, пищеварительная железа; hg, гипобранхиальная железа; nep, нефридий; ng, нефридиальная железа; os, осфрадий; p, пенис; per, перикард; pr, хобот; prp, проподий; re, ректум; s, сифон; sp, семявыносящая папилла; tn, щупальце.

ко тонкими, слегка изогнутыми, наклоненными вперед осевыми линиями роста. Устье высокое, широкое, закругленное в передней части и заостренное сзади, расположено к оси раковины под углом 16° . Внешняя губа равномерно закруглена, тонкая. Столбик короткий, составляет около $1/3$ высоты устья, вогнутый, с сильной колумеллярной складкой. Каллус тонкий, прозрачный, распространяется на париетальную стенку и сифональную фасциолу. Сифональная вырезка широкая, слегка загнута на дорсальную сторону, с прямым колумеллярным краем и закругленным устьевым краем, которые образуют границы фасциолы. Раковина розоватая, с прозрачным беловатым наружным слоем, перекрывающим внутренний слой цвета карамели, что

заметно на верхних эродированных оборотах и у внешней губы устья. Устье гляцевое, беловатое. Перистракум незаметен из-за эрозии раковины. Крышечка отсутствует.]

External anatomy (Fig. 2, A-B). The upper part of the digestive gland was damaged during the extraction of the body from the shell. The remaining soft tissues comprise approximately $1\frac{1}{2}$ whorls. Mantle cavity spans $< 1/3$ whorl, kidney $1/4$ whorl. Mantle edge thick, does not cover head and base of penis. Columellar muscle short, broad, attached to shell at rear of mantle cavity. Foot large, broadly

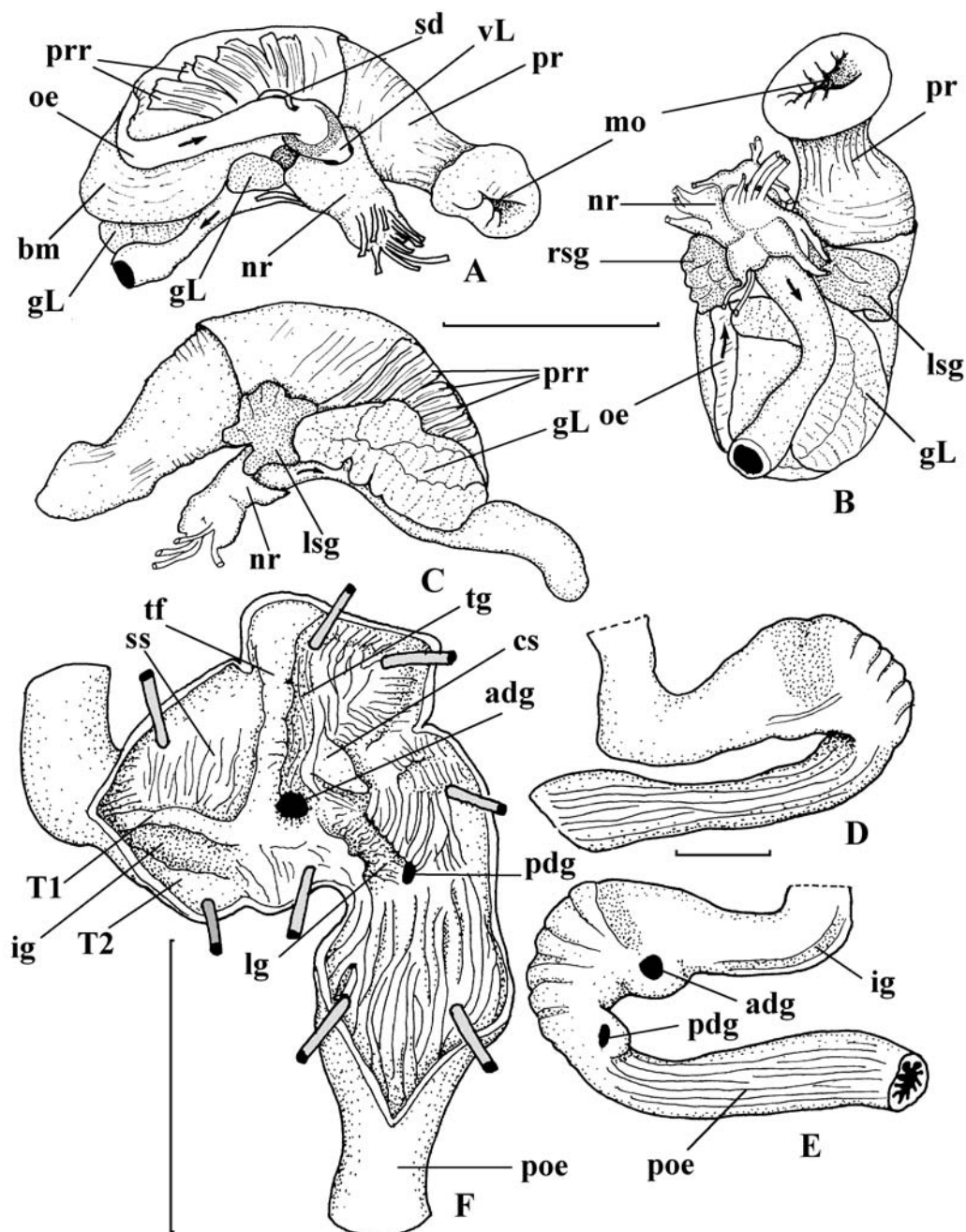


FIG. 3. Digestive system of *Chlanidota (Paranotoficula) anomala* sp. nov. A. Right lateral (right salivary gland removed to show the valve of Leiblein), B. ventral and C. left lateral views of anterior alimentary system. D. dorsal, and E. ventral views of stomach. F. stomach, opened mid-dorsally. Scale bars = 5 mm for A-C, F, 2 mm for D-E.

adg, anterior duct of the digestive gland; bm, buccal mass; cs, cuticularized shield; gL, gland of Leiblein; ig, intestinal groove; lg, longitudinal groove; lsg, left salivary gland; mo, mouth opening; nr, circumoesophageal nerve ring; oe, esophagus; pdg, posterior duct of the digestive gland; poe, posterior esophagus; pr, proboscis; prr, proboscis retractors; rsg, right salivary gland; sd, salivary duct; ss, style sac; T1, T2, major and minor typhlosoles; tf, transverse fold; tg, transverse groove; vL, valve of Leiblein.

FIG. 3. Пищеварительная система *Chlanidota (Paranotoficula) anomala* sp. nov. A. правый латеральный (правая слюнная железа удалена, чтобы показать железу Лейблеина), B. вентральный и C. левый латеральный виды переднего отдела пищеварительной системы. D. дорсальный и E. вентральный вид желудка. F. желудок, вскрытый по средней дорсальной линии. Масштаб = 5 мм для A-C, F, 2 мм для D-E.

adg, передний проток пищеварительной железы; bm, буккальная масса; cs, кутикулизованный щиток; gL, железа Лейблеина; ig, интестинальный желобок; lg, продольный желобок; lsg, левая слюнная железа; mo, ротовое отверстие; nr, окологлоточное нервное кольцо; oe, пищевод; pdg, задний проток пищеварительной железы; poe, задний пищевод; pr, хобот; prr, ретракторы хобота; rsg, правая слюнная железа; sd, слюнной проток; ss, мешок кристаллического стебелька; T1, T2, большая и малая тифлозоли; tf, поперечная складка; tg, поперечный желобок; vL, клапан Лейблеина.

oval (length/width ~ 1.3). Body base color pinkish-yellow, dorsal surfaces of the head, tentacles, siphon, and anterior part of the foot mottled with dark greyish black. Head large, with broad, tapering tentacles, black eyes. Siphon long, free, muscular. Operculum and opercular disk absent.

Mantle cavity. (Fig. 2, C). Mantle edge smooth, thickened. Mantle cavity short, length about 1/2 of width. Siphon long (~ 0.4 of aperture length, AL), muscular, extending substantially beyond mantle edge. Osphradium greenish, bipectinate, with broad axis, spanning about 0.6 of mantle cavity length. Ctenidium large, wide, spanning about 3/4 mantle cavity length. Hypobranchial gland formed of numerous distinct closely spaced oblique folds.

Alimentary system. (Fig. 3). Proboscis smooth, unpigmented, of moderate length when retracted (~ 0.7 AL). Holotype specimen preserved with proboscis slightly protruded through rhynchostome. Proboscis sheath very thin-walled, translucent in anterior half, becoming muscular and of same thickness as proboscis wall. Mouth opening forming triangular slit.

Buccal mass muscular, large, protruding beyond rear end of retracted proboscis (Fig. 3, A — **bm**). Odontophoral cartilages paired, fused anteriorly, spanning nearly entire length of buccal mass. Radular ribbon long (8.2 mm; 0.44 AL), slightly longer than odontophoral cartilages, wide (~ 580 µm; 0.031 AL), triserial (Fig. 1, D-F), consisting of 67 rows of teeth; posteriormost 5 rows nascent. Rachidian teeth with 3 equal, recurved, closely spaced cusps on posterior portion of broad, anteriorly deeply arched basal plate. Lateral teeth with 3 cusps. Outer cusp stoutest, nearly twice as long as inner cusp. Intermediate cusp shortest, nearly half the length of inner cusp, immediately adjacent to it. Salivary glands small, compact, ascinous, separate, dark-pink, dorsal to nerve ring, right salivary gland totally (Fig. 3, B — **rsg**) covering valve of Leiblein. Salivary ducts thin, passing loosely along both sides of esophagus. Valve of Leiblein well defined, large, pyriform (Fig. 3, A — **vL**). Gland of Leiblein long, narrowly tubular, highly coiled, opens with slight constriction to mid-esophagus close to the nerve ring. Esophagus not wide, muscular, of similar diameter along most of its length, widening before opening into the stomach. Posterior part of esophagus (Fig. 3, D-F — **poe**) lined with epithelium somewhat darker than that of the stomach, forming very tall, distinct folds. Transition of posterior esophagus into stomach marked by change in epithelium color and arrangement of folds. Stomach U-shaped, without caecum (Fig. 3, D-E). Folds of stomach epithelium rather low (accentuated on drawing). Posterior duct of digestive gland (Fig. 3, F — **pdg**) lying immediately at esophagus opening, small, situated in shallow groove (**lg**), bordered by low longitudinal folds. This groove

continuing to larger anterior duct (Fig. 3, F — **adg**), then becoming obsolete. Both ducts lying in shallow depressions, visible on outer surface of stomach, adjacent to digestive gland (Fig. 3, E). Stomach subdivided into ventral (longitudinal groove, Fig. 3, F — **lg**) and dorsal channels. Dorsal channel lined with minute mostly longitudinally oriented folds. A medium-sized subtriangular cuticularized shield (Fig. 3, F — **cs**), present along the right side of anterior duct of digestive gland, slightly above stomach floor. A transverse groove (Fig. 3, F — **tg**) lined with orange epithelium arranged in sharp, low folds leads from the dorsal channel toward the anterior duct of the digestive gland. Transverse groove bordered anteriorly by tall, thick transverse fold (Fig. 3, F — **tf**) directing flow of food particles towards ventral channel. Anterior to this fold is a style sac lined with numerous, low, narrow folds (Fig. 3 F — **ss**).

Typhlosoles low, bordering shallow intestinal groove (Fig. 3, F — **ig**), lined with very low epithelium. Intestinal groove visible through stomach walls as a dark band (Fig. 3, E — **ig**). Rectum thin walled, terminating with small, well-defined anal papilla. Stomach and rectum filled with sand grains.

Male reproductive system. Seminal vesicle large, of small, numerous loops. Penis short, occupying entire mantle cavity length, slightly dorsoventrally compressed, with smooth walls (Fig. 2, D-E). Penis with long (about 1/3 of the total penis length) papilla, expanded at midlength, surrounded by deep circular fold around its base.

Female reproductive system. Unknown.

Type locality. Elephant Island, South Shetland Islands, Antarctica, 60°53'S, 55°32'W, 120-178 m (R/V *Polarstern*, Sta. 42/079).

Type material. Holotype, USNM 1010542, from the type locality.

Distribution. (Fig. 4). The species is known only from the type locality.

Etymology. *anomala* from Greek *anomalos*, irregular, abnormal, reflecting the abnormal absence of operculum and significant differences in shell sculpture from the typical representatives of *Chlanidota*.

Remarks. Although the genus *Chlanidota* has a circum-Antarctic distribution at depths ranging from 3 to 1559 m, the subgenus *Pfeferria* is endemic to the waters surrounding South Georgia Island (Harasewych & Kantor, 1999). *Chlanidota (Paranotoficula) anomala* is presently known only from the South Shetland Islands, where it co-occurs with *Chlanidota (Chlanidota) signeyana* Powell, 1951, at comparable depths. It may be readily distinguished from *C. signeyana* on the basis of its thicker shell, shorter spire, absence of spiral sculpture, and an aperture that tapers posteriorly. *Chlanidota (Paranotoficula) anomala* differs from all species of

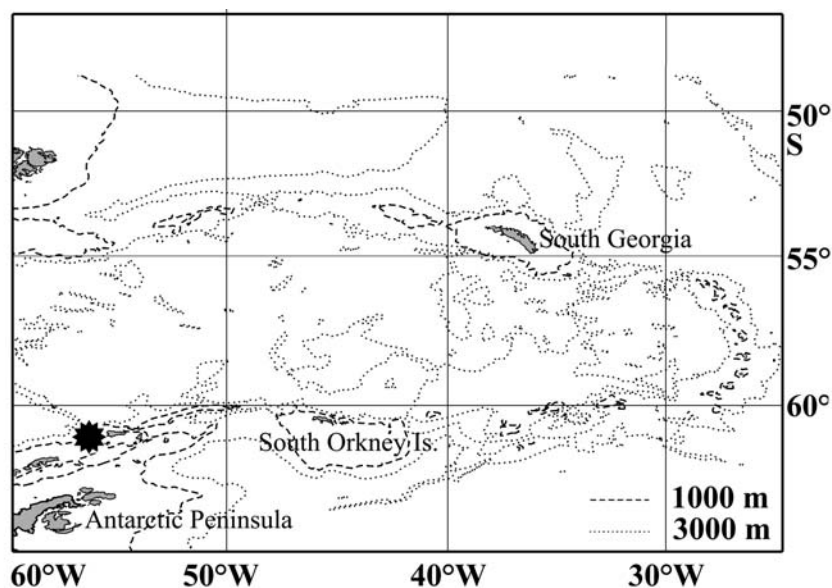


FIG. 4. *Chlanidota (Paranotoficula) anomala* sp. nov. Geographic distribution range. ★ = Type locality.

РИС. 4. *Chlanidota (Paranotoficula) anomala* sp. nov. Распространение. ★ = типовое местонахождение.

Chlanidota sensu stricto and *Chlanidota (Pfefferia)* in lacking an operculum, and in having separate salivary glands, a gland of Leiblein that is long and tubular, and a complex stomach morphology with a subtriangular cuticularized shield.

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Chlanidota (Paranotoficula) anomala, новый подрод и вид Buccinulidae (Gastropoda: Neogastropoda) из района Южных Шетландских островов

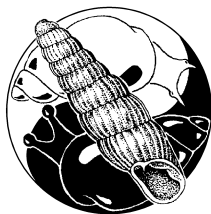
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РЕЗЮМЕ. Описан новый подрод *Paranotoficula* рода *Chlanidota* Martens, 1878, включающий единственный новый для науки вид *Chlanidota (Paranotoficula) anomala*. *Paranotoficula* напоминает как *Chlanidota sensu stricto*, так и *Chlanidota (Pfefferia)* по морфологии раковины и радулы, но отличается от обоих подродов отсутствием крышечки, трубчатой железой Лейбейна, у которой отсутствует терминальная ампула, а также более сложно устроенным желудком с кутикулизированным гастрическим щитком и более широкой семявыносящей папиллой пениса.

Типовой вид *Chlanidota (Paranotoficula) anomala* n. sp., описан по единственному экземпляру, собранному у Южных Шетландских островов.



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