



# The species usually reported in the subgenus *Brochina* (*Caecum*, Caecidae, Caenogastropoda) from Brazil and some relevant type specimens from western Atlantic

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**KEY WORDS:** Caecidae, *Caecum*, *Brochina*, taxonomy, primary types, Brazil, western Atlantic.

**ABSTRACT** Conchological analysis revealed the existence of eight species belonging to the genus *Caecum*, subgenus *Brochina* in Brazilian waters: *Caecum antillarum* Carpenter, 1858, *C. someri* de Folin, 1867, *C. achironum* de Folin, 1867, *C. circumvolutum* de Folin, 1867, *C. multicostratum* de Folin, 1867, *C. strigosum* de Folin, 1867, *C. marmoratum* de Folin, 1870 and *C. lineicinctum* de Folin, 1879. The record of the latter is the first from Brazil. The eight species are discussed, established synonymies reported, and some new synonymies proposed. Scanning electron microscope illustrations are provided of the following type-specimens: the holotypes of *C. venosum* de Folin, 1867, *C. lineicinctum* de Folin, 1879, and *C. butoti* De Jong & Coomans, 1988; paratypes of *C. antillarum* Carpenter, 1858 and *C. johnsoni* Winkley, 1908; syntypes of *C. beladum* Olsson & Harbison, 1954; and lectotypes (herein designated) of *C. achironum* de Folin, 1867, *C. multicostratum* de Folin, 1867, *C. someri* de Folin, 1867, *C. strigosum* de Folin, 1867, *C. subvolutum* de Folin, 1867, *C. striatum* de Folin, 1868, *C. carmenensis* de Folin, 1870, *C. marmoratum* de Folin, 1870, *C. veracruzianum* de Folin, 1870, *C. vestitum* de Folin, 1870, *C. limpidum* de Folin, 1874 and *C. subornatum* de Folin, 1874.

**RIASSUNTO** L'analisi conchigliare ha rivelato l'esistenza, nelle acque del Brasile, di otto specie appartenenti al Genere *Caecum*, Sottogenere *Brochina*: *Caecum antillarum* Carpenter, 1858; *C. someri* de Folin, 1867, *C. achironum* de Folin, 1867, *C. circumvolutum* de Folin, 1867, *C. multicostratum* de Folin, 1867, *C. strigosum* de Folin, 1867; *C. marmoratum* de Folin, 1870; e *C. lineicinctum* Folin, 1879. Il ritrovamento di quest'ultimo è il primo per il Brasile. Queste otto specie vengono discusse, sono fornite alcune sinonimie e ne sono proposte altre nuove. Sono inoltre fornite fotografie al Microscopio Elettronico a Scansione (MES) dei seguenti esemplari-tipo: gli olotipi rispettivamente di *C. venosum* Folin, 1867, *C. lineicinctum* Folin, 1879, e *C. butoti* De Jong & Coomans, 1988; paratipi di *C. antillarum* Carpenter, 1858 e *C. johnsoni* Winkley, 1908; sintipi di *C. beladum* Olsson & Harbison, 1954; e lectotipi (qui designati) di *C. achironum* de Folin, 1867, *C. multicostratum* de Folin, 1867, *C. someri* de Folin, 1867, *C. strigosum* de Folin, 1867, *C. subvolutum* de Folin, 1867, *C. striatum* de Folin, 1868; *C. carmenensis* de Folin, 1870, *C. marmoratum* de Folin, 1870, *C. veracruzianum* de Folin, 1870, *C. vestitum* de Folin, 1870, *C. limpidum* de Folin, 1874 e *C. subornatum* de Folin, 1874.

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## INTRODUCTION

The family Caecidae Gray, 1850 has a controversial phylogenetic history, having been previously allocated to the Scaphopoda, the Pteropoda, and even the Cephalopoda (MOORE, 1962). These various allocations were made because of the cylindrical shell and the successive discarding of the old end of the shell during the development of the animal. This distinct manner of shell growth also causes problems in defining the boundaries between supraspecific taxa within the family.

According to CARPENTER (1858), the genus *Brochina* Gray, 1857 could be distinguished from *Caecum* Fleming, 1817 by the convex operculum, but he expressed his concern about the status of the taxon at the generic level because of the differing degree of convexity in different individuals. This character was also used by BARTSCH (1920) in his key to the genera of the family. De Folin (1867) considered *Brochina* as a valid genus, and described *Brochina achirona* and *Brochina someri*.

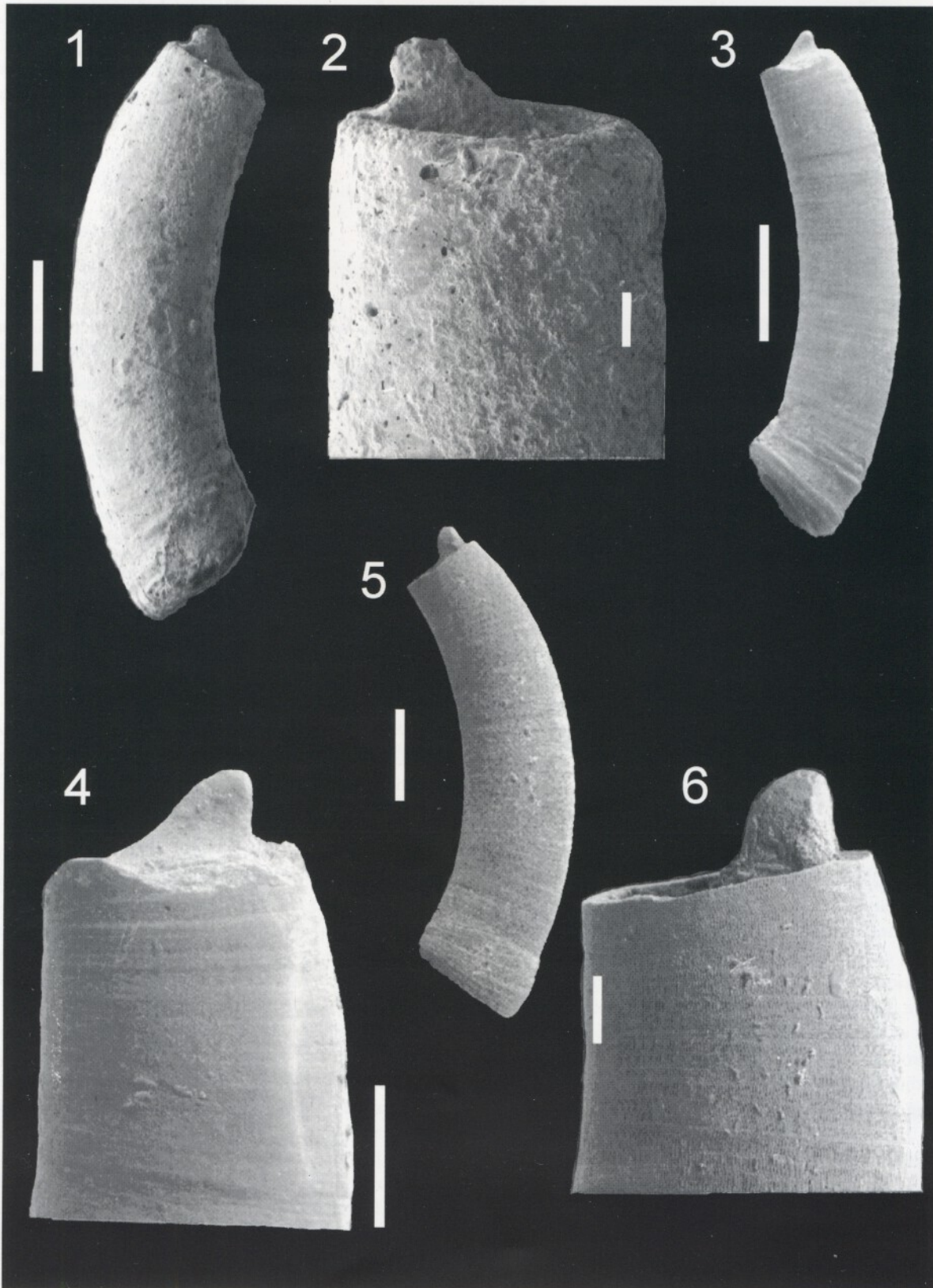
DALL (1892) did not consider the genus *Brochina* as a member of the family Caecidae, including only members of *Meioceras* Carpenter, 1858 and *Caecum* Fleming, 1817 among the Recent species. KEELER (1981), MELLO & MAESTRATI (1986), and RIOS (1994) all considered *Brochina* as a subgenus of *Caecum*. LIGHTFOOT (1992)

divided the family into different subgenera according to the shape of the mucro, and formulated the diagnosis of subgenus *Brochina* as follows: "coin-edge mucro, variable projection; septum often blistered, inflated to unguulate." BANDEL (1996) characterized the subgenus *Brochina* Gray, 1857 by its smooth teleoconch, with delicate longitudinal striae, and circular aperture.

The generic and subgeneric concepts within this family are still not clearly defined. MOORE (1962) expressed concern about the taxonomic status of the species, noting the disorder created because most authors have failed to characterize intraspecific variability, thus generating a large number of synonyms. This regrettable practice has continued, as reported by VAN AARTSEN (1977), ABSALÃO (1997), ABSALÃO & GOMES (1995) and GOMES & ABSALÃO (1996).

Turning to the representatives of the family along the Brazilian coast, de Folin was the first to describe a Brazilian *Caecum*. Between 1867 and 1874, de Folin recognized among his "smooth" taxa, eight valid species and four varieties (KISCH, 1959). DUNKER (1875) described *C. corneum*, but only three-quarters of a century late did LANGE-DE-MORRETES (1949) discuss the family in his catalogue of Brazilian mollusks. LANGE-DE-MORRETES (1954) described *C. berthae*, and RIOS (1970, 1975, 1994), MELLO & MAE-





Figures 1-6. 1, 2. *Caecum lineicinctum* holotype, BMNH 1887.2.9.2314. 2. Posterior region. 3, 4. *Caecum subvolutum* lectotype herein designated, MNHN. 4. Posterior region. 5, 6. *Caecum lineicinctum*, MORG 20113. 6. Posterior region. Scale bars. Figs. 1, 3 and 5: 500  $\mu$ m; figs. 2, 4 and 6: 100  $\mu$ m.





STRATI (1986), ABSALÃO (1994, 1997), ABSALÃO & GOMES (1995), and GOMES & ABSALÃO (1996) also reported on Brazilian Caecidae.

Presently, eight species in Brazil are assigned to the subgenus *Brochina* (see RIOS, 1994): *Caecum achironum* (de Folin, 1867); *C. antillarum* Carpenter, 1858; *C. circumvolutum* de Folin, 1867; *C. johnsoni* Winkley, 1908; *C. multicoatum* de Folin, 1867; *C. striatum* de Folin, 1868; *C. strigosum* de Folin, 1867; and *C. subornatum* de Folin, 1874. The present study revises the taxonomy of these species as a first step toward a complete revision of the Brazilian Caecidae. We intend eventually to extend this revision to the remaining western Atlantic species.

## MATERIAL AND METHODS

The following abbreviations are used: ANSP, Academy of natural Sciences of Philadelphia; BMNH: The Natural History Museum, London; FLMNH: Florida Museum of Natural History, Gainesville, Florida; GEOMAR: Oceanographic expedition from Brazilian navy on Marine Geology; IB-UFRJ: Instituto de Biologia da Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil; MCZ: Museum of Comparative Zoology, Cambridge, Massachusetts; MNHN: Muséum National d'Histoire Naturelle, Paris; MORG: Museu Oceanográfico Prof. Eliézer de Carvalho Rios, Rio Grande, Rio Grande do Sul, Brazil; ZMA: Zoologisch Museum Amsterdam, Amsterdam, The Netherlands.

Brazilian material was identified according to the original descriptions and checked by conchological comparison with material (especially types) held at the above institutions. All the material was illustrated by SEM photographs, after sputter-coating with gold (see BANDEL, 1996, for details). The total length was measured including both septum and mucro.

## RESULTS AND CONCLUSIONS

### Family Caecidae Gray, 1850

Subgenus *Brochina* Gray, 1857

Type: *glabrum* Montagu, 1803.

### *Caecum lineicinctum* de Folin, 1879

(Figs. 1 and 2)

*C. lineicinctum* de Folin, 1879: 808-809; MOORE, 1972: 884, figs. 3-5; KEELER, 1981: 69, fig. 10; LIGHTFOOT, 1992a: 184, fig. 20.

Shell medium in size, reaching 3 mm in length, moderately and regularly curved throughout the shell. The caliber is practically the same except for some weak rounded rings, only visible in the anterior region. Mammillated septum, partially retracted, mucro distinct with slight dorsal concavity and blunt edge.

**Material Examined:** *C. lineicinctum*: BMNH 1887.2.9.2314 holotype, St. Thomas, West Indies; MORG 20113, Abrolhos, Brazil, 1978; MORG 26240 Ilha Guarita, Abrolhos - BA, Brazil, 1978. *C. subvolutum*: MNHN syntypes, Barbados; FLMNH 236013, SW Egmont Key, Florida, 1962.

**Remarks:** The eroded condition of the type did not allow precise identification. It was impossible to determine the constriction, the extension of rings towards the posterior end, or the presence or absence of an aperture varix. MOORE (1972: 886, fig. 1) interpreted the holotype of *C. lineicinctum* de Folin, 1879 (*sic*) as a young speci-

men, and illustrated another specimen with a varicose aperture. He also discussed the differences between *C. lineicinctum* de Folin, 1879 and *C. subvolutum* de Folin, 1867 (Figs. 3 and 4), their closest conchological relations, based on septum and mucro differences and the extent and intensity of the ring sculpturing. Although LIGHTFOOT (1992a: 172) considered the septum and mucro variability, she emphasized the mucro of *C. lineicinctum* as a diagnostic character, defining it as a narrow finger-shape with a large blunt ball at its top.

In addition to these characters, Moore considered *C. lineicinctum* as being wider than *C. subvolutum*. In Table 1 we compare the length/width (l/w) ratio of the type of each species, and of the specimens studied by MOORE (1972), LIGHTFOOT (1992a, b), and KEELER (1981).

The specimen illustrated by LIGHTFOOT (1992b: 23, fig. 25) as *C. subvolutum* is actually *C. circumvolutum*, since it lacks the mammillated mucro of *C. subvolutum*. It seems that Lightfoot misunderstood the concepts of these two species, since of the 13 lots labeled by her as *C. subvolutum*, only 1 was correctly identified (see Table 1); all the others were *C. circumvolutum* de Folin, 1867.

*C. lineicinctum* has a very characteristic finger-shaped mucro, and differs from *C. subvolutum* in the apertural ring sculpture, the shape of the anterior region, and the width of the shell. When the photographs of the types of both species are compared, the septum and mucro differences are not very evident because of the erosion in the holotype of *C. lineicinctum*. We have not found *C. subvolutum* in Brazilian waters. The Brazilian form of *C. lineicinctum* (Figs. 5 and 6) differs from the holotype figured by MOORE (1972) and LIGHTFOOT (1992a: 184, fig. 20) specimen in the weakness of the ring sculpturing near the aperture and the presence of irregular growth lines.

### *Caecum strigosum* de Folin, 1867

(Figs. 7 and 8)

*Caecum strigosum* de Folin, 1867: 53, pl. 5, fig. 5; LYONS, 1989: pl. 3, fig. 13; LIGHTFOOT, 1992b: 28, fig. 31; RIOS, 1994: 57, pl. 18, fig. 208; LEAL, 1991: 321, pl. 13, figs. h-i.

*Caecum striatum* de Folin, 1868: 49, pl. 5, fig. 3.

*Caecum strigosum* var. *obsoleta* de Folin, 1874: 212.

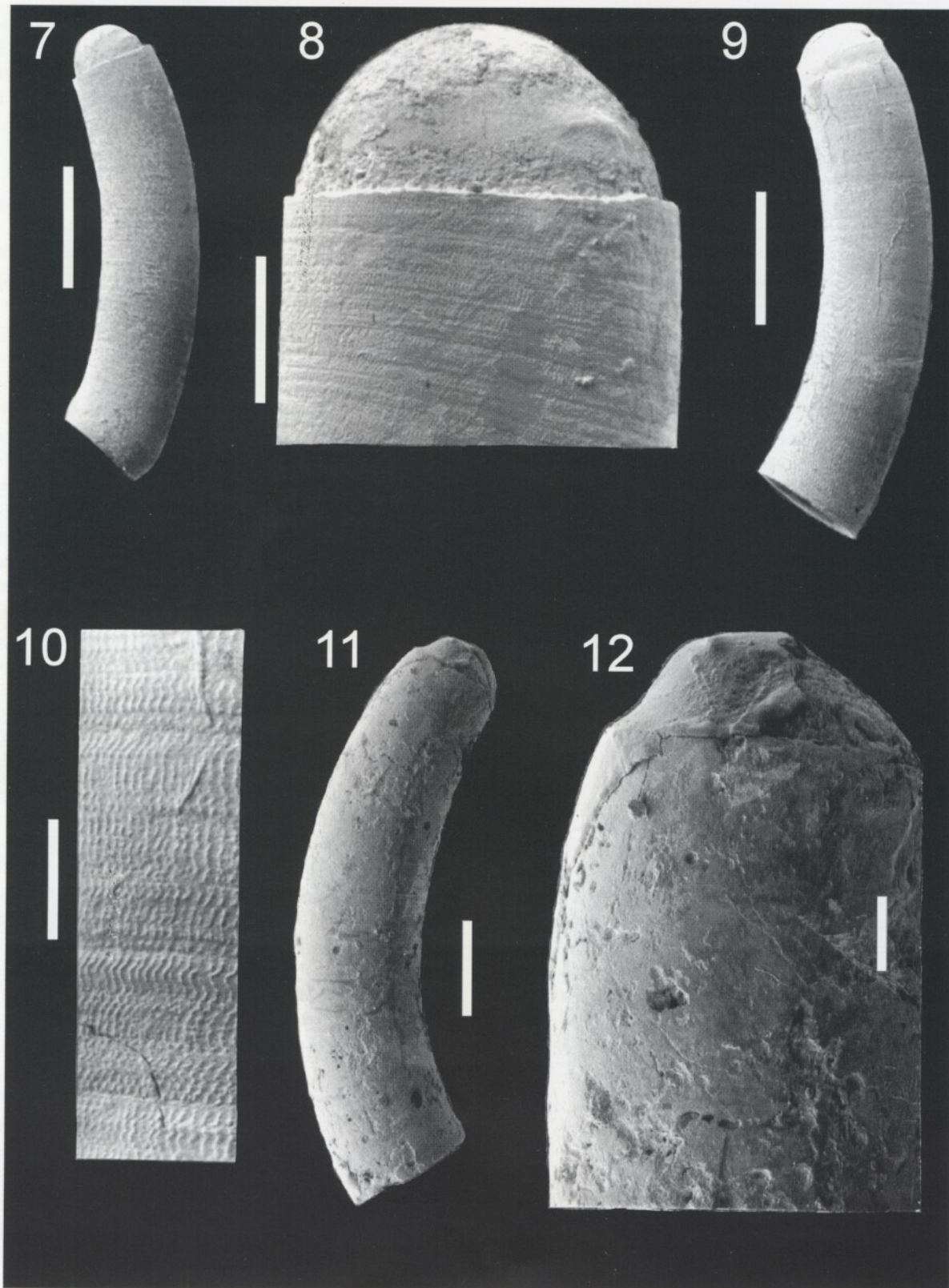
*Caecum antillarum* Carpenter, 1858. KEELER, 1981: 71, fig. 18; RIOS, 1994: 56, pl. 18, fig. 203.

Shell small (1.5 mm), moderately and regularly curved. Anterior region with diameter greater than remainder of shell. Adult specimens may show a slight swelling just behind the aperture. Shell surface smooth, but under high magnification (about 200 x), longitudinal microstriae visible all over the shell. Septum hemispheric, mucro tiny and blunt, in left lateral-dorsal position.

**Material Examined:** *Caecum strigosum*: MNHN syntypes, Rio de Janeiro and Pernambuco, Brazil; IB-UFRJ 7434 Geomar XII #29, Brazil, 1979. *C. striatum*: MNHN syntypes Bahia and Pernambuco, Brazil, and Panama; IB-UFRJ 7433 Geomar XII #19, Brazil, 1979; IB-UFRJ 7493 Ribeira - BA, Brazil, 1994; IB-UFRJ 8457 Geomar XII #53, Brazil, 1979; IB-UFRJ Geomar XII #56, Brazil, 1979; IB-UFRJ 7432 Ribeira - BA, Brazil, 1994.

**Remarks:** de Folin's original illustration and the specimens illustrated by MELLO & MAESTRATI (1986) show a constriction in





Figures 7-12. 7, 8. *Caecum strigosum* lectotype herein designated, MNHN. 8. Posterior region. 9, 10. *Caecum striatum*, lectotype herein designated, MNHN. 10. Sculpture pattern. 11, 12. *Caecum antillarum* holotype, BMNH 1858.12.9.23. 12. Posterior region. Scale bars. Figs. 7 and 9: 500  $\mu$ m; figs. 8 and 10: 100  $\mu$ m; fig. 11: 250  $\mu$ m; fig. 12: 50  $\mu$ m.





the posterior extremity. Only one of the syntypes shows this character. We conclude that this is an individual variation rather than a species character. If we disregard this constriction as typical for the species, there are many similarities between *C. striatum* and *C. strigosum* de Folin, 1867. These similarities led LEAL (1991: 321, pl. 13, figs. h-i) to illustrate *C. striatum* as *C. strigosum*. Both species show the same kind of sculpturing, but in *C. strigosum* this sculpturing is thinner than in *C. striatum* (Figs. 9 and 10) and is visible only under high magnification. The main distinctive characteristic of *C. strigosum* is the swelling next to the aperture, which de Folin exaggerated in his figure. Actually the swelling is subtle, and is observed only in adult specimens. If we consider the conchological variability found in the family Caecidae, especially the changes from young to adult stages (BANDEL 1996), we are led to the conclusion that *C. striatum* is actually a young individual of *C. strigosum*, which would develop the anterior swelling at sexual maturity. Knowledge of the anatomy of the soft parts may help to support this proposed synonymy, but such information is not yet available for most species in the family.

***Caecum antillarum* Carpenter, 1858**  
(Figs. 11 and 12)

*Caecum antillarum* Carpenter, 1858: 433; BANDEL, 1996: pl. 3, figs. 4 and 5; De JONG & COOMANS, 1988: 38; KEELER, 1981: 71, fig. 18. *Caecum subornatum* de Folin, 1874: 212, pl. 9, fig. 5.

*Caecum vestitum* de Folin, 1870: 183-184, pl. 25, figs. 3-4; KEELER, 1981: 70, fig. 17.

*Caecum johnsoni* Winkley, 1908. KEELER, 1981: 71, fig. 20; LIGHTFOOT, 1992b: 28, fig. 32.

Shell small (2.6 mm) to medium in size (3.5 mm), moderately curved but strongly curved in the aperture end, usually with a slight increase in the caliber towards the aperture. Surface of shell may be smooth or with very weak growth rings, these rings more visible near the aperture and becoming obsolete posteriorly. No varix or swelling present. Hemispheric septum; mucro, when visible, blunt and low.

**Material Examined:** *Caecum dextroversum antillarum*: BMNH 1858 12.9.23 holotype; West Indies. *Caecum subornatum*: MNHN syntypes, Brazil. *Caecum johnsoni* FLMNH 267514, USA; FLMNH 267489 Bermuda Id., Howard Beach.

**Remarks:** The main problem regarding this species is the badly eroded condition of the holotype, which renders it impossible to observe the microscopic annular sculpturing. Furthermore, it is an immature specimen without the typical deflection at the apertural end easily visible in adult shells, e.g., FLMNH 267514 (Fig. 13) and Brazilian material IB-UFRJ 7425 (Fig. 14). Superficially, *C. antillarum* Carpenter, 1858 is similar to *C. striatum*, but the longitudinal microsculpturing is lacking. Except for slight annular sculpturing near the aperture, the shell is almost completely smooth. BANDEL (1996: pl. 2, fig. 6; pl. 3, fig. 4 - 6) figured *C. antillarum* and *C. vestitum* at various growth stages. Neither of the adult stages illustrated by BANDEL (1996: pl. 3, figs. 5 and 6) is similar to the respective types. Actually the *C. antillarum* illustrated by BANDEL (1996, pl. 3, fig. 6) is most similar to the syntypes of *C. vestitum* (figs. 15 and 16); Bandel possibly inadvertently reversed the captions. In the original description of *C. antil-*

*larum*, CARPENTER (1858) did not indicate the presence of rings near the somewhat constricted aperture. On the other hand, de Folin's (1874) illustration of *C. subornatum* clearly shows rings near the aperture, exactly as in our SEM photographs of the lectotype (Figs. 17, 18 and 19). Other than these differences, there is no distinctive characteristic separating these two types. This strongly suggests that the type of *C. antillarum* is in fact an immature specimen. We believe that both belong to the same species. The shell figured by BANDEL (1996, pl. 3, fig. 5) as *C. antillarum* may be a typical *C. subornatum* de Folin, 1874. De JONG & COOMANS (1988) discussed the same species, and mentioned (but without providing illustrations) that some specimens show weak rings in the anterior region. The material that DIAZ & PUYANA (1994: 121; pl. 26, fig. 18) and VOKES & VOKES (1984: 121, pl. 26, fig. 18) illustrated as *C. antillarum* is actually *C. rissotium*, which is characterized by the smooth and swelling shell with a constricted aperture. RIOS (1994) reported that a varix is not present in *C. antillarum*.

***Caecum achironum* de Folin, 1867**  
(Figs. 20 and 21)

*Caecum achironum* de Folin, 1867: 57, pl. 3, fig. 1; RIOS, 1994: 56, pl. 18, fig. 202.

*Caecum achironum* var. *striata* de Folin, 1867: 57, pl. 3, fig. 2.

Shell medium in size (3.0 mm length), with slight regular curvature throughout the shell. Caliber increasing towards aperture. No terminal varix present. Shell surface sculptured by longitudinal microstriation interrupted by growth lines. Septum much produced and tongue-like (unguiculate) and blunt; mucro weakly projecting.

**Material Examined:** *Caecum achironum*: MNHN syntypes, Pernambuco and Bahia, Brazil.

**Remarks:** *Caecum achironum* was described by de Folin with two varieties: *C. achironum* var. *someri* and *C. achironum* var. *striata*. Conchologically *C. achironum* s.s. and *C. achironum* var. *striata* are identical, and at first sight they should be considered as a synonym. Our observations indicate that *C. someri* (see below) is a common species in Brazilian waters, while *C. achironum* de Folin, 1867 is rare. *C. someri* is not a sculptured form of *C. achironum* s.s., as might be expected. The surface of *C. someri* is always smooth and shiny, with no signs of erosion. MELLO & MAESTRATI (1986) also recognized both species as valid, but did not discuss the diagnoses.

***Caecum someri* de Folin, 1867**  
(Figs. 22 and 23)

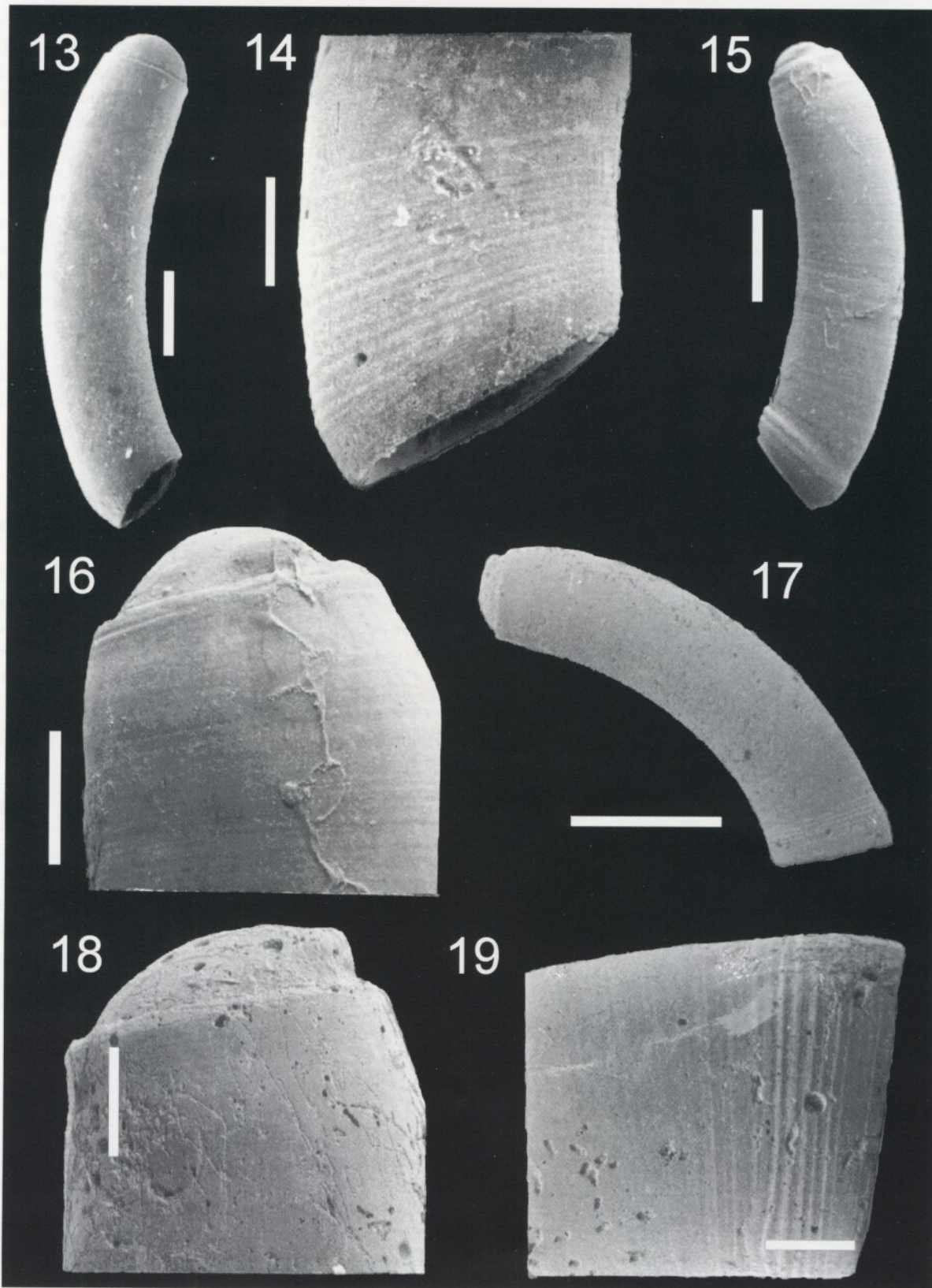
*Caecum someri* de Folin, 1867: 56, pl. 3, fig. 2; MELLO & MAESTRATI, 1986, p. 157, fig. 12; GOMES & ABSALÃO, 1996: 518, fig. 6.

*Caecum achironum* de Folin, 1867; 56, pl. 3, fig. 1. LIGHTFOOT, 1992b: 24, fig. 24; RIOS, 1994: 56, pl. 18, fig. 202.

Shell medium in size (3.0 mm), with a slight, even curvature throughout the shell. Caliber increasing moderately towards aperture. Shell surface smooth and shiny. No terminal varix. Septum greatly produced and tongue-like (unguiculate); mucro blunt and weakly projecting.

**Material Examined:** *Caecum someri*: MNHN syntypes, Pernambuco, Brazil; IB-UFRJ 7428 Geomar XII #55, 1979; IB-UFRJ 7383 Geomar XII #97, 1979; IB-UFRJ 7363 Geomar XII #43,





Figures 13-19. 13. *Caecum antillarum* (smooth pattern), FLMNH 267514. 14. *Caecum antillarum*, IB-UFRJ 7425, anterior region. 15, 16. *Caecum vestitum* lectotype herein designated, MNHN. 16. Posterior region. 17-19. *Caecum subornatum* lectotype herein designated, MNHN. 18. Posterior region. 19. Anterior region. Scale bars. Figs. 13 and 18: 50  $\mu$ m; figs. 16 and 19: 100  $\mu$ m; figs. 14 and 17: 200  $\mu$ m; fig. 15: 500  $\mu$ m





1979; IB-UFRJ 7376 Geomar XII #67, 1979; IB-UFRJ 7392 Geomar XII #51, 1979; IB-UFRJ 7385 Geomar XII #49, 1979; IB-UFRJ 7391 Geomar XII #85, 1979; IB-UFRJ 7367 Geomar XII #50, 1979; IB-UFRJ 7431 Geomar XII #85, 1979; IB-UFRJ 7368 Geomar XII #42, 1979; IB-UFRJ 7372 Geomar XII #56, 1979; IB-UFRJ 7364 Geomar XII #75, 1979; IB-UFRJ 7371 Geomar XII #104, 1979; IB-UFRJ 7379 Geomar XII #65, 1979; IB-UFRJ 7402 Geomar XII #71, 1979; IB-UFRJ 7370 Geomar XII #68, 1979; IB-UFRJ 7430; Geomar XII #26, 1979; IB-UFRJ 7365 Geomar XII #69, 1979; IB-UFRJ 7390 Geomar XII #51, 1979; IB-UFRJ 7375 Geomar XII #53, 1979; IB-UFRJ 7389 Geomar XII #79, 1979; IB-UFRJ 7395 Geomar XII #37, 1979; IB-UFRJ 7419 PITA, Macaé, 1993; IB-UFRJ 7382 Geomar XII #55, 1979; IB-UFRJ 7366 Geomar XII #52, 1979; IB-UFRJ 7386 Geomar XII #78, 1979; IB-UFRJ 7393 Geomar XII #51, 1979; IB-UFRJ 7396 Geomar XII #46, 1979; IB-UFRJ 7377 Geomar XII #132, 1979; IB-UFRJ 7397 Geomar XII #80, 1979; IB-UFRJ 7374 Geomar XII #73, 1979; IB-UFRJ 7381 Geomar XII #102, 1979; IB-UFRJ 7380 Geomar XII #70, 1979; IB-UFRJ 7429 Geomar XII #80, 1979; IB-UFRJ 7369 Geomar XII #86, 1979; IB-UFRJ 7394 Geomar XII #81, 1979; IB-UFRJ 7373 Geomar XII #74, 1979; IB-UFRJ 7384 Geomar XII #65, 1979; IB-UFRJ 7378 Geomar XII #71, 1979; IB-UFRJ 7388 Geomar XII #45, 1979, all from Brazil.

**Remarks:** LIGHTFOOT (1992b: 24) illustrated a smooth shell as *Caecum achironum*. It appears that this is *Caecum someri* (Fig. 22).

#### *Caecum circumvolutum* de Folin, 1867

(Figs. 24 and 25)

*Caecum circumvolutum* de Folin, 1867: 29, pl. 3, fig. 3; MELLO & MAESTRATI, 1986: 155, fig. 10; RIOS, 1994: 56, pl. 18, fig. 204; GOMES & ABSALÃO, 1996: 518, fig. 4.

*Caecum limpidum* de Folin, 1874: 211-212.

*Caecum buccina* de Folin, 1870: 184-185, pl. 25, figs. 7-8.

*Caecum carmenensis* de Folin, 1870: 184, pl. 25, figs. 5-6.

*Caecum veracruzianum* de Folin, 1870: 183, pl. 25, figs. 1-2.

*Caecum rijgersmai* De Jong & Coomans, 1988: 170, pl. 2, fig. 171.

*Caecum vestitum* de Folin, 1870. LEAL, 1991: 13, figs. J-K.

*Caecum subvolutum* de Folin, 1867. LIGHTFOOT 1992b: 23, fig. 23

Shell medium in size (3.2 mm), moderately and regularly curved, cylindrical, caliber increasing regularly towards aperture. Strong and blunt to rounded terminal varix. Weak growth rings may be present. Remainder of shell smooth and shiny. Septum mammillated, somewhat retracted, mucro is a dorsal projection, deviating to the right, and acuminate.

**Material Examined:** *Caecum circumvolutum*: IB-UFRJ 7291 Geomar XII #32, Brazil, 1979; IB-UFRJ 7409 Ribeira - BA, Brazil, 1994; IB-UFRJ 7285 Geomar XII #61, Brazil, 1979; IB-UFRJ 7406 Natal - RN, Brazil, 1992; IB-UFRJ 7422 Abrolhos - BA, Brazil, 1993; IB-UFRJ 7994 Pernambuco, Brazil, 1992; IB-UFRJ 7286 Geomar XII #56, Brazil, 1979. *Caecum limpidum*: MNHN syntypes, Côtes du Bresil. *Caecum buccina*: MNHN syntypes, Vera Cruz. *Caecum carmenensis*: MNHN syntypes, Carmen, Vera Cruz. *Caecum veracruzianum*: MNHN syntypes, Vera Cruz. *Caecum subvolutum*: FLMNH 267496 Virgin Ids., St. Croix, 1987; FLMNH 267491 Palm Beach, Florida, 1973-1980; FLMNH 267492 West

Sarasota, Florida, 1976; FLMNH 267486 Trinidad & Tobago; FLMNH 267489 Tucker Town Bay, Bermuda, 1989; FLMNH 267488 Cancun, Mexico; FLMNH 267487 Trinidad & Tobago, 1992; FLMNH 267497 Exuma Id., Bahama, 1992.

**Remarks:** This species has been synonymized (MELLO & MAESTRATI, 1986; RIOS, 1994) or confounded (LEAL, 1991) with *Caecum vestitum*. Figure 15 shows the lectotype (herein designated) of *C. vestitum*. Although there is a considerable similarity between it and *C. circumvolutum*, the septum of *C. vestitum* is hemispheric and not mammillated as in *C. circumvolutum* (Fig. 25). The mucro of *C. vestitum* is almost obsolete and barely visible as a blunt projection, while in *C. circumvolutum* it is a small but distinct pointed "beak". In general *C. circumvolutum* increases its caliber gradually towards the aperture, while in *C. vestitum* there is practically no alteration in the caliber, except for the abrupt constriction just before the septum. The terminal varix of *C. circumvolutum* is a large round/blunt swelling like that of *C. vestitum*, but in the latter the varix is much weaker and always preceded by a few low rings. We consider these species distinct. The illustration by VOKES & VOKES (1984, pl. 26, fig. 20) of "*C. vestitum*" is unidentifiable. *C. vestitum* has not been found in Brazilian waters. All eight individuals of the type series of *C. buccina* are immature, and show two growth stages. There is a constriction separating these two stages, formed by the abrupt increase of the shell during the late growth stage. Thus it is not possible to see any swelling near the aperture, which is characteristic of adult individuals. The types of *C. carmenensis* (Figs. 26, 27, 28 and 29) are immature, with fused growth stages, and show a slight increase in caliber towards the aperture. As noted by Dr. Pizzini (personal communication, 1998) *C. carmenensis* as illustrated in figures 28 and 29 is quite similar to *C. cuspidatum* Chaster, 1896 (type locality: Tangiers, Morocco, western Sahara). It is our intention to treat the eastern Atlantic species separately in the future. The problem is more complicated when we examine *C. veracruzianum* (Fig. 30), because all 37 individuals in the type series are short and wide, with no swelling near the aperture, as if they had reached the last growth stage but failed to reach maturity (indicated by the presence of the aperture varix). *C. limpidum* (Fig. 31), *C. buccina*, *C. carmenensis*, and *C. veracruzianum* we considered synonyms of *C. circumvolutum*. This synonymy enlarges the distribution of *C. circumvolutum* from Florida, the Gulf of Mexico, and the Caribbean Sea south to Brazil. *C. rijgersmai* is absolutely identical to *C. circumvolutum*. Despite the brief description and confusing illustrations, there is no doubt of this synonymy. De JONG & COOMANS (1988) failed to compare their taxon, which is more common in the Caribbean Sea, to any of the above taxa (see also *C. marmoratum* below).

#### *Caecum multicostratum* de Folin, 1867

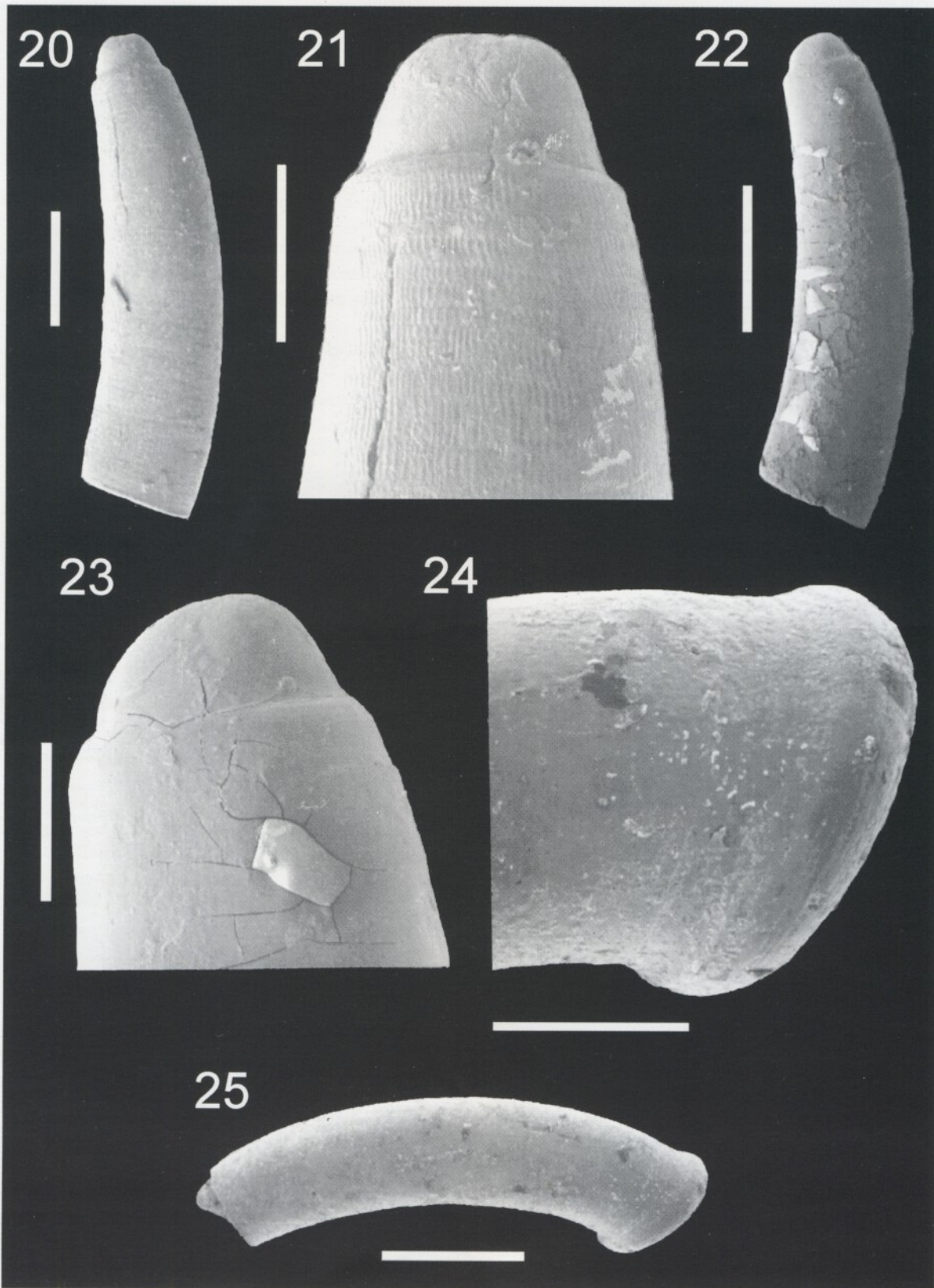
(Figs. 32, 33 and 34)

*Caecum multicostratum* de Folin, 1867: 32, pl. 3, figs. 4,5. MELLO & MAESTRATI, 1986: 158, fig. 13.

*Caecum venosum* de Folin, 1867: 46. GOMES & ABSALÃO, 1996: 520, figs. 8, 9.

*Caecum beladum* Olsson & Harbison, 1954. KEELER, 1981: 71, fig. 19; LYONS, 1989: pl. 3, fig. 10; LIGHTFOOT 1992b: 24, fig. 25; ABBOTT, 1974: 93, fig. 886; VOKES & VOKES, 1984: pl. 26, fig. 19.





Figures 20-25. 20, 21. *Caecum achironum* lectotype herein designated, MNHN. 21. Posterior region. 22, 23. *Caecum someri* lectotype herein designated, MNHN. 23. Posterior region. 24, 25. *Caecum circumvolutum*. 24. Anterior region. Scale bars. Figs. 20 and 22: 500  $\mu$ m; figs. 21 and 24: 200  $\mu$ m; figs. 23 and 25: 100  $\mu$ m.





*Caecum johnsoni* Winkley, 1908: 54; MORSE, 1919: 75, fig. 3.

Shell reaching 2 mm in length, moderately curved, with a slight swelling behind the aperture. Diameter constant. Sculpturing with short longitudinal cords as wide as the interspaces. Microlongitudinal striation covering cords and interspaces. Aperture with rings over the swelling. Septum hemispheric rugosely mammillate; mucro blunt, projecting dorsally, and directed left.

**Material Examined:** *Caecum johnsoni*: MCZ 33917 paratypes; FLMNH 267514 Sarasota Co., Florida, USA, 1985; FLMNH 267511 Martin Co. Florida, USA, 1991; FLMNH 267512 St. Johns Co. Florida, USA, 1972; FLMNH 231533 Bocas dei Tara, Panama; FLMNH 267498 Tobago Id., USA, 1992; FLMNH 00125837 Franklin Co., Florida, USA; FLMNH 267516 Bermuda Ids, USA, 1989; FLMNH 267515, Franklin Co, Florida, USA, 1988; IB-UFRJ 7425 Geomar XII #101, 1979; IB-UFRJ 7292 Geomar XII #74, 1979. *Caecum beladum*: FLMNH 267520 Florida, USA, 1972; FLMNH 267517 Bermuda Ids, USA, 1989; FLMNH 267522 Martin Co. USA; FLMNH 267524 Florida, USA, 1991; FLMNH 267519 Florida, USA, 1986; FLMNH 176713 Palm Beach Co. USA, 1951; FLMNH 267527 Florida, USA, 1974; FLMNH 267518 Tobago Id; Off Scarborough, 1991; FLMNH 231527, Panama, 1951; FLMNH 267526 Sarasota Co., USA, 1976; FLMNH 267521 Martin Co., Florida, 1989; FLMNH 267523 Palm Beach Co., USA, 1973-1980; FLMNH 267525 Sarasota Co., Florida, USA, 1985. *Caecum venosum*: MNHN syntypes, Pernambuco, Brazil; IB-UFRJ 7426 Guarajuba - BA, Brazil, 1993; IB-UFRJ 7448 Pernambuco, Brazil, 1993; IB-UFRJ 7290 Geomar XII #32, Brazil, 1979; IB-UFRJ 7404 Ribeira - BA, Brazil, 1994; IB-UFRJ 7446 Bahia, Brazil, 1994; *Caecum multicostratum*: MNHN syntypes, Brazil, Venezuela, Mexico.

**Remarks:** It is clear from inspection of the holotype of *C. venosum* (Figs. 35 and 36), that the species was described based on a broken shell with the anterior third missing. Thus the characters of the anterior region are not available for comparison. On the other hand, the longitudinal sculpturing and the septum are the same as in *C. multicostratum* (Fig. 32). For this reason, we propose that *C. venosum* be synonymized with *C. multicostratum* de Folin, 1867. The original description of *C. multicostratum* did not mention the type locality, but the original label assigned it to Brazil, Venezuela, the Dutch Antilles, and the Gulf of Mexico. We designate the type locality as Brazil, specifically the coastal state of Pernambuco, where M. de Somer was visiting the country as a naval commander and took shell samples. According to MELLO & MAESTRATI (1986), *C. multicostratum* is reticulated, but the illustrations of the lectotype and paralectotype do not show this feature. The longitudinal sculpture is much stronger than the rings, except near the aperture.

Comparison of *C. johnsoni* (Figs. 39, 40 and 41) with *C. multicostratum* is difficult, because the paratypes of the former are poorly preserved. MORSE (1919) illustrated a co-type of *C. johnsoni*, which is smooth with transverse lines of growth, and has a sub-ungulate septum. According to MORSE (1919), it resembles the figure in Tryon of *C. achironum* de Folin. We have had no opportunity to examine this material until now, but it scarcely matches the paratypes illustrated here. Probably the material examined by MORSE (1919) was poorly conserved or had elements of two species intermingled.

The longitudinal cords of both species are the same, but the microlongitudinal striation sculpturing present in *C. multicostratum* is undetectable in *C. johnsoni*, and the swelling behind the aperture, characteristic of mature individuals, is not present in the paratypes of *C. johnsoni*.

Despite the differences in L/W ratios between *C. johnsoni* and *C. multicostratum*, we can draw no conclusions, as we had only three individuals in each type series to measure (Table 2). VOKES & VOKES (1984, pl. 26, fig. 19) reported the occurrence of *C. beladum* Olsson & Harbison, 1954 in Recent deposits of the Yucatan Peninsula, even though this species was described based on fossil material from Florida. The study of *C. beladum* (Figs. 37 and 38) clarified questions related to intrapopulational variability of the L/W ratio and the expression of the longitudinal and annular sculpturing. As an example, VOKES & VOKES (1984) illustrated a specimen of *C. beladum* in which the ring sculpturing predominated over the longitudinal sculpturing, but examination of the original illustrations and the syntypes of this taxon demonstrates the existence of considerable variability of these characters. Furthermore, the L/W measurements of *C. beladum* overlap those of *C. johnsoni* and *C. multicostratum* (Table 2).

Initially we were hesitant about synonymizing the Pliocene *C. beladum* with a Recent species, but we noted that *C. beladum* had already been assigned as a Recent species (ABBOTT, 1974; KEELER, 1981; VOKES & VOKES, 1984; LYONS, 1989; LIGHTFOOT, 1992b). *C. carolinianum* Dall, 1892, a Pliocene species of North Carolina, was also reported by ABBOTT (1974), KEELER (1981), and LIGHTFOOT (1992a) from the Recent. Thus, considering the range of variation of the shell characters of the species concerned, it is impossible to establish distinct boundaries among *C. beladum*, *C. johnsoni*, and *C. multicostratum*. We therefore conclude that *C. johnsoni*, *C. multicostratum*, and *C. beladum* belong to the same taxon.

RTOS (1994) proposed that *C. beladum* Olsson & Harbison, 1954 is a synonym of *C. striatum*; this proposal is clearly erroneous.

#### *Caecum marmoratum* de Folin, 1870

(Figs. 43 and 44)

*Caecum marmoratum* de Folin, 1870: 126, pl. 15, figs. 1, 2.

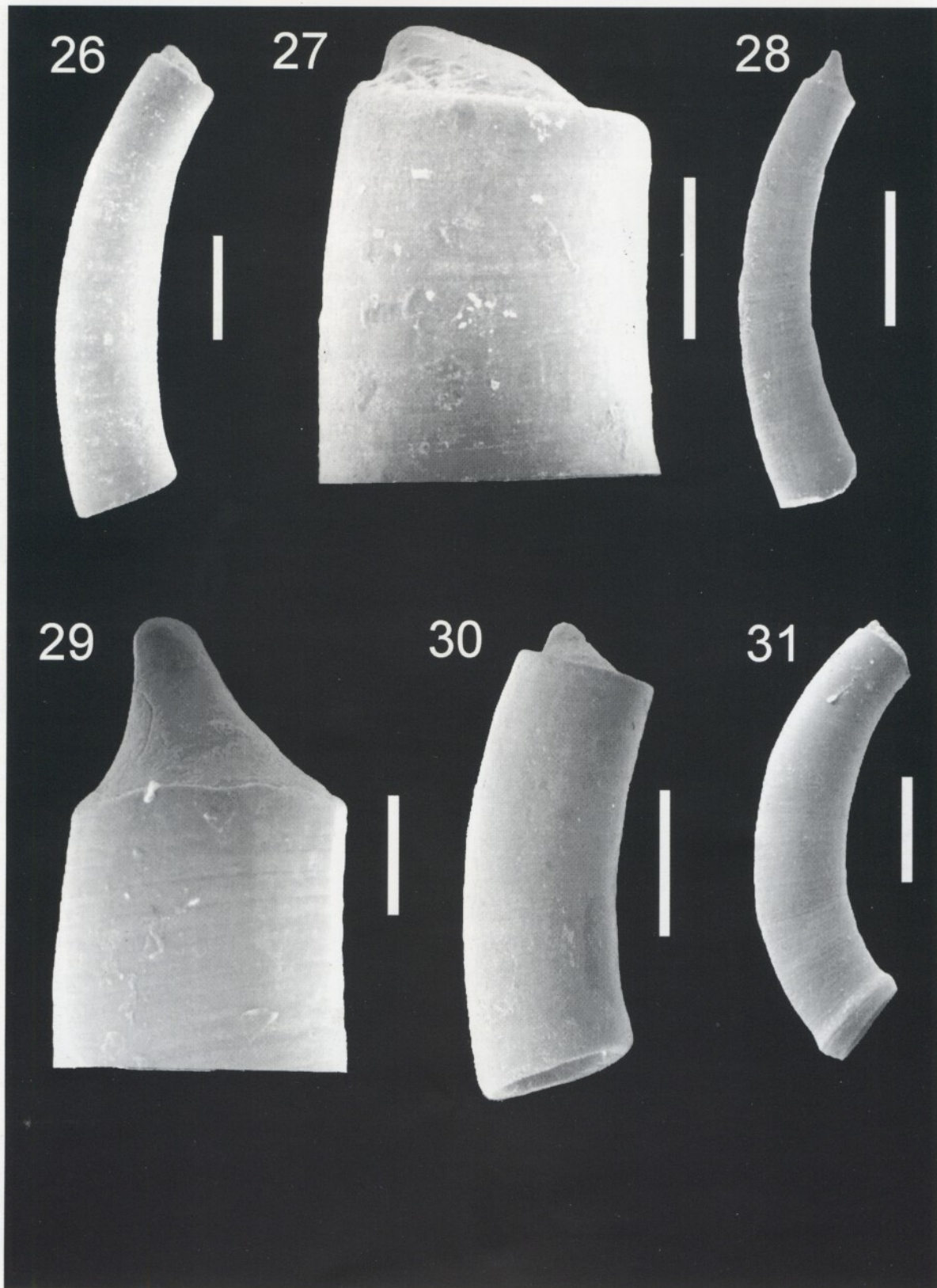
*Caecum butoti* De Jong & Coomans, 1988: 39, fig. 177; ABSALÃO & GOMES, 1995: 211, fig. 1 a, b).

*Caecum antillarum* Carpenter, 1857. VOKES & VOKES, 1984: 121, pl. 26, fig. 18.

Shell medium in size, reaching 2.4 mm in length; curvature moderate, accentuated anteriorly. Caliber increasing moderately towards anterior region, greatest in apertural region. Live individuals brownish with irregular white bands. Surface completely smooth. Aperture slightly constricted. Septum mammillated and retracted. Mucro a blunt triangular projection.

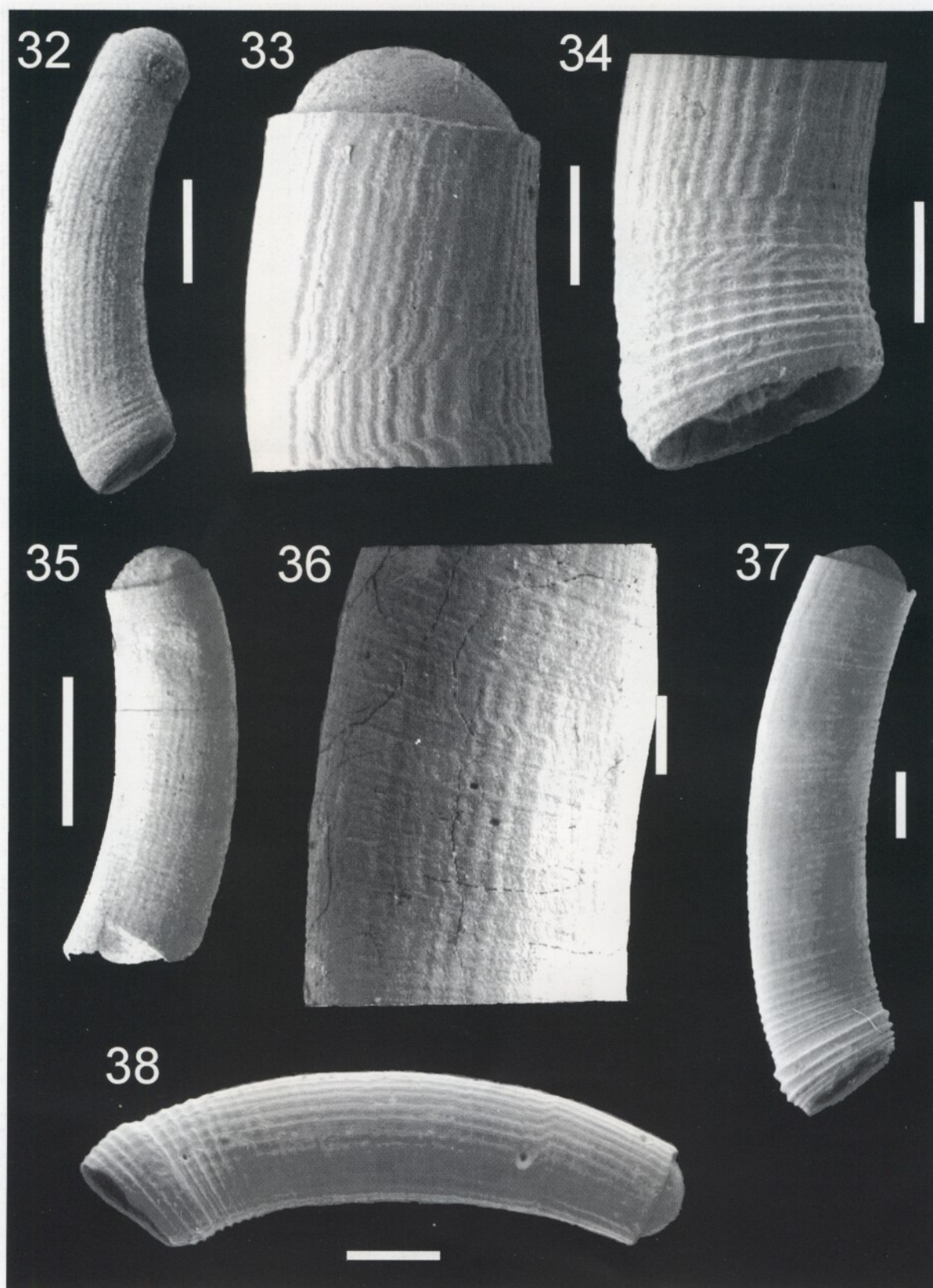
**Material examined:** *Caecum butoti*: IB-UFRJ 6499 Aruba and West Indies; IB-UFRJ 7353 Geomar XII #8, Brazil, 1979; IB-UFRJ 7403 Geomar XII #71, Brazil, 1979; IB-UFRJ 7359 Geomar XII #114, Brazil, 1979; IB-UFRJ 7362 Geomar XII # 61, Brazil, 1979; IB-UFRJ 7400 Geomar XII #97, Brazil, 1979; IB-UFRJ 7358 Geomar XII #120, Brazil, 1979; IB-UFRJ 7360 Geomar XII #9, Brazil, 1979; IB-UFRJ 7357 Geomar XII #114, Brazil, 1979; IB-UFRJ 6865 Geomar XII #5, Brazil, 1979; IB-





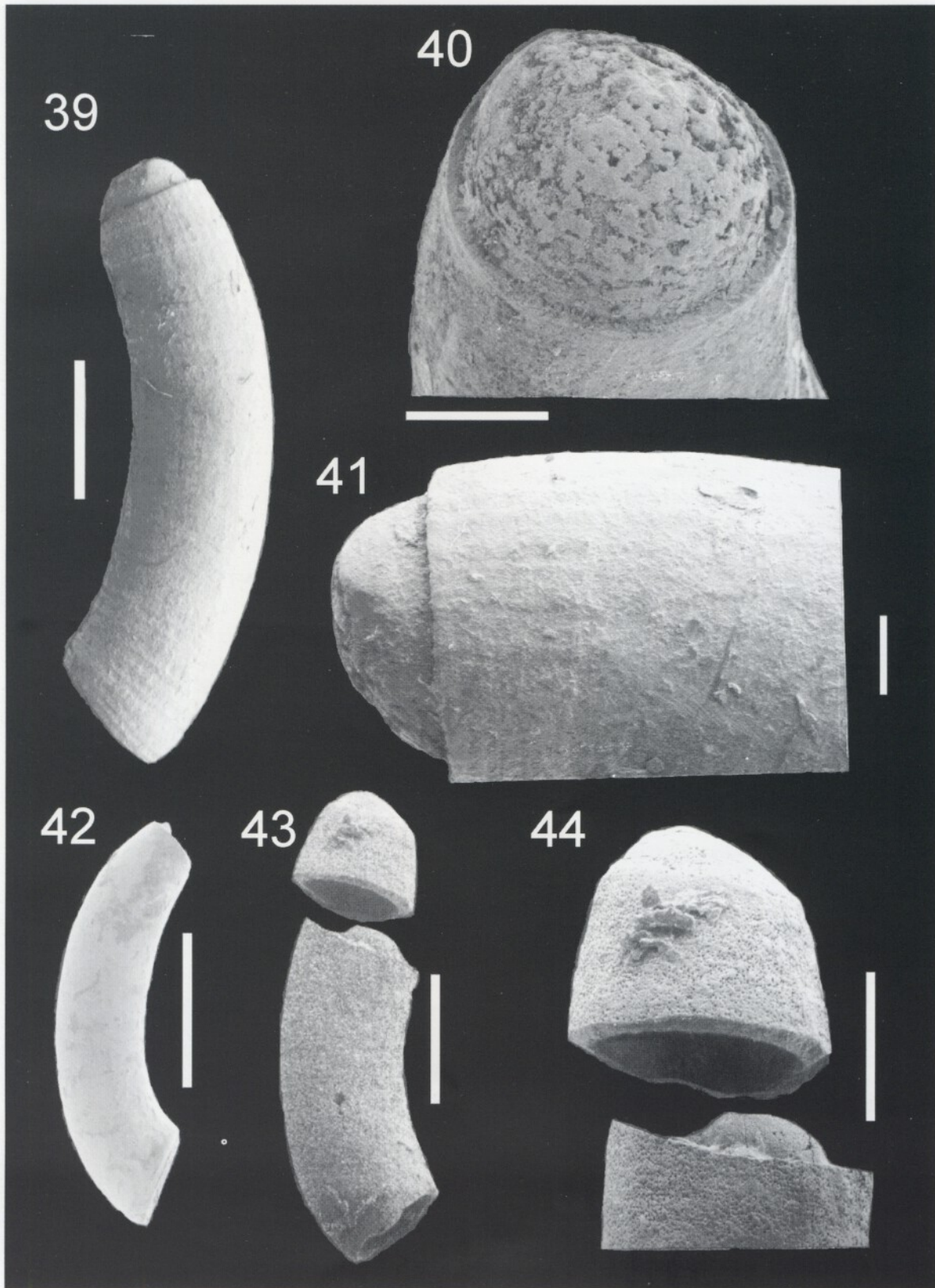
Figures 26-31. 26, 27. *Caecum carmenensis* lectotype herein designated, MNHN. 27. Posterior region. 28, 29. *Caecum carmenensis* young, paralectotype herein designated, MNHN. 29. Posterior region. 30. *Caecum veracruzianum*, lectotype herein designated, MNHN. 31. *Caecum limpidum*, lectotype herein designated, MNHN. Scale bars. Figs. 26, 28, 30 and 31: 500  $\mu$ m; fig. 27: 200  $\mu$ m; fig. 29: 100  $\mu$ m.





Figures 32-38. 32-34. *Caecum multicostatum* lectotype herein designated, MNHN. 33. Posterior region. 34. Anterior region. 35, 36. *Caecum venosum* holotype MNHN. 36. Sculpture pattern. 37, 38. *Caecum beladum* syntypes, ANSP 19007. Scale bars. Figs. 32, 35, 37 and 38: 500  $\mu$ m; fig. 33: 200  $\mu$ m; figs. 34 and 36: 100  $\mu$ m.





Figures 39-44. 39-41. *Caecum johnsoni* paratype MCZ 33917. 40. Septum/mucro view. 41. Posterior region. 42. *Caecum butoti* from Brazilian waters, IB-UFRJ 6499. 43, 44. *Caecum marmoratum* holotype, MNHN (accidentally destroyed). 44. Posterior region. Scale bars. Fig. 39: 500  $\mu\text{m}$ ; fig. 40: 100  $\mu\text{m}$ ; figs. 41 and 43: 200  $\mu\text{m}$ ; fig. 44: 250  $\mu\text{m}$ ; fig. 42: 1000  $\mu\text{m}$ .





UFRJ 7502 Cabo Frio VII, Brazil, 1983; IB-UFRJ 8482 Geomar XII #7, #22, #124, Brazil, 1979; IB-UFRJ 7356 Geomar XII #112, #125, Brazil, 1979; IB-UFRJ 7499 Cabo Frio VII, Brazil, 1983; IB-UFRJ 7355 Geomar XII #22, Brazil, 1979; IB-UFRJ 7361 Geomar XII #34, #21, Brazil, 1979; IB-UFRJ 7354 Geomar XII #89, #127, Brazil, 1979. *Caecum dextroversum* var. *antillarum*: BMNH 1858 12.9.23 holotype, West Indies. *Caecum marmoratum*: MNHN syntypes, Bahamas.

**Remarks:** Unfortunately the holotype of *C. marmoratum* de Folin, 1870 was destroyed after being photographed (Figs. 43, 44), but it could be compared with Brazilian specimens and positively identified. The original illustration of *C. butoti* (De JONG & COOMANS, 1988: 170, pl. 2, fig. 177) is too unclear to support any remarks. However, the holotype was examined (ZMA 387067), as were specimens from the Brazilian coast (Fig. 42). We are confident in assigning *C. butoti* as a synonym of *C. marmoratum*, and propose the holotype of *C. butoti* as the neotype of *C. marmoratum*. The material illustrated by VOKES & VOKES (1984) as *C. antillarum* is actually *C. marmoratum*.

At first sight one might question the conspecific status of *C. butoti* and *C. marmoratum*, since de Folin's original publication showed differences between the two species. To understand our proposal, it is necessary to evaluate de Folin's taxonomic practices. Despite his meticulous descriptions, he exaggerated his drawings more than once, attempting to emphasize tenuous shell differences to readers. For example, compare the original illustration of *Caecum strigosum* de Folin, 1867 with the photograph of the type (Figs. 7 and 8) in this paper. Another example is *C. armoricum*, which was allocated to its own subgenus (*Armata*) by de Folin, because of the "prickles" on the shell surface. It is now known that the "prickles" are extensions of the periostracum, since MOORE (1970), after examining the type of *Caecum armoricum* stored at the Muséum National d'Histoire Naturelle, considered the species as a synonym of *Caecum glabra*. For this reason it is essential to consider the descriptions and illustrations of de Folin with great care, and to examine each case individually.

In regard to the differences between the proposed neotype and the destroyed type specimen of *C. marmoratum* (Figs. 43 and 44), we must understand the *sui generis* manner of growth in the Caecinae, with the old posterior end of the shell successively being discarded. During this process, the constancy and degree of the shell sculpturing and the septum and mucro can change. Beyond the natural variability among individuals of the same species, there is also the possibility that the same specimen may show more than one type of sculpturing, according to its age. For example, in 1870 de Folin described *Caecum bipartitum* and *C. triornatum*, which clearly show two kinds of ornamentation. This fact leads us to the conclusion that each part of a shell, if examined in different stages, could provide a basis for allocating the same specimen to different subgenera. Additional examples were provided by PIZZINI (1998, figs. 12 and 13, 16c: *C. neocaledonium*). The septo/mucro region also changes according to shell growth. During the growing process, a succession of new septa are secreted. For example, the pointed septum of *C. carmenensis* (Fig. 27) is transitory and shows the variability that this character may assume. The discovery of PIZZINI *et al.* (1998: 137) about the confection in Caecinae of a temporary sep-

tum, morphologically distinct from the semipermanent septa (which remains with the animal until the next discarding of the old shell), is important in supporting this assumption.

LIGHTFOOT (1992) stated that the thickened opening was a sign of sexual maturity, when the animal stops growing. PIZZINI *et al.* (1995: 83, figs. 10-13: *C. auriculatum*) and BANDEL (1996, pl.8, fig. 3 of *C. plicatum*) proved that this does not actually happen. According to their new view, the presence or absence of a slight constriction near the aperture could be understood as an indication of the growth stage of the individual, not a species-level difference.

Therefore, the subtle differences between the specimen proposed as the neotype, and the holotype of *C. marmoratum* have no significance, in view of the intrinsic variability of the characters. We could also mention the coloration, but once again the variability in Caecinae is great, e.g., NOFRONI *et al.* (1997, figs. 109-112: *C. vitreum*; figs. 115-117: *C. clarkii*; figs. 121-125: *C. searliswood*, and figs. 128-133: *C. atlantis*). The yellowish and white spots that produce an ivoried effect in the shell were present (although faded with age) in the type of *C. marmoratum*, and are also present in the type and paratypes of *C. butoti*. This ivoried effect is not exclusive to *C. marmoratum-butoti*, but is also common in species of *Meioceras*.

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Table 1 : Length/width ratios of *C. lineicinctum* and *C. subvolutum* specimens. \* FLMNH 236013

	<i>Caecum lineicinctum</i>	<i>Caecum subvolutum</i>
holotype/lectotype	4.21	4.71
Moore's (1972) figures	4.39	5.06
Lightfoot's material	4.65	5.50*
Keeler's (1981) figures	4.20	5.18

Table 2 : L/W ratio measurements from types

<i>Caecum johnsoni</i>	<i>Caecum multicostatum</i>	<i>Caecum beladum</i>
4.13	4.47	4.95
4.26	4.65	4.17
4.13	4.39	4.35

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