

The genus *Brookula* Iredale, 1912 (Gastropoda, Trochidae) from Brazil: description of a new species, with notes on other South American species

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ABSTRACT

The taxonomy of the species belonging to the genus *Brookula* Iredale, 1912, mainly from the Atlantic coast of South America and some others from adjacent Antarctic waters is reviewed. The following species are reported from South America: *Brookula decussata* (Pelseneer, 1903); *Brookula crassicostata* (Strebel, 1908); *Brookula calypso* (Melvill & Standen, 1912); *Brookula powelli* Clarke, 1961; *Brookula exquisita* Clarke, 1961; *Brookula lamonti* Clarke, 1961; *Brookula pfefferi* Powell, 1951; *Brookula conica* (Watson, 1886); and *Brookula spinulata* n. sp., the three latter species occurring off the Brazilian coast. *Brookula strebeli* Powell, 1951, *Brookula sinusbreidensis* Numanami & Okutani, 1991 and *Brookula delli* Numanami, 1996 are considered to be junior synonym of *B. pfefferi*. *Brookula spinulata* n. sp. is distinguished from all other species known from the southwestern Atlantic by the nature of the spiral revolving threads.

KEY WORDS

Mollusca,
Gastropoda,
Trochidae,
Brookula,
South America,
new species.

RÉSUMÉ

Le genre *Brookula* Iredale, 1912 (*Gastropoda*, *Trochidae*) du Brésil : description d'une nouvelle espèce, avec notes sur d'autres espèces Sud américaines.

La taxonomie des espèces du genre *Brookula* Iredale, 1912, essentiellement de la côte Atlantique de l'Amérique du Sud et des eaux antarctiques adjacentes, est révisée. Les espèces suivantes sont décrites : *Brookula decussata* (Pelseneer, 1903) ; *Brookula crassicosata* (Strebel, 1908) ; *Brookula calypso* (Melvill & Standen, 1912) ; *Brookula powelli* Clarke, 1961 ; *Brookula exquisita* Clarke, 1961 ; *Brookula lamonti* Clarke, 1961 ; *Brookula pfefferi* Powell, 1951 ; *Brookula conica* (Watson, 1886) ; et *Brookula spinulata* n. sp. ; les trois dernières espèces sont rencontrées sur les côtes brésiliennes. *Brookula strebeli* Powell, 1951, *Brookula sinusbreidensis* Numanami & Okutani, 1991 et *Brookula delli* Numanami, 1996 sont considérés comme des synonymes plus récents de l'espèce *B. pfefferi*. *Brookula spinulata* n. sp. est distinguée des autres espèces connues de la côte sud-est de l'Atlantique en raison de sa spirale en forme de filet retourné.

MOTS CLÉS

Mollusca,
Gastropoda,
Trochidae,
Brookula,
Amérique du Sud,
nouvelle espèce.

INTRODUCTION

The genus *Brookula* Iredale, 1912 comprises a group of microgastropods usually associated with deep temperate waters. Eight species of this genus have been recorded from South America, most of them recorded off the southernmost part of the continent, adjacent to Antarctic waters: *Brookula decussata* (Pelseneer, 1903); *Brookula crassicosata* (Strebel, 1908); *Brookula calypso* (Melvill & Standen, 1912); *Brookula strebeli* Powell, 1951; *Brookula pfefferi* Powell, 1951; *Brookula powelli* Clarke, 1961; *Brookula exquisita* Clarke, 1961; and *Brookula lamonti* Clarke, 1961. In Brazil, only *Brookula conica* (Watson, 1886) has been previously reported.

This work presents the description of a new species of *Brookula* from off southeastern Brazil, a redescription of *B. conica* and *B. pfefferi*, and remarks on the taxonomy of other South American species and adjacent Antarctic areas, including SEM illustrations of the type specimens of most of the species listed above.

The whole paper is based on empty shells. In the material examined lists, the number of shells studied for each species is given between brackets. Counting of protoconch whorls followed the method used by Leal (1991).

ABBREVIATIONS

| | |
|-------------|---|
| Collections | |
| BMNH | British Museum of Natural History, London; |
| IBUERJ | Instituto de Biologia da Universidade do Estado do Rio de Janeiro, Rio de Janeiro; |
| IBUFRJ | Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro; |
| MACN | Museo Argentino de Ciencias Naturales, Buenos Aires; |
| MCZ | Museum of Comparative Zoology, Cambridge; |
| MNHN | Muséum national d'Histoire naturelle, Paris; |
| MNRJ | Museu Nacional / Universidade Federal do Rio de Janeiro, Rio de Janeiro; |
| MORG | Museu Oceanográfico "Eliézer de Carvalho Rios" da Fundação Oceanográfica do Rio Grande, Rio Grande; |
| MZSP | Museu de Zoologia da Universidade de São Paulo, São Paulo; |
| NMC | Canadian Museum of Nature, Ottawa; |
| RSM | National Museums of Scotland, Edinburgh; |
| USNM | National Museum of Natural History, Washington, D.C.; |
| ZMA | Zoölogisch Museum Amsterdam, Amsterdam; |
| ZMH | Zoologisches Institut und Museum der Universitaet Hamburg, Hamburg; |
| NSMT | National Science Museum of Tokyo, Tokyo; |
| Expeditions | |
| JOPS | Joint Oceanographic Projects, Research Vessel, Victor Hansen coll.; |

- PADCT Programa de Apoio ao Desenvolvimento Científico e Tecnológico (National Support Program for the Development of Science and Technology), Oceanographic Vessel, Professor W. Besnard coll.;
- REVIZEE Recursos Vivos da Zona Econômica Exclusiva (Assessment of the Sustainable Potential of the Living Resources of the Economic Exclusive Zone), Oceanographic Vessel, Professor W. Besnard coll.

SYSTEMATICS

Family TROCHIDAE Rafinesque, 1815
 Subfamily EUCYCLINAE Koken, 1897

Genus *Brookula* Iredale, 1912

Brookula Iredale, 1912: 219.

TYPE SPECIES. — *Brookula stibarochila* Iredale, 1912: 220 by original designation (holotype's photograph in Clarke 1961: pl. 1, fig. 5).

DIAGNOSIS. — Shell small, globose-turbinata, thin, umbilicate, with inflated whorls. Protoconch smooth or sculptured with anastomosing ribs forming microscopic pits or with irregular wart-like concretions. Axial sculpture dominant; raised spiral sculpture well-defined, but weaker, in some species overriding and forming beads at intersections with axial ribs; fine incremental growth lines are present. Suture deeply constricted. Aperture rounded, slightly oblique, with a slightly thickened lip and complete peritreme.

REMARKS

The genus *Brookula* was created by Iredale (1912), based on *Brookula stibarochila*, to include certain species that he could not place in any other genus of Cyclostrematidae. *Cyclostrema conicum* Watson, 1886, was a member of that group. Clarke (1961) divided the species of *Brookula* into three subgenera: *Brookula* sensu stricto; *Vetulonia* Dall, 1913 (type-species: *Vetulonia galapagana* Dall, 1913); and *Benthobrookula* Clarke, 1961 (type-species: *Brookula* (*Benthobrookula*) *exquisita* Clarke, 1961).

Warén (1992) regarded *Brookula* as belonging to the family Trochidae, subfamily Eucyclinae

(sensu Hickman & McLean 1990: 74, 75) and raised the taxon *Benthobrookula* Clarke, 1961 to generic level, considering it as probably related to *Lissotesta* Iredale, 1915, because of the protoconch type shared by both taxa. However, Warén (1992: 170) expressed doubts whether that type of protoconch is a “synapomorphy or caused by modification in the larval development”. The subfamily Eucyclinae is largely characterized by the radulae (diagnosis in Hickman & McLean 1990), but we have no information about radulae from local Brazilian *Brookula* species. In the other hand, the radulae of *B. powelli* (Clarke 1961: pl. 4, fig. 9) seems to fit well within the definition given by Hickman (1998: 680) for this subfamily. Therefore, we follow Hickman & McLean (1990) in considering the genus *Brookula* as included in the subfamily Eucyclinae, but regard all species herein treated as belonging to the genus *Brookula* sensu lato, because of the insufficiently well-established supraspecific classification, even in a conchological sense.

Among the South American species of *Brookula*, there are two or perhaps three recognizable kinds of protoconch sculpture. *Brookula calypso*, *B. powelli* and *B. exquisita* have protoconchs consisting of a surface covered by very low, irregular wart-like concretions (Fig. 1B, D, F). This kind of protoconch ornamentation differs from that found in the three species discussed in this paper (*B. conica*, *B. pfefferi*, and *B. spinulata* n. sp.), which consists of very fine and densely crowded anastomosing ribs, forming microscopic pits in a somewhat alveolar pattern (Figs 2F, G; 4E-G; 5G). A third pattern seems to be present in the topotype of *B. stibarochila* (figure in Warén 1992: 224, fig. 23B), which shows an apparently smooth protoconch surface.

Beside the Brazilian species reported herein, additional species from southwestern Atlantic and adjacent Antarctic waters have been, elsewhere, referred to *Brookula*. We give a brief summary of some of them:

1. *Cyclostrema liratula* Pelseneer, 1903 and *Cyclostrema humile* Pelseneer, 1903, were included in *Brookula* by Carcelles (1953). However, these species do not fit the genus *Brookula* as

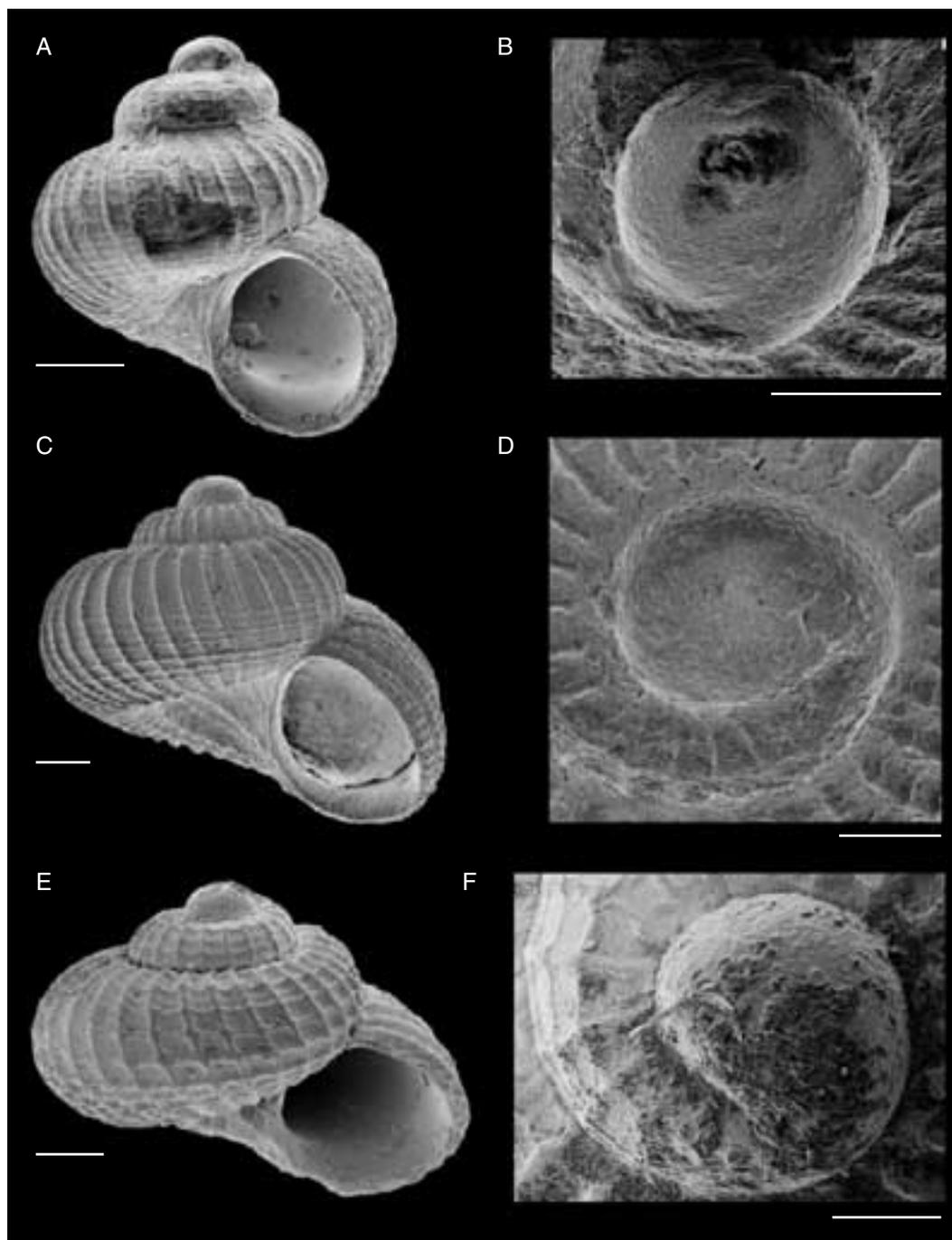


FIG. 1. — Holotypes of *Brookula* species from southeast South American coast; **A, B**, *Brookula calypso* Melvill & Standen, 1912 (RSM 153599); **A**, apertural view; **B**, protoconch detail; **C, D**, *Brookula powelli* Clarke, 1961 (MCZ 224960); **C**, apertural view; **D**, protoconch detail; **E, F**, *Brookula exquisita* Clarke, 1961 (MCZ 225964); **E**, apertural view; **F**, protoconch detail. Scale bars: 200 μ m.

defined herein, since they lack axial sculpturing and have only spiral sculpture. Both species were referred to *Lissotesta* Iredale, 1915 by Warén (1992);

2. *Brookula crassicosata* (Strebel, 1908). Described from 54°43'S, 064°08'W, 36 m. According to a syntype (ZMH), *B. crassicosata* shows no trace of spiral sculpture, having only low and strong rounded ribs. This species was illustrated by Castellanos & Landoni (1989: 12, fig. 1a, b, c) and, according Warén (*in litt.*) this species fits in the *Liotella* Iredale, 1915 concept;

3. *Brookula decussata* (Pelseneer, 1903: 19, pl. 5, fig. 48). Described from the Bellingshausen Sea (70°S, 080°48'W, 500 m). The type for this species has not been located, and our comparisons to the Brazilian species are based on the original description and figure;

4. *Brookula rossiana* Dell, 1990: 102, fig. 169 and *Brookula antarctica* Dell, 1990: 102, fig. 170. Both described from the Ross Sea, at 362 m. Although the original description of *B. rossiana* fits very well in our concept for *B. pfefferi*, considering the scope of variation we found in the latter, we do not feel secure to consider them co-specific since we could not exam the holotype of *B. rossiana* and the original figure provided by Dell (1990) does not allow a precise evaluation of their conchological characters. On the other hand, the description of *B. antarctica* suggests it to be distinct enough to be consider as a valid species;

5. *Brookula lamonti* Clarke, 1961: 357, pl. 4, fig. 3. Described from the Scotia Sea, around 96 km south of South Georgia, at 3758 m. Although the holotype (MCZ 225963) is only a shell fragment, some parts of the shell sculpture, the aperture (partly broken), and the umbilicus are still visible. The narrow umbilicus and the somewhat posteriorly angled aperture are the distinctive characters, although the sculpture pattern shows no distinctions from *B. pfefferi*;

6. *Brookula calypso* (Melvill & Standen, 1912: 345, fig. 3). Described from Burdwood Bank, 54°25'S, 057°32'W (at 102 m). We illustrate the holotype (RSM 143.599) (Fig. 1A, B);

7. *Brookula powelli* Clarke, 1961: 355, pl. 3, fig. 7; pl. 4, figs 1, 9. Described from the mid-

Argentine Basin, around 1609 km east-southeast of Buenos Aires, at 4587 m. We illustrate the holotype (MCZ 224960) (Fig. 1C, D). There are also paratypes at MCZ and NMC;

8. *Brookula exquisita* Clarke, 1961: 356, pl. 3, fig. 8; pl. 4, fig. 2. Described from around 96 km south of South Georgia, at 3758 m. We illustrate the holotype (MCZ 225964) (Fig. 1E, F). There is also a paratype at NMC 4742.

Brookula conica (Watson, 1886)

(Fig. 2)

Cyclostrema conicum Watson, 1886: 122, pl. 8, fig. 9.

Brookula conica – Rios 1994: 39, pl. 12, fig. 128.

TYPE MATERIAL. — Three syntypes (BMNH 1887.2.9.432).

TYPE LOCALITY. — Off Pernambuco, Brazil, stn 120, 08°37'S, 034°28'W, 1235 m. — Stn 122, 09°05'S, 034°50'W, 640 m.

MATERIAL EXAMINED. — The photograph of the syntype herein figured and:

PADCT. [15], 28°00.05'S, 046°59.67'W, 490 m, 29.XI.1997 (IBUERJ 1519: # 6608); [50], 27°10.38'S, 047°27.54'W, 129 m, 09.XII.1997 (IBUFRJ 10872: # 6635); [20], 24°17.13'S, 044°12.15'W, 163 m, 10.I.1998 (MNRJ 8423); [25], 25°15.76'S, 45°04.62'W, 124 m, 21.XI.1997 (MORG 41033: # 6577); [2], 23°35.82'S, 041°42.42'W, 143 m, 15.XI.1997 (MZSP 32480: # 6541); [225], 24°12.74'S, 044°58.98'W, 79 m, 20.XI.1997 (MZSP 32481: # 6571); [3], 24°42.61'S, 044°43.42'W, 155 m, 20.XI.1997 (MZSP 32482: # 6573); [25], 25°15.76'S, 45°04.62'W, 124 m, 21.XI.1997 (MZSP 32483: # 6577); [5] (24°42.30'S, 045°18.83'W, 84 m, 21.XI.1997 (MZSP 32484: # 6579); [2] 25°17.66'S, 046°21.16'W, 81 m, 26.XI.1997 (MZSP 32485: # 6587); [55], 26°23.55'S, 046°39.49'W, 175 m, 27.XI.1997 (MZSP 32486: # 6595); [68], 27°48.07'S, 047°24.04'W, 175 m, 29.XI.1997 (MZSP 32487: # 6606); [14], 28°00.05'S, 046°59.67'W, 490 m, 29.XI.1997 (MZSP 32488: # 6608); [2], 23°57.99'S, 043°52.56'W, 133 m, 07.XII.1997 (MZSP 32489: # 6627); [51], 27°10.38'S, 047°27.54'W, 129 m, 09.XII.1997 (MZSP 32490: # 6635); [1], 25°49.30'S, 046°34.00'W, 128 m, 11.XII.1997 (MZSP 32491: # 6642).

REVIZEE. [1], 25°51.04'S, 045°47.30'W, 206 m, 15.XII.1997 (MZSP 32492: # 6652); [9], 25°43.50'S, 046°02.50'W, 155 m, 15.XII.1997 (MZSP 32493: # 6653); [1], 24°17.68'S, 043°48.20'W, 314 m, 09.I.1998 (MZSP 32494: # 6660); [150], 24°00.95'S,

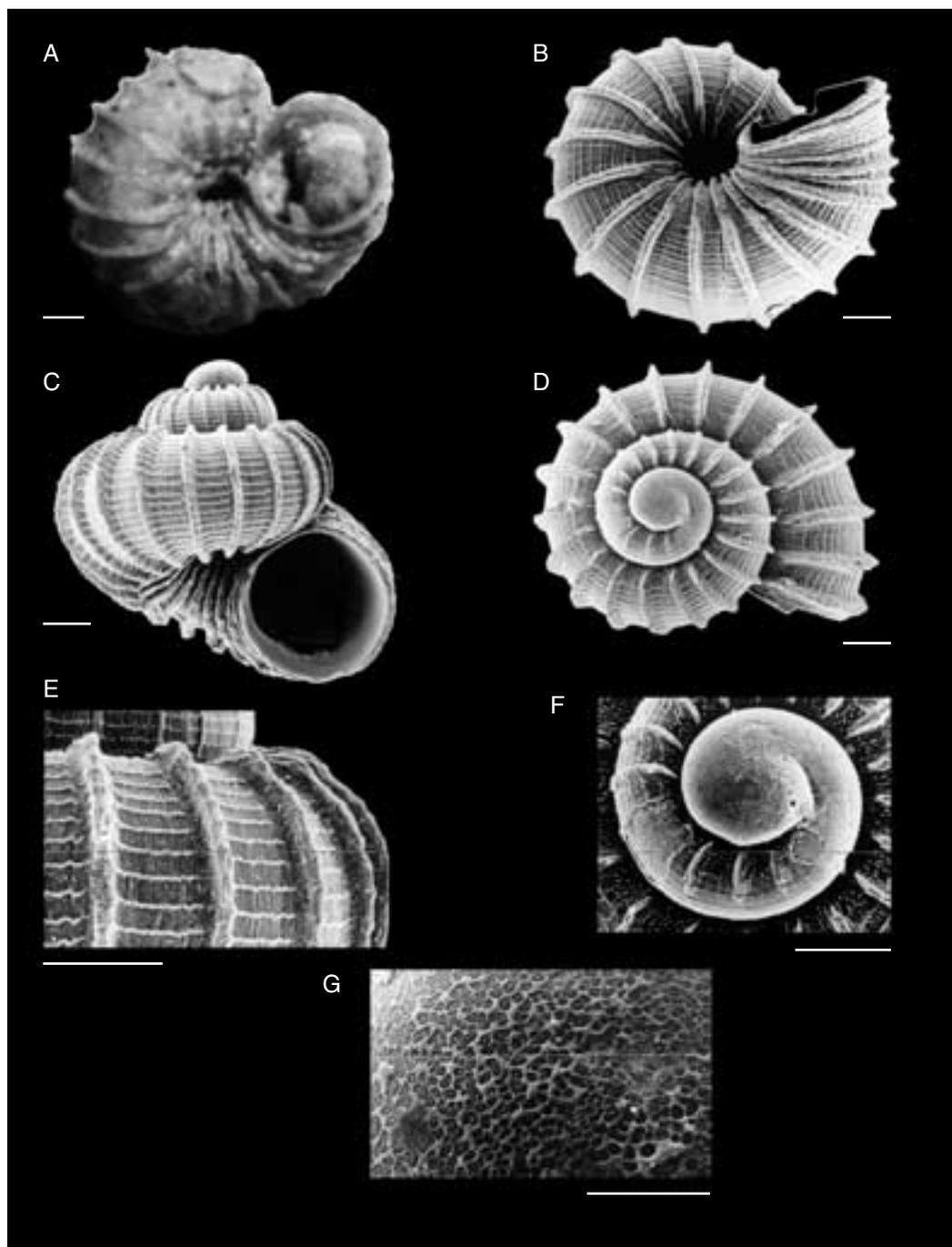


FIG. 2. — *Brookula conica* (Watson, 1886); **A**, syntype (BMNH 1887.2.9.432); **B-G**, Brazilian material (all from MZSP 32495); **B**, basal view; **C**, apertural view; **D**, apical view; **E**, sculpture detail of last adult whorl; **F**, protoconch; **G**, protoconch sculpture detail. Scale bars: A-F, 100 μ m; G, 20 μ m.

043°55.54'W, 135 m, 09.I.1998 (MZSP 32495: # 6662); [4], 24°26.48'S, 044°06.55'W, 500 m, 10.I.1998 (MZSP 32496: # 6664); [30], 24°17.13'S, 044°12.15'W, 163 m, 10.I.1998 (MZSP 32497: # 6666); [3], 23°55.40'S, 044°24.45'W, 107 m, 10.I.1998 (MZSP 32498: # 6668); [22], 24°07.42'S, 044°42.22'W, 101 m, 11.I.1998 (MZSP 32499: # 6669); [2], 24°32.91'S, 044°27.46'W, 260 m, 11.I.1998 (MZSP 32500: # 6671); [1], 24°40.75'S, 044°50.82'W, 137 m, 12.I.1998 (MZSP 32501: # 6677); [1], 25°10.00'S, 044°56.65'W, 167 m, 12.I.1998 (MZSP 32502: # 6681).

REDESCRIPTION

Shell trochiform, reaching 1.8 mm in height, 1.83 mm in width; spire elevated, umbilicate, color white. Protoconch globose, around one and a half whorls, about a half emerged from first teleoconch whorl, and sculptured with fine, densely crowded anastomosing ribs forming microscopic pits in a somewhat alveolar pattern. Teleoconch with up to two whorls, with convex profiles. Suture deep. Axial sculpture consisting of heavy, narrow, slightly prosocline axial ribs (19 on last whorl of syntype, illustrated herein), ribs continuing through base of shell, reaching umbilical region; microscopic axial lines present through interspaces. Spiral sculpture formed by about 20 (last whorl + base) prominent, thin, regularly spaced, revolving cords, cords crossing axial ribs; spirals forming no stronger cords surrounding umbilicus. Aperture rounded, holostomate. Umbilicus large, circular, deep. Outer lip thin.

REMARKS

Brookula conica is the only member of the genus previously recorded off Brazil, and seems to be one of the few *Brookula* species associated with tropical environments.

The type series of *B. conica* includes three syntypes, two of them broken (K. Way *in litt.*). Although we had access to a photograph of only one of the type specimens of *B. conica* (Fig. 2A), which is glued on a piece of cardboard and does not show the spire, protoconch, or sculpturing, the original description and illustrations (Watson 1886) provide good representation of this species. This allowed us to recognize a large number

TABLE 1. — Shell measurements and counting of Brazilian specimens of *Brookula*. Abbreviations: **h/w**, ratio height / width; **sd**, standard deviation; **slw**, range of spiral threads on last whorl; **sb**, range of spiral threads on base; **ribs**, range of ribs on last whorl; **n**, number of specimens measured; **slw**, and **sb**, for *B. conica* (Watson, 1886) were not possible to be accurately measured in optical microscopy.

| | h/w ± sd (range) | slw | sb | ribs | n |
|-------------------------------------|-----------------------------|------------|-----------|-------------|----------|
| <i>Brookula conica</i> | 1.01 ± 0.05 (0.9-1.11) | - | - | 15-27 | 20 |
| <i>Brookula pfefferi</i> | 1.01 ± 0.04 (0.98-1.08) | 6-12 | 6-11 | 27-40 | 13 |
| <i>Brookula spinulata</i> n. sp. | 1.06 ± 0.05 (1.0-1.16) | 6-8 | 9-17 | 17-21 | 19 |

of shells of *B. conica* from different localities along the Brazilian coast, and to redescribe the species. Our redescription includes several characters not mentioned by Watson (1886), such as the protoconch microsculpture (Fig. 2F, G), minor details of the shell sculpture (Fig. 2E), and an evaluation of the variability in shell shape (h/w varying from 0.9 to 1.11, see Table 1). We found that the number of axial ribs varies from 15 to 27 (Table 1), which fits well with the number (15-25) reported by Watson (1886).

Brookula conica can be distinguished from all other species previously reported from the South Atlantic by the absence of keels or spiral cords bordering or entering the umbilicus (Fig. 2B).

Brookula pfefferi Powell, 1951
(Figs 3; 4)

Brookula pfefferi Powell, 1951: 104, pl. 5, fig. 8. — Carcelles 1953: 170. — Castellanos & Landoni 1989: 8, pl. 5, fig. 5.

Brookula strebeli Powell, 1951: 104, pl. 5, fig. 7. — Carcelles 1953: 170. — Castellanos & Landoni 1989: 7, 8, pl. 5, fig. 7.

Brookula sinusbreidensis Numanami & Okutani, 1991: 39, figs 2-6.

Brookula delli Numanami, 1996: 55, figs 30A-E.

TYPE MATERIAL. — Holotype of *B. pfefferi* (BMNH 1961.368); holotype of *B. strebeli* (BMNH 1961.369); described from off the mouth of Stromness Harbor,

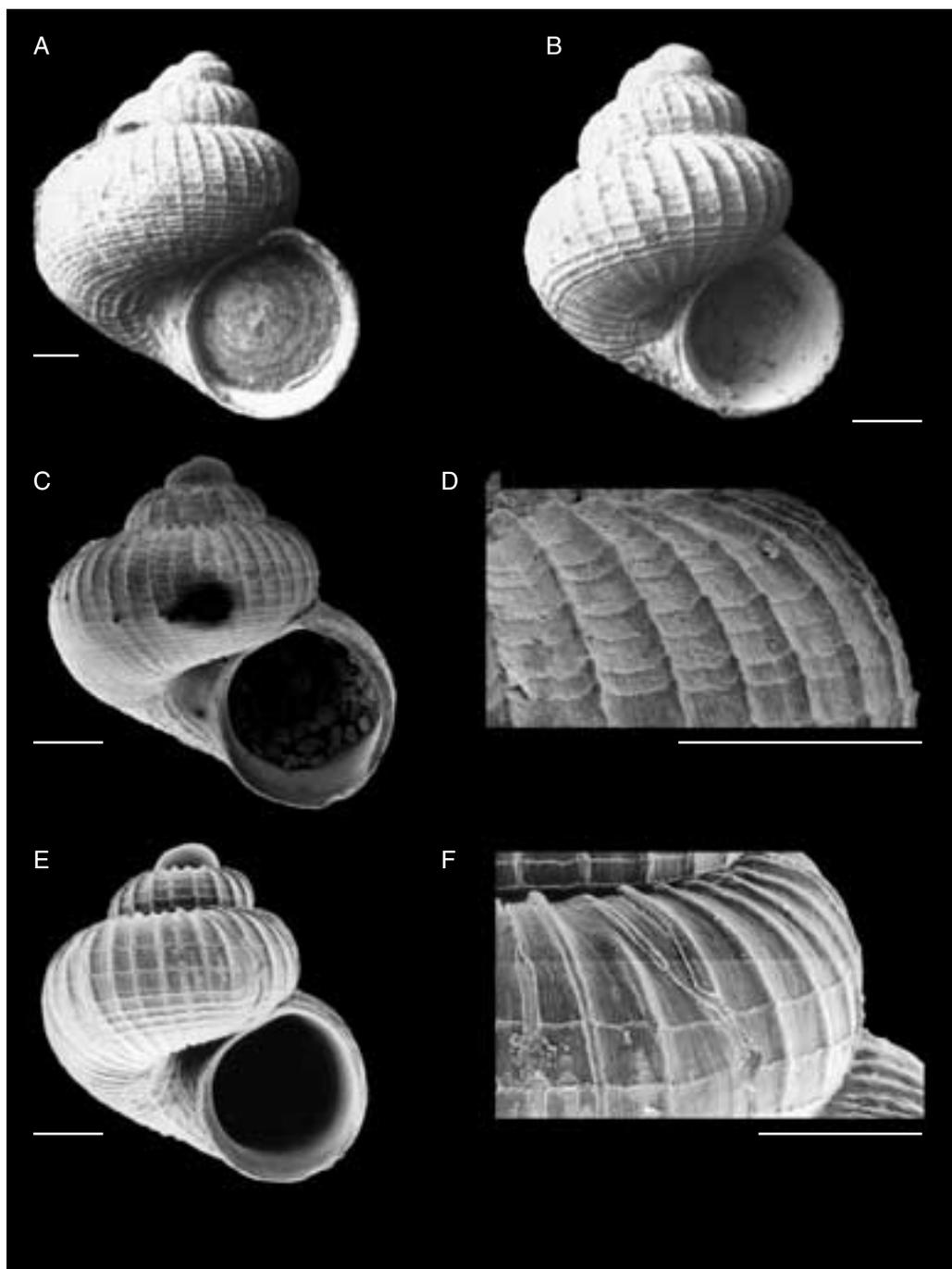


FIG. 3. — **A**, holotype of *Brookula pfefferi* Powell, 1951 (BMNH 1961.368); **B**, holotype of *Brookula strebeli* Powell, 1951 (BMNH 1961.369); **C-F**, *Brookula pfefferi* Powell, 1951, Brazilian material; **C**, **D**, from MZSP 32506; **C**, apertural view; **D**, sculpture detail of last adult whorl; **E**, **F**, from MZSP 32504; **E**, apertural view; **F**, sculpture detail of last adult whorl. Scale bars: 250 μ m.

South Georgia (from 54°04'S, 036°27'W to 53°58'S, 036°26'W, 155-178 m); holotypes of *B. sinusbreidensis* (NSMT-Mo 69595) and *B. delli* (NSMT-Mo 70613); both described from Breid Bay, Antarctica.

TYPE LOCALITY. — Off mouth of Stromness Harbour, South Georgia, from 54°04'S, 036°27'W to 53°58'S, 036°26'W, 155-178 m.

MATERIAL EXAMINED. — Holotypes of *Brookula sinusbreidensis* and *Brookula delli*; holotype photographs of *Brookula pfefferi* and *Brookula strebeli* and:

PADCT. [1], 27°18.28'S, 047°08.77'W, 228 m, 28.XI.1997 (MZSP 32503: # 6601); [5], 27°48.07'S, 047°24.04'W, 175 m, 29.XI.1997 (MZSP 32504: # 6606); [1], 26°30.99'S, 046°15.27'W, 474 m, 02.XII.1997 (MZSP 32505: # 6622).

REVIZEE. [5], 25°53.58'S, 045°42.13'W, 256 m, 15.XII.1997 (MZSP 32506: # 6651); [1], 25°51.04'S, 045°47.30'W, 206 m, 15.XII.1997 (MZSP 32507: # 6652); [1], 24°17.68'S, 043°48.20'W, 314 m, 09.I.1998 (MZSP 32508: # 6660); [2], 24°00.95'S, 043°55.54'W, 135 m, 09.I.1998 (MZSP 32509: # 6662); [1], 24°49.70'S, 044°44.97'W, 153 m, 12.I.1998 (MZSP 32510: # 6676).

REDESCRIPTION

Shell trochiform, reaching 1.8 mm in height, 1.6 mm in width; spire elevated, umbilicate, color white. Protoconch globose, around one and a half whorls, about a half emerged from first teleoconch whorl, and sculptured with fine, densely crowded anastomosing ribs forming microscopic pits in a somewhat alveolar pattern. Teleoconch with up to two three-quarter whorls, with convex profiles. Axial sculpture consisting of narrow, orthocline ribs (38 on last whorl of holotype), ribs continuing through base of shell, reaching umbilical region; microscopic axial lines present through interspaces. Spiral sculpture formed by prominent, thin, irregularly spaced, revolving threads (11 on last whorl of holotype), threads crossing axial ribs and present on base (10 on base of holotype), forming two or three moderately strong cords surrounding umbilicus. Aperture rounded, holostomate. Umbilicus circular, deep. Outer lip thin.

REMARKS

Clarke (1961: 358) stated that *B. strebeli* and *B. pfefferi* “[...] are so similar to each other that they appear to represent the same species”. In

TABLE 2. — Height/width ratio of types of *Brookula*.

| Species | Height/ width ratio | Species | Height/ width ratio |
|---------------------------|---------------------------|----------------------------------|---------------------------|
| <i>Brookula powelli</i> | 0.84 | <i>Brookula sinusbreidensis</i> | 1.16 |
| <i>Brookula exquisita</i> | 0.66 | <i>Brookula calypso</i> | 1.19 |
| <i>Brookula pfefferi</i> | 1.11 | <i>Brookula spinulata</i> n. sp. | 1.13 |
| <i>Brookula strebeli</i> | 1.15 | <i>Brookula rossiana</i> | 1.06 |
| <i>Brookula delli</i> | 1.17 | <i>Brookula antarctica</i> | 1.27 |

fact, it is not possible to distinguish the type of *B. strebeli* (Fig. 3B) from the type of *B. pfefferi* (Fig. 3A). Powell (1951), when describing the species, stated that *B. pfefferi* is umbilicate, while *B. strebeli* is imperforate; however, an umbilicus is clearly present in the holotype of *B. strebeli* (Fig. 3B); besides that, any known *Brookula* species lack an umbilicus. Secondly, there are also subtle differences in the ornamentation and h/w ratio, but those are due to intraspecific variation (Fig. 3A-C, E; Table 2).

Brookula sinusbreidensis Numanami & Okutani, 1991 and *Brookula delli* Numanami, 1996 fit the concept herein adopted to *B. pfefferi*; the number of spiral threads in the holotypes of both taxa is encompassed by the intraspecific variation present in *B. pfefferi* (compare Figs 3; 4A-C in this work and Numanami & Okutani 1991: 39, figs 2-6 and Numanami 1996: 56, fig. 30A-D). The apparent weaker axial and spiral sculpture in the holotype of *B. sinusbreidensis* is due to its eroded surface. The protoconchs of the types of both *B. sinusbreidensis* and *B. delli* are a little larger than the protoconch of *B. pfefferi* (1.75, 1.75 and 1.5 whorls, respectively) but the sculpture pattern in *B. delli* (Numanami 1996: fig. 30C, E) is identical to that in *B. pfefferi* (Fig. 4E-G). The protoconch sculpture in *B. sinusbreidensis* (Numanami & Okutani 1991: 39, fig. 6) described as smooth by the author is due to the general eroded state of the shell.

The spiral threads on the base of *B. pfefferi* may be evanescent cords, or cords regularly spaced near the umbilical region (Fig. 4A-C and Numanami 1996: fig. 30D). *Brookula pfefferi*

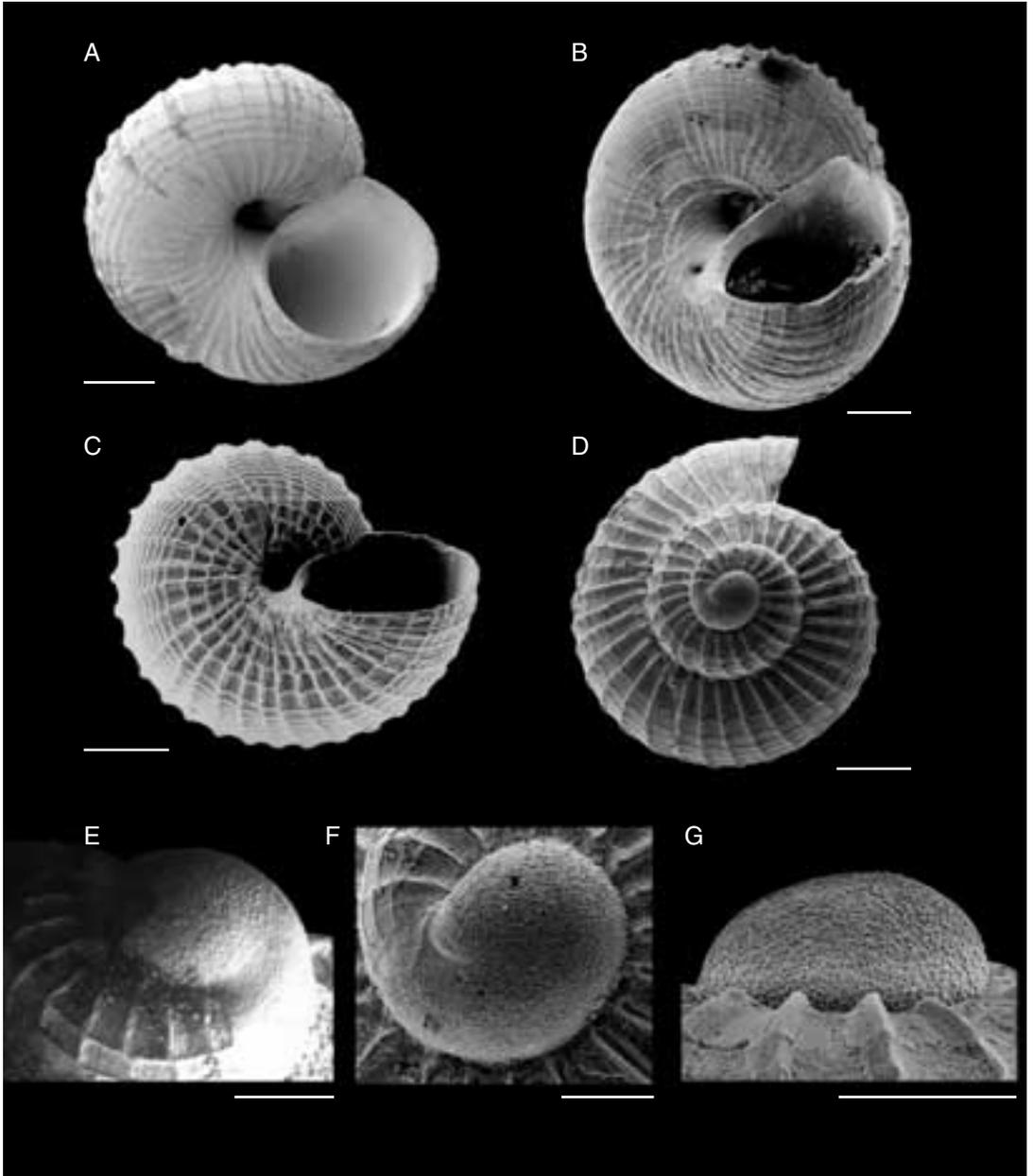


FIG. 4. — **A-D, F, G**, *Brookula pfefferi* Powell, 1951; **A, C**, from MZSP 32504; **B, D, F, G**, from MZSP 32506; **E**, holotype of *B. strebeli* Powell, 1951; **A-C**, basal view of three specimens showing the variation on the spiral cords; **D**, apical view; **E-G**, protoconch sculpture detail. Scale bars: A-C, 250 μ m; D-G, 100 μ m.

bears three or four cords surrounding the umbilicus, one or two of them entering the umbilicus, the others surrounding it. Those cords distinguish

B. pfefferi from *B. calypso*, *B. decussata*, and *B. conica*, since these species lack umbilical cords (as noted by Clark 1961: 357 for *B. calypso*).

Although the Brazilian material could not be distinguished from the type of *B. pfefferi* on the basis of sculpture (see cline variation in Fig. 3A-C, E and Fig. 3D, F), e.g., axial ribs varying from 27 to 40, spiral sculptures in the last whorl varying from 6 to 12 and base spirals varying from 6 to 11; it does have a consistently lower h/w ratio (1.01, sd = 0.04, Table 1) than that of the types of *B. pfefferi* (1.11), *B. strebeli* (1.15), *B. sinusbreidensis* (1.16) and *B. delli* (1.17) (Table 2). For now, until more material from both the type localities and the Brazilian continental shelf becomes available for study, we have determined the Brazilian specimens as *B. pfefferi*.

Brookula spinulata n. sp.
(Fig. 5)

TYPE MATERIAL. — Holotype (MNRJ 8424); paratypes (two shells in each lot) (MNRJ 8425; MORG 41032; MZSP 32511; IBUFRJ 10873; USNM 880655; MCZ 320998; MNHN; ZMA 4.01.013; MACN 34733). All types from type locality, except: MORG 41032 and MZSP 32511: PADCT # 6625, 24°29'S, 043°37.4'W, 980 m, 06.XII.1997; and MCZ 320998: PADCT # 6643, 25°25.2'S, 046°04'W, 120 m, 11.XII.1997.

TYPE LOCALITY. — South of Abrolhos Bank, 19°38.5'S, 038°43'W, 775 m, 19.IV.1995 (JOPS # 3229).

ETYMOLOGY. — From Latin *spinula*: small spine; *-atus*: abundant, referring to the small spine-like projections formed at the intersections of the spiral and axial ornamentation.

DESCRIPTION

Shell trochiform, reaching 1.54 mm in height, 1.52 mm in width; spire elevated, umbilicate, color white. Protoconch globose, around one and a half whorls, about half emerged from first teleoconch whorl, and sculptured with fine, densely crowded anastomosing ribs forming microscopic pits in a somewhat alveolar pattern. Teleoconch with up to two three-quarter whorls, with convex profiles and somewhat flat shoulders next to deeper suture. Axial sculpture consisting of heavy, narrow, slightly prosocline ribs (20 on last whorl of holotype), ribs conti-

nuing through base of shell, reaching umbilical region; microscopic axial lines present through interspaces. Spiral sculpture formed by prominent, thin, well-spaced, revolving threads (six on last whorl of holotype), threads crossing axial ribs, forming small delicate spine-like projections; spirals becoming thicker, very close, and numerous on base (12 on base of holotype), and forming two or three stronger cords surrounding umbilicus. Aperture rounded, holostomate, slightly elliptical, projecting anteriorly, with flat shoulder next to suture. Umbilicus circular, deep. Outer lip thin.

REMARKS

The microsculpture of the protoconch (Fig. 5G), that consists of very fine and densely crowded anastomosing ribs, forming microscopic pits in a somewhat alveolar pattern distinguishes *B. spinulata* n. sp. from *B. calypso* (Fig. 1B), *B. powelli* (Fig. 1D), and *B. exquisita* (Fig. 1F). This type of microsculpture is shared with *B. conica* (Fig. 2F, G) and *B. pfefferi* (Fig. 4E-G).

Brookula spinulata n. sp. is closely related to *Brookula pfefferi* Powell, 1951, being distinguished by the spine-like nodules formed by the crossing of the axial and spiral sculpture (Fig. 5A, B, F), which are less developed (Fig. 3C, D), or absent (Fig. 3E, F) in *B. pfefferi*; and by the number of axial ribs on the penultimate whorl (about 33 in *B. pfefferi*; 20 in *B. spinulata* n. sp.). In addition, the spiral ornamentation in *B. spinulata* n. sp. shows a very constant distribution pattern, with about seven threads on the last whorl (Fig. 5A, B; Table 1) and about 12 (range 9-17) on the base (Fig. 5D, E; Table 1); whereas in *B. pfefferi*, the distribution pattern of spiral threads is variable, with 6-12 on the last whorl (Fig. 3A-C, E; Table 1), and 6-11 on the basal area (Fig. 4A-C; Table 1).

Brookula spinulata n. sp. can be distinguished from *B. conica* by the spiral striae, which are weaker in *B. conica* (Fig. 2E), and do not form small spine-like nodules as in *B. spinulata* n. sp. There are strong spiral threads surrounding the umbilicus in *B. spinulata* n. sp. (Fig. 5D); such threads are absent in *B. conica* (Fig. 2B).

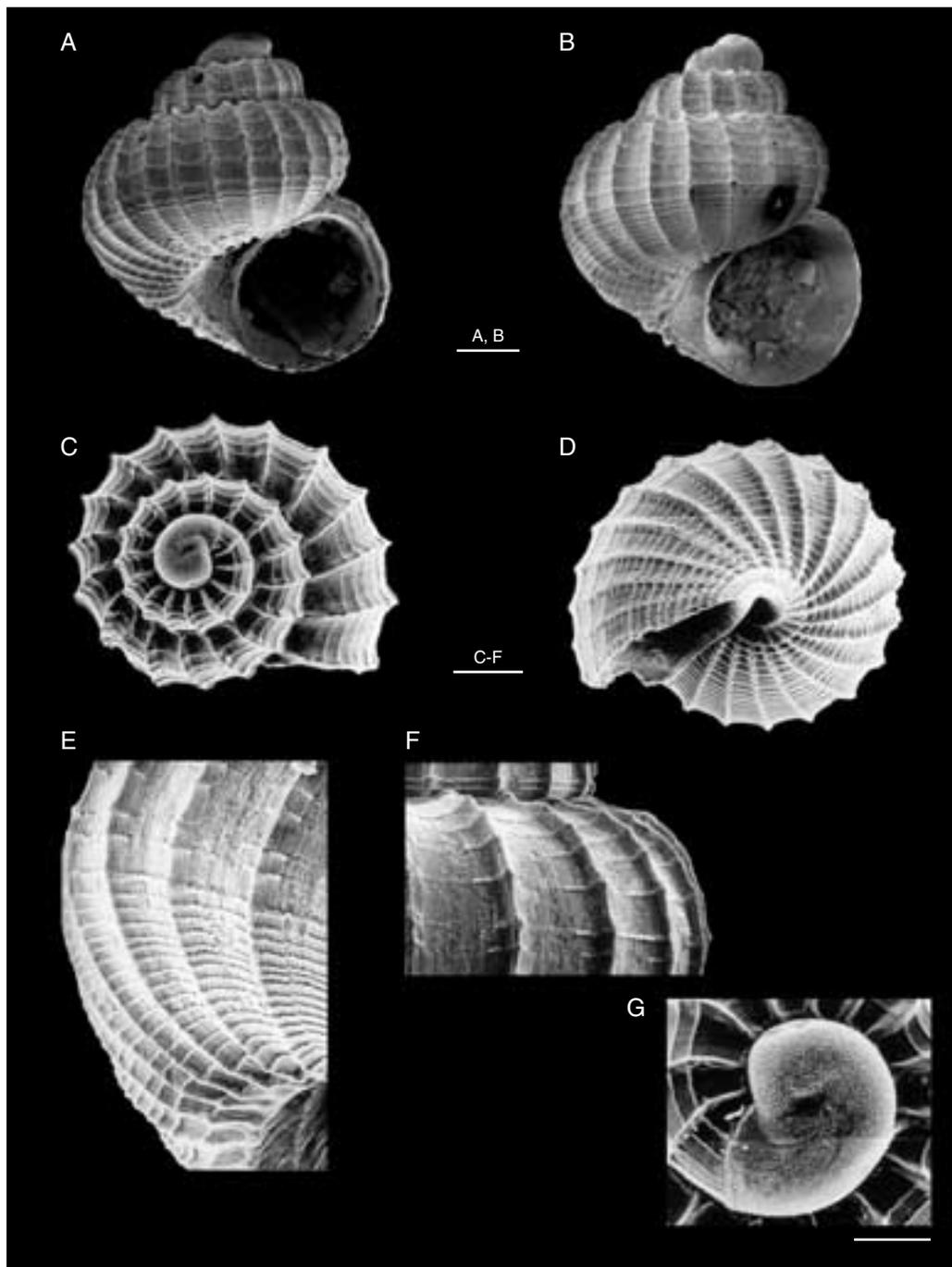


FIG. 5. — *Brookula spinulata* n. sp.; **A**, holotype (MNRJ 8424); **B-G**, paratypes; **B**, apertural view (IBUFRJ 10873); **C**, apical view (MNRJ 8425); **D**, basal view (ZMA 4.01.013); **E**, sculpture detail of base (ZMA 4.01.013); **F**, sculpture detail of last adult whorl (USNM 880655); **G**, protoconch (USNM 880655). Scale bars: A-D, 250 µm; E-G, 100 µm.

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REFERENCES

- CARCELLES A. R. 1953. — Catalogo de la malacofauna Antartica Argentina. *Anales del Museu Nahuel Huapi* 3: 155-250.
- CASTELLANOS Z. J. A. & LANDONI N. A. 1989. — *Catalogo Descriptivo de la Malacofauna Marina Magalánica*. Vol. 4. Comisión de Investigaciones Científicas, La Plata, 44 p.
- CLARKE A. H. 1961. — Abyssal mollusks from the south Atlantic Ocean. *Bulletin of the Museum of Comparative Zoology* 125 (12): 345-387, pls 1-4.
- DELL R. K. 1990. — Antarctic Mollusca, with special reference to the fauna of the Ross Sea. *Royal Society of New Zealand Bulletin* 27: iv + 311 p.
- HICKMAN C. S. & MCLEAN J. H. 1990. — *Systematic Revision and Suprageneric Classification of Trochacean Gastropods*. Science Series no. 35, Natural History Museum of Los Angeles County, California, 169 p.
- HICKMAN C. 1998. — Superfamily Trochoidea, in BEESLEY P. L., ROSS G. J. B. & WELLS A. (eds), *Mollusca: The Southern Synthesis. Fauna of Australia*. Part B., vol. 5. CSIRO Publishing, Melbourne: 671-692.
- IREDALE T. 1912. — New generic names and new species of marine Mollusca. *Proceedings of the Malacological Society of London* 10: 217-228, pl. 9.
- LEAL J. H. 1991. — *Marine Prosobranch Gastropods from Oceanic Islands off Brazil*. Universal Book Services, Oegstgeest, 418 p.
- MELVILL J. C. & STANDEN R. 1912. — The marine Mollusca of the Scottish National Antarctic Expedition. *Report on the Scientific Results of the Voyage of S. Y. Scotia* 5 (zool.) (8): 89-127, 1 pl.
- NUMANAMI H. & OKUTANI T. 1991. — A new species of the genus *Brookula* collected by the icebreaker *Shirase* from Breid Bay, Antarctica (Gastropoda: Cyclostrematidae). *Venus* 50 (1): 37-42.
- NUMANAMI H. 1996. — Taxonomic study on Antarctic gastropods collected by Japanese Antarctic research expeditions. *Memoirs of the National Institute of Polar Research* series E 39: 1-244.
- PELSENEER P. 1903. — Résultats du voyage du S. Y. *Belgica* en 1897-1898-1899. *Rapports scientifiques*, Zoologie, Mollusques: 1-85, pl. 1-9.
- POWELL A. W. B. 1951. — Antarctic and subantarctic Mollusca: Pelecypoda and Gastropoda. *Discovery Reports* 26: 47-196, pls 5-10.
- RIOS E. C. 1994. — *Seashells of Brazil*. 2nd ed. Museu Oceanográfico Prof. E. C. Rios da Fundação Universidade do Rio Grande, Rio Grande, 368 p., 113 pls.
- STREBEL H. 1908. — Die Gastropoden (mit Ausnahme der nackten Opisthobranchier). *Wissenschaftliche Ergebnisse der Schwedischen Südpolar-Expedition 1901-1903* 6 (1): 111 p., 6 pls.
- WARÉN A. 1992. — New and little known "skeneimorph" gastropods from the Mediterranean Sea and the adjacent Atlantic Ocean. *Bollettino Malacologico* 27: 149-247.
- WATSON R. B. 1886. — Report on the Scaphopoda and Gastropoda collected by H. M. S. *Challenger* during the years 1873-1876. *Scientific Results of the Voyage of the H. M. S. Challenger*, Zoology 15 (42): 756 p., 50 pls.

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