Antarctic Science 11 (4): 430–435 (1999) © British Antarctic Survey Printed in the United Kingdom

Rediscovery of the Antarctic species *Sipho gaini* Lamy, 1910 (Gastropoda: Neogastropoda) with remarks on its taxonomic position

YURI I. KANTOR[1], and M.G. HARASEWYCH[2]*

[1]*A.N. Severtzov Institute of Problems of Evolution, Russian Academy of Sciences, Leninski prospect 33, Moscow 117071, Russia*
[2]*Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560-0118, USA*
**corresponding author*

Abstract: Examination of the holotype of *Sipho gaini* Lamy, 1910, attributed by recent authors to the genus *Chlanidota* (Buccinulidae), revealed that this species belongs to the genus *Belaturricula* and is a senior synonym of *Belaturricula antarctica* Dell, 1990. A redescription of the shell, anterior alimentary system, and radular morphology of *Belaturricula gaini* is provided. The genus *Belaturricula* is transferred to the family Conidae (*sensu* Taylor *et al.* 1993) on the basis of its radula, which is composed of hollow marginal teeth. The presence of a large shell, prominent operculum, acinous salivary glands, radular teeth with narrow bases in *B. gaini*, as well as the absence of buccal lips and rhyncodeal introvert, all indicate affinities with the conid subfamily Clathurellinae. Because the radula of *Pontiothauma ergata* Hedley (1916) is nearly indistinguishable from that of *Belaturricula gaini*, we reassign Hedley's species to the genus *Belaturricula* as *Belaturricula ergata* (Hedley, 1916).

Received 11 November 1998, accepted 12 July 1999

Key words: bathyal, benthos, Conidae, Gastropoda, Mollusca, Scotia Plate, systematics

Introduction

Sipho gaini Lamy, 1910, was described on the basis of a single specimen collected off the South Shetland Islands. Thiele (1912) provisionally included this species when describing the genus *Prosipho*. More recently, *S. gaini* has been assigned to the related genus *Chlanidota* Martens, 1878, by Powell (1951) and Carcelles (1953). Dell (1990) referred to *Chlanidota gaini* as a species of uncertain affinity known only from its holotype. This species has not been illustrated since Lamy (1911) figured the holotype, and there have been no new records or findings of this taxon reported since the original description.

In the course of a revision of the genus *Chlanidota* (Harasewych & Kantor 1999), we were able to examine the holotype of *Sipho gaini* as well as several additional specimens collected by the United States Antarctic Program (USAP) and the Alfred-Wegener-Institut für Polar- und Meeresforschung (RV *Polarstern*, Cruise ANT XIV/2). The anatomy and radular morphology clearly indicate that this species does not belong to the Buccinoidea, but rather has strong affinities to the Conoidea, particularly the family Conidae (*sensu* Taylor *et al.* 1993). Comparison of the holotype of *S. gaini* with the holotype and paratypes of *Belaturricula antarctica* Dell, 1990, revealed these two taxa to be conspecific. The following re-description of *Belaturricula gaini* uses the anatomical terminology of Taylor *et al.* (1993), as well as their classification of the Conoidea. Throughout the text, "specimen" refers to a shell with preserved animal; "shell" refers to an empty shell.

Systematics

Family Conidae Fleming, 1822
Subfamily Clathurellinae H. & A. Adams, 1858

Belaturricula Powell, 1951
Powell, 1951:170; Powell, 1966: 34, pl. 3, fig. 5; Dell, 1991: 227–228.

Type species – *Bella turrita* Strebel, 1908, by original designation.

Belaturricula gaini (Lamy, 1910)
Sipho gaini Lamy, 1910: 319, Lamy, 1911: 7, pl. 1, figs 7–8.
Prosipho? gaini – Thiele, 1912: 262.
?Chlanidota gaini – Powell, 1951: 142.
Chlanidota gaini – Carcelles, 1953: 191, Dell, 1990: 177; Harasewych & Kantor, 1999: 293.
Belaturricula antarctica Dell, 1990: 228–229, figs 401, 431.

Type locality: [*Sipho gaini*] Off King George Island, South Shetlands, in 420 m; [*Belaturricula antarctica*] RV *Hero* Sta. 465, off South Shetland Islands, 62°56.9'S, 60°50.1'W, in 154 m.

Type material: [*Sipho gaini*] Holotype (Fig. 1a–d, h), Museum national d'Histoire naturelle, Paris (MNHN), shell length = 32.9 mm; [*Belaturricula antarctica*] Holotype (Fig. 1e–g), National Museum of Natural History, Smithsonian Institution, USNM 860141, shell length = 67.6 mm, from the type locality;

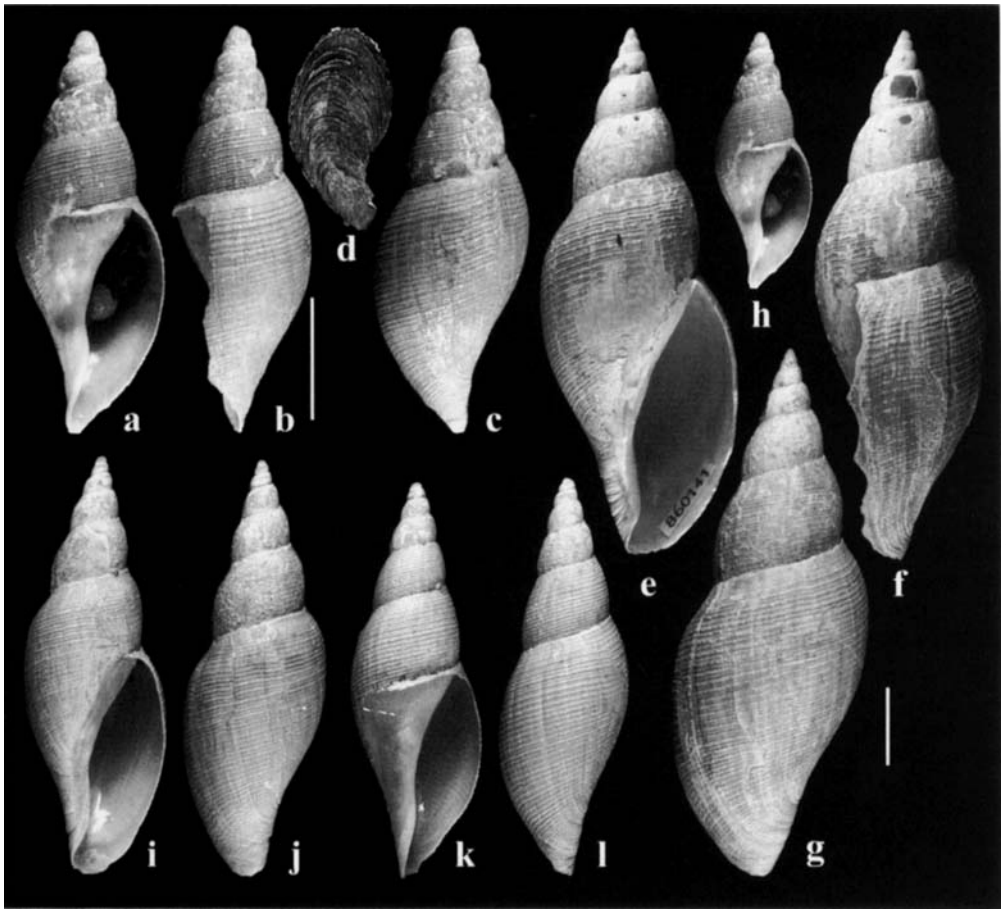

Fig. 1. *Belaturricula gaini* (Lamy, 1910). **a–d.** Holotype of *Sipho gaini* Lamy, 1910. (**d.** operculum). Scale bar =1 cm. **h.** Holotype of *Sipho gaini* at the same scale as other specimens in figure. **e–g.** Holotype of *Belaturricula antarctica* Dell, 1990, USNM 860141, **i–j.** USNM 901688, **k–l.** USNM 901689 (anatomy examined). Scale bar = 1 cm.

paratype 1, USNM 860142, RV *Eltanin*, Sta. 437, Bransfield Strait, 62°50'S, 60°40'W, in 267–311 m; paratypes 2–3, USNM 860143, paratype 4, National Museum of New Zealand MF. 56619, RV *Eltanin*, Sta. 1003, Bransfield Strait, 62°41'S, 54°43'W, in 210–220 m; paratype 5, USNM 860144, RV *Eltanin*, Sta. 1079, E of South Orkney Islands, 61°26'S, 41°55'W, in 593–598 m.

Material examined: Holotype of *Sipho gaini*, holotype and paratypes 1–3, 5 of *Belaturricula antarctica*. RV *Eltanin*: Sta. 410, off Elephant Island, South Shetland Islands, 61°18'S, 56°09'W, in 220–240 m, 2 specimens, USNM 881894; Sta. 1002, Palmer Peninsula, Joinville Island, 62°40'S, 54°45'W, in 265 m, 1 specimen, USNM 881974; Sta. 1079, Scotia Ridge, 61°26'S, 41°55'W, in 593–598 m, 1 specimen, USNM 881986; Sta. 1885, S of Coulman Island, Victoria Land, Antarctica, 74°30'S, 170°10'E, in 311–328 m, 1 specimen, USNM 870946; Sta. 1995, E of Cape Hallett, Moubray Bay, Victoria Land, Antarctica, 72°03'–72°04'S, 172°38'–172°06'E, in 344–348 m, 1 shell fragment, USNM 898007. RV *Polarstern*: Sta. 42/008, off Elephant Island, South Shetland Islands, 61°16'S, 55°50'W, 142–158 m, 1 specimen, USNM 901688; Sta. 42/028, E of Elephant Island, South Shetland Islands, 60°59'S, 55°55'W, 214–219 m, 1 specimen, USNM 901689 (anatomy examined); Sta. 42/034, N of Elephant Island, South Shetland Islands, 60°53'S, 55°25'W, 281–302 m, 1 specimen, USNM 901690.

Bransfield Strait, 63°23.27'S, 57°00.41'W, 276–280 m, 1 specimen, USNM 897602; Low Island, South Shetlands, 63°18.51'S, 61°53.03'W, 228–264 m, 3 specimens, USNM 897631.

Description. Shell large (>90 mm, based on broken specimen measuring 83 mm, lacking lower part of columella and aperture), thin, fragile, narrow, fusiform, with tall spire. Protoconch large (2.4–2.8 mm diameter), rounded, of about 1⅓ whorls, usually eroded. Teleoconch of up to 7.5 evenly rounded whorls. Suture tightly adpressed. Spiral sculpture of prominent spiral cords (55–82 on body whorl, 15–28 on penultimate whorl) of irregular width, as wide to much wider than intervening spaces. Axial sculpture of very fine axial striae, some raised to form inconspicuous axial folds. Posterior sinus very shallow, subsutural, nearly indistinct. Aperture narrow, ovate, deflected from shell axis by 14–18°. Outer lip very thin, fragile, evenly rounded, simple. Columella slightly less than half of aperture length, convex, with strong siphonal fold. Callus consisting of thin glaze overlying parietal region and siphonal fasciole. Siphonal canal broad, short, straight. Shell color grayish to yellowish white inside and out, aperture thinly glazed. Periostracum yellowish, very thin, smooth, strongly adherent. Operculum very small (<¼ aperture length), unguiculate, its nucleus strongly deflected posteriorly.

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One well-preserved specimen (USNM 901689, shell length = 50.7 mm, Fig. 1k–l) was dissected and its anterior foregut embedded in paraffin and serially sectioned (10 μm sections, stained with Masson's trichrome).

Epithelium of entire rhynchodeal cavity wall formed of tall, glandular cells, indicating that the rhynchodeal wall does not take part in proboscis protraction. Retracted proboscis (Fig. 2) of moderate length, broad, with very thin walls. Mouth narrow in relaxed animals, capable of great expansion. Muscles of proboscis walls uniformly developed along its entire length. Buccal tube wide, with thin, folded walls lined with tall, columnar non-ciliated epithelium (Fig. 3g, ep), lacks sphincters, and forms an introvert (valvule) (Fig. 2, v; Fig. 3g) near the anterior third of the proboscis. Buccal cavity lined with tall epithelium (Fig. 2 bc). Buccal mass with thick, muscular walls and narrow lumen, partially projects from the rear of the retracted proboscis, spanning about ¾ of proboscis length. Buccal lips absent. Circumoesophageal nerve ring (Fig. 2, con) at rear of proboscis. Salivary glands (Fig. 2, sg; Fig. 3f, sg) acinous, medium-sized, paired, not fused. Venom gland uniform throughout its length. Muscular bulb elongate–oval, its wall formed of two layers of longitudinal muscle of equal thickness separated by a layer of connective tissue. Lumen of bulb lined with tall epithelium. Radula (Fig. 3) of long, slender, hypodermic marginal teeth with small bases and two distinct, medium-sized apical barbs. Tooth length about 810 μm (0.016 x shell length). A well-developed ligament (Fig. 3a) maintains regular tooth arrangement within the radular sac.

Distribution: (Fig. 4) *Belaturricula gaini* occurs off the Palmer Peninsula, off the South Shetland and South Orkney Islands, as well as off the eastern margin of the Ross Sea, at depths ranging from 142 to 598 m. This species appears limited to bathyal depths along the Antarctic continent bordering the southern Pacific Ocean, and the southern margins of the Scotia Plate. Dell (1990: 229) conjectured that *Belaturricula antarctica* may prove to have a circum-Antarctic distribution, and tentatively identified a single, narrower, more strongly ribbed shell from the South Sandwich Islands as this species. We have examined this worn shell (USNM 870759) and regard it to represent a different, possibly undescribed species of *Belaturricula*.

Remarks: Direct comparison of the holotype of "*Sipho*" *gaini* (Fig. 1a–d, h) with the holotype (Fig. 1e–g) and paratypes of *Belaturricula antarctica* confirms that these two taxa are indistinguishable in shell morphology, radular morphology or anatomical organization, and therefore conspecific. The holotype of *Sipho gaini* is a juvenile specimen, and conforms to all the characters used to diagnose *B. antarctica* (Dell, 1990: 229) apart from size. The correct binomen for this taxon is *Belaturricula gaini* (Lamy, 1910).

Discussion

The genus *Belaturricula* was proposed by Powell (1951: 170) to include the single species *Bela turrita* Strebel, 1908, described from the Shag Rock Bank, west of South Georgia. Powell did not compare *Belaturricula* to other genera of Turridae, but mentioned that the type species was similar to *Pleurotoma* (*Surcula*) *dissimilis* Watson, 1886, from bathyal depths off the Philippines. Later, Powell (1969: 362) tentatively transferred *P. dissimilis* to *Belaturricula*. As *P. dissimilis* is

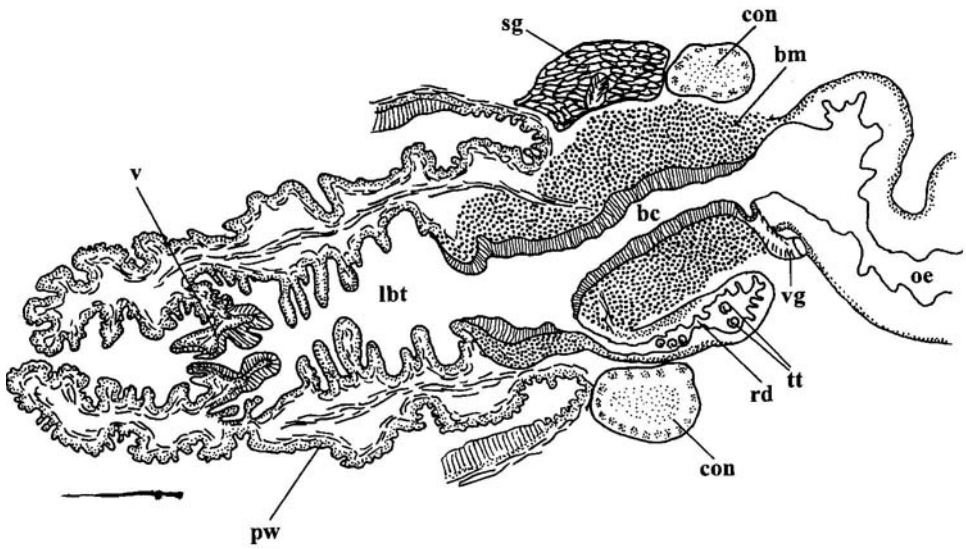

Fig. 2. Semi-diagrammatic longitudinal section through the proboscis. Salivary ducts and loops of the venom gland are not shown. A radular tooth is shown below the proboscis tip at the same scale. Abbreviations: bc = buccal cavity; bm = buccal mass, con = circum-oesophageal nerve ring, lbt = lumen of the buccal tube, oe = oesophagus, pw = proboscis wall, rd = radular caecum, sg = salivary gland, tt = radular teeth, v = valvule, vg = venom gland.

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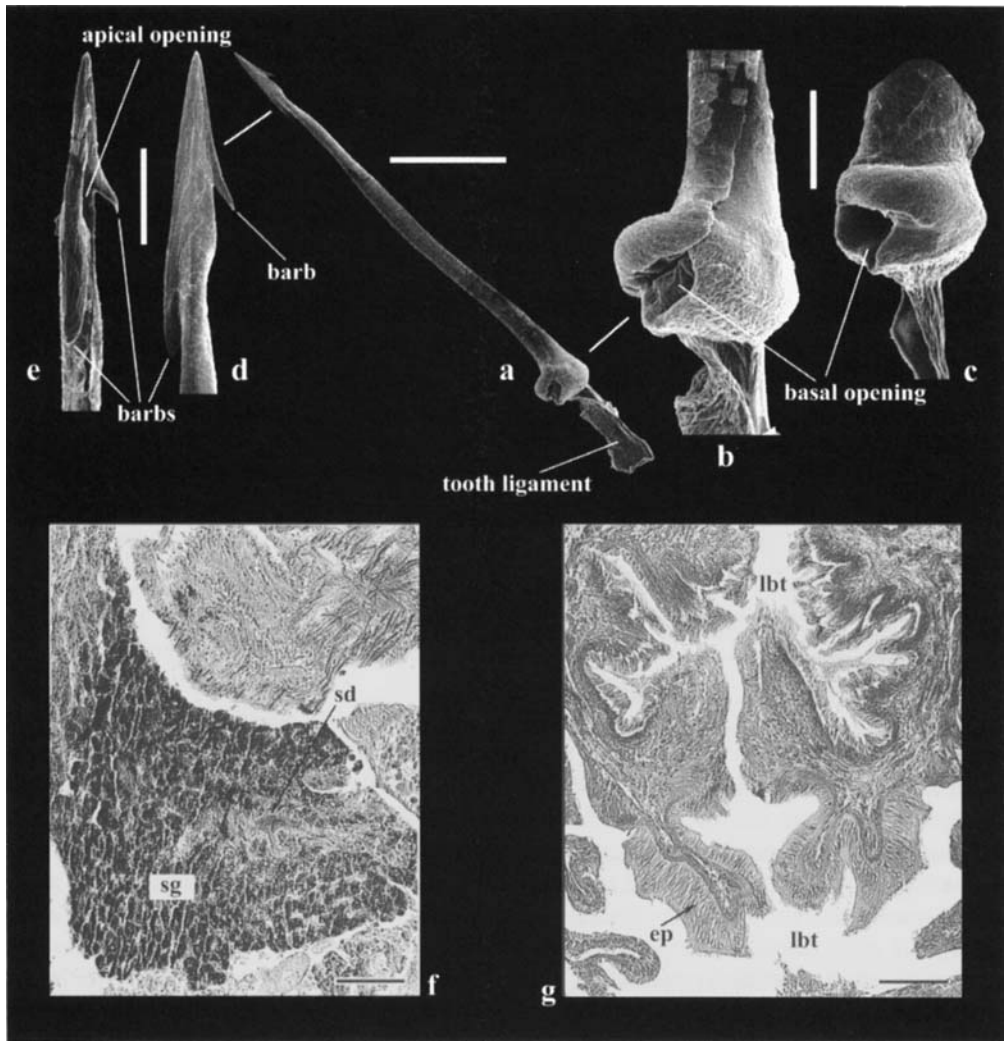

Fig. 3. Radula of *Belaturricula gaini* (Lamy, 1910) (**a–e**). **a.** single marginal tooth, scale bar = 200 mm, **b, c.** tooth base in two slightly different orientations to show the basal opening, scale bar = 50 mm, **d, e.** tooth tip in two different orientations to show the apical opening and barbs, scale bar = 50 mm, **f.** section through the salivary gland, **g.** section through the valvule. Scale bars = 200 mm. Abbreviations: ep = tall, columnar epithelium, lbt = lumen of the buccal tube, sd = salivary duct, sg = salivary gland.

presently known only from the dead-collected holotype, a reassessment of the relationships of this species must await the availability of anatomical material.

In treating the genus *Belaturricula*, Dell (1990) subdivided the type species into two geographically separated subspecies, *Belaturricula turrita turrita* (Strebel, 1908), endemic to South Georgia, and *B. turrita multispirata* Dell, 1990, from the Antarctic Peninsula and the South Shetland Islands. In the same work, Dell (1990) described a second species, *Belaturricula antarctica* (a junior synonym of *Belaturricula gaini*), which he regarded to have a broader, circum-Antarctic distribution.

Examination of the substantial holdings of *Belaturricula* at USNM confirms that the subspecies *B. turrita turrita* is restricted in its distribution to South Georgia and the neighbouring Shag Rock Bank. It resembles *B. gaini*, which does not occur off South Georgia, but differs in having finer surface sculpture (>30 cords on penultimate whorl). The subspecies *B. turrita multispirata* Dell, 1990, is characterized by an even finer spiral sculpture (51–63 cords on penultimate whorl). It overlaps geographically with *B. gaini*, but not bathymetrically. *Belaturricula turrita multispirata* has been reported from shallower depths (73–101 m) than *B. gaini* (154–598 m).

When describing the genus *Belaturricula*, Powell (1951: 166) did not assign it to any of the subfamilies of Turridae. Later (Powell 1969: 362), he treated the genus as a member of the subfamily Turriculinae. At that time, *Belaturricula* included species known only from dead-collected material, so neither radulae, nor opercula were known. Dell (1990: 227) was the first to observe the opercula and radulae of *B. turrita* and *B. gaini* (as *B. antarctica*), and provided schematic drawings of the radular teeth of both species (Dell 1990: figs 430, 431). Because the radula is composed of hollow marginal teeth, the

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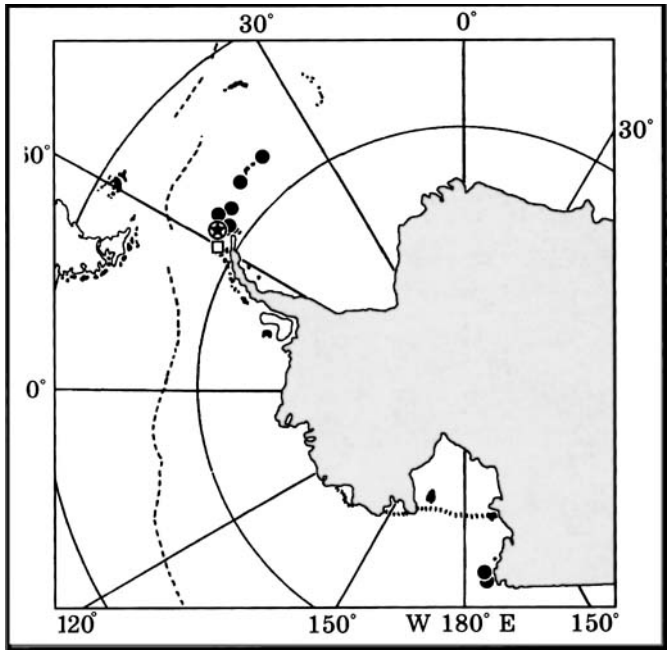

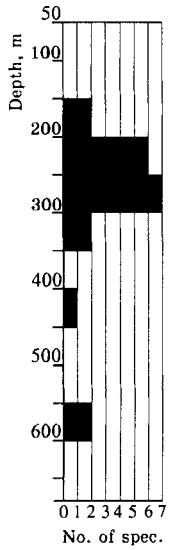

Fig. 4. Geographic and bathymetric distribution of *Belaturricula gaini* (Lamy, 1910): star = type locality, open square = type locality of *B. antarctica* (Dell, 1990), circles = examined material.

genus belongs to the family Conidae (*sensu* Taylor *et al.* 1993).

In his list of generic names of conoideans, Sysoev (*in* Taylor *et al.* 1993) transferred *Belaturricula* to the subfamily Mangeliinae of Conidae. The subfamily Mangeliinae is characterized by a small shell (usually 5–12 mm, but reaching 20 mm), the lack of an operculum, and by salivary glands that are tubular. Our study of *B. gaini* revealed this species to have a large shell (up to 90 mm), a large, distinctive operculum, and acinous salivary glands. The long, slender, narrow-based, radular teeth of *B. gaini* are most similar to those of species included in the highly variable subfamily Clathurellinae (e.g. Taylor *et al.* 1993, fig. 20 c, Schimek & Kohn 1981, fig. 12). The teeth of *B. gaini* are relatively long (about 1.6% of shell length) and comparable in size to those Clathurellinae. Other characters that unite *Belaturricula* with Clathurellinae are the lack of buccal lips as well as a rhynchodeal introvert. The buccal tube introvert (valvule) (Fig. 2, v) of *B. gaini* is the first record of this structure in the subfamily Clathurellinae. Since *B. gaini* lacks buccal tube sphincters, this introvert is likely used to grasp and hold the radular tooth at the proboscis tip while stabbing prey. The distance from the mouth opening to the introvert is roughly equal to the length of tooth [a single tooth is shown (Fig. 2) at the same scale as the proboscis].

In his description of *Pontiothauma ergata* Hedley (1916) commented on the similarity of this species to *Sipho gaini*. Comparison of the radula of *Belaturricula gaini* (Fig. 3a) with that of *P. ergata* (Hain 1990, pl. 17, fig. 2, Numanami 1996, figs 159D–E) reveals the two to be nearly identical in overall morphology, especially in the shape of the tooth base and in the number and orientation of barbs near the tooth apex. The radula of *P. ergata* has little in common with the radulae of *P. mirabile* Smith, 1895 (type species of *Pontiothauma*) or *P. abyssicola* Smith, 1895, which both have a typical daphnelline radula with a large tooth base and a single, small barb at the apex (Powell 1966: figs 165–166). We therefore reassign Hedley's species to the genus *Belaturricula* as *Belaturricula ergata* (Hedley, 1916).

Another species assigned to the genus *Ponthiothauma*, *P. hedleyi* Dell (1990), resembles *Pontiothauma ergata* in shell morphology. This species is presently known only from dead-collected material, and neither its radula nor its operculum, which could resolve its generic assignment, are known.

Acknowledgements

We are grateful to Philippe Bouchet for the loan of the holotype of *Sipho gaini*, and to Michael Vecchione for providing preserved material collected aboard the RV *Polarstern*. Thanks are due to Walt Brown and Sussann Bradon for their assistance with scanning electron microscopy, and to Dr Donn Tippett and the referees, Drs H. Wägele and P. Bouchet, for helpful comments on the manuscript.

This research was supported by a grant from the NSF-USAP United States Antarctic Program [Contract No. OPP-9509761].

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